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Consistent representation of lands

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Areas of land use, land-use change subcategories

- Represent the activity data in LULUCF
- Are the prerequisite for any estimate of emissions/removals in the LULUCF sector
- Cannot be substituted by default values in the IPCC (2006) GL

➢ The development, implementation and improvement of the land use and land-use change assessment system(s) should be given highest priority in LULUCF

Land use, land-use change subcategories

- Six sub categories (and land-use changes between these subcategories):
  - Forest land
  - Cropland
  - Grassland
  - Wetlands
  - Settlements
  - Other land

Stratification of the country:

- into areas subject to the six land-use categories, and associated (land-use change) subcategories, as defined in the *2006 IPCC Guidelines*;
- The six land-use categories may be further stratified into:
  - Areas of different climate zones
  - Areas of different vegetation types
  - Areas of different soil types (e.g. mineral and organic soils);
  - Areas of different management practices (e.g. different cropland and grazing land management)

Some notes on further stratification:

- Stratification beyond the six land-use categories is needed if:
  - Tier 1 emission factors are used and available for a country's
    - different climate zones (e.g. mediterranean, continental),
    - different vegetation types (e.g. coniferous, deciduous)
    - different soil types (e.g. mineral and organic soils);
    - different management practices (e.g. different cropland and grazing land management)

    If stratification is not possible, inventory estimation can still proceed, but the emissions and removals estimates should reflect uncertainties in the assignment of emission/stock change factors (and associated parameters) that vary along these different zones/types/practices

  - For higher Tier methods other ways of further stratification may be more appropriate

UN-FCCC land use and land-use change assessment vs. reporting principles:

- **adequate**,
  i.e., capable of representing land-use categories, and conversions between land-use categories, as needed to estimate carbon stock changes and greenhouse gas emissions and removals;
- **consistent**,
  i.e., capable of representing land-use categories consistently over time, without being unduly affected by artificial discontinuities in time-series data;
- **complete**,
  which means that all land within a country should be included, with increases in some areas balanced by decreases in others, recognizing the bio-physical stratification of land if needed (and as can be supported by data) for estimating and reporting emissions and removals of greenhouse gases; and
- **transparent**,
  i.e., data sources, definitions, methodologies and assumptions should be clearly described.

- Subcategory „Other land“ can be used to meet exactly the total area of the country

UN-FCCC land use and land-use change assessment, three approaches:

- Approach 1: total land-use area, no data on conversions between land uses
- Approach 2: total land-use area, including changes between categories (not spatially explicit)
- Approach 3: spatially-explicit land-use conversion data

- Frequently areas of the different subcategories are reported from different sources representing different approaches:
  - National Forest Inventories
  - Remote sensing like Corine Land Cover
  - Statistics

Approach 1

- Only total areas of land categories across time are available
- land-use conversion matrix is not possible (unless further information is available or expert judgement on a likelihood basis is carried out – but then it represents already Approach 2)
- estimates for the emissions/removals due to land-use changes are not possible

Example for Approach 1 (IPCC 2006 GL)

TABLE 3.2
EXAMPLE OF APPROACH 1: AVAILABLE LAND USE DATA WITH COMPLETE NATIONAL COVERAGE

Time 1			Time 2			Net land-use conversion between Time 1 and Time 2		
F	=	18	F	=	19	Forest Land	=	+1
G	=	84	G	=	82	Grassland	=	-2
C	=	31	C	=	29	Cropland	=	-2
W	=	0	W	=	0	Wetlands	=	0
S	=	5	S	=	8	Settlements	=	+3
O	=	2	O	=	2	Other Land	=	0
Sum	=	140	Sum	=	140	Sum	=	0

Note: F = Forest Land, G = Grassland, C = Cropland, W = Wetlands, S = Settlements, O = Other Land. Numbers represent area units (Mha in this example).

Approach 2

- provides an assessment of both the net losses or gains in the area of specific land-use categories and what these conversions represent (i.e., changes both from and to a category)
- land-use conversion matrix is possible
- estimates for the emissions/removals due to land-use changes are possible

Example for Approach 2 (IPCC 2006 GL)

TABLE 3.6
SIMPLIFIED LAND-USE CONVERSION MATRIX FOR APPROACH 2 EXAMPLE

Net land-use conversion matrix

Final \ Initial	F	G	C	W	S	O	*Final sum*
F	**15**	3	1				*19*
G	2	**80**					*82*
C			**29**				*29*
W				**0**			*0*
S	1	1	1		**5**		*8*
O						**2**	*2*
Initial sum	*18*	*84*	*31*	*0*	*5*	*2*	*140*

Note:
F = Forest Land, G = Grassland, C = Cropland, W = Wetlands,
S = Settlements, O = Other Land
Numbers represent area units (Mha in this example).

Approach 3

- spatially-explicit observations of land-use categories and land-use conversions
- Needed for KP activity reporting
- Allows to trace accurately land-use changes and land management and related emissions/removals across time

Examples:

- Wall-to-wall mapping on basis of satellite images, orthophotos, frequently updated cadaster
- Spatially explicit forest inventories using a fixed grid (use of statistical systems is possible)

Reporting LULUCF subcategories

Potential challenges due to the possible need of stratification of the estimates and available area data into:

- Climate zones
- Vegetation types
- Soil types
- Different management types

Reporting LULUCF subcategories

Possible solutions to these challenges:

- Use of dis-aggregated statistics and maps
- Use of correlation of crop types with climate and soil types
- Aggregation or dis-aggregation according to similar/different C stock change factors

Completeness and consistency of time series of LULUC areas

Potential challenges due to:

- Assessment systems for (some) land-use and land-use change subcategories are not in place or were not in place in historic years or in the transition period before the base year (need for LUC areas back to 1971);
- The land use and land-use change assessment systems do not allow the land-use changes to be tracked

Completeness and consistency of time series of LULUCF areas

Possible solutions to these challenges:

1. Use of one LULUCF approach/assessment system across time and improve it according to the reporting needs, e.g.;
   - secure the minimum mapping unit required,
   - back extrapolation with the help of historic images/orthophotos
   - expand the system from region or land use type to the total country,
   - improve the frequency of the update/re-assessment.
2. A broad exploration of all available information sources on (historic) land-use and land-cover in the country, incl.:
   - Historic images from earth observation, orthophotos
   - Historic land-use and land-cover statistics, thematic maps
   - Information on surrogate parameters for the needed data (e.g. a known trend in yield may be correlated with the un-known trend in area of the related crop type)
   - Expert Judgements
3. Adjustment of the results to current assessment systems using splicing techniques (IPCC 2006 Guidelines, Vol. 1, Chapter 5).

Splicing techniques to reach consistency

(see IPCC 2006 Guidelines, Vol. 1, Chapter 5)

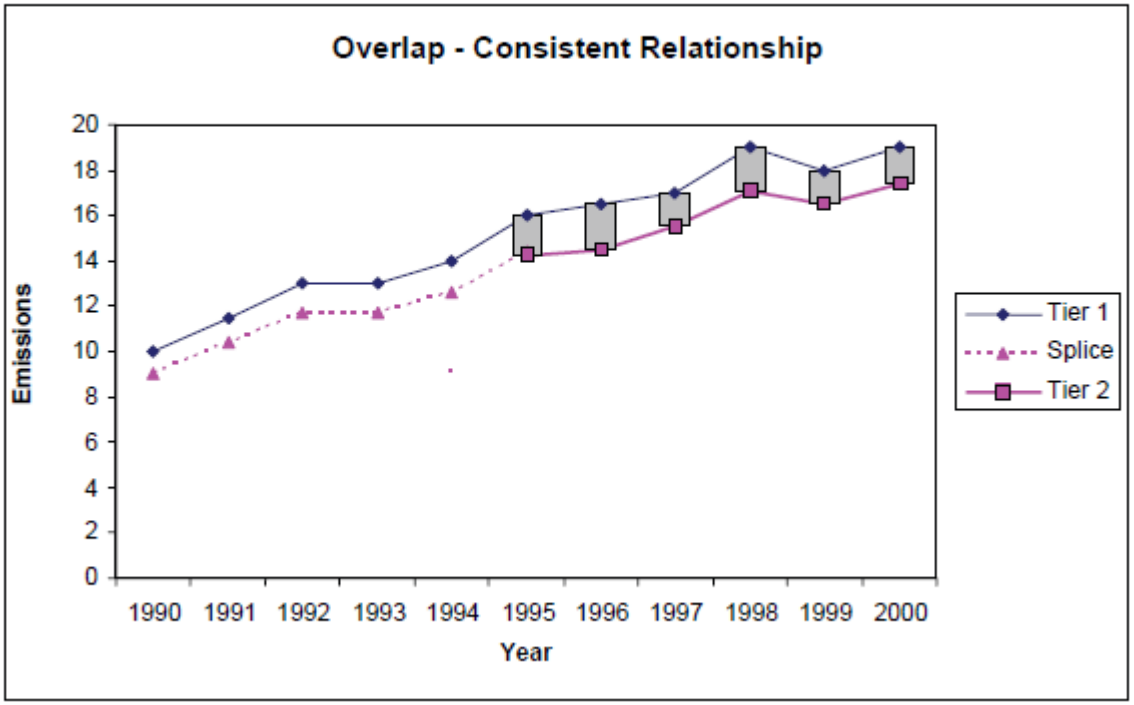
Different techniques:

- Overlap
- Surrogate data
- Interpolation
- Trend extrapolation
- Other techniques

Splicing techniques – Overlap

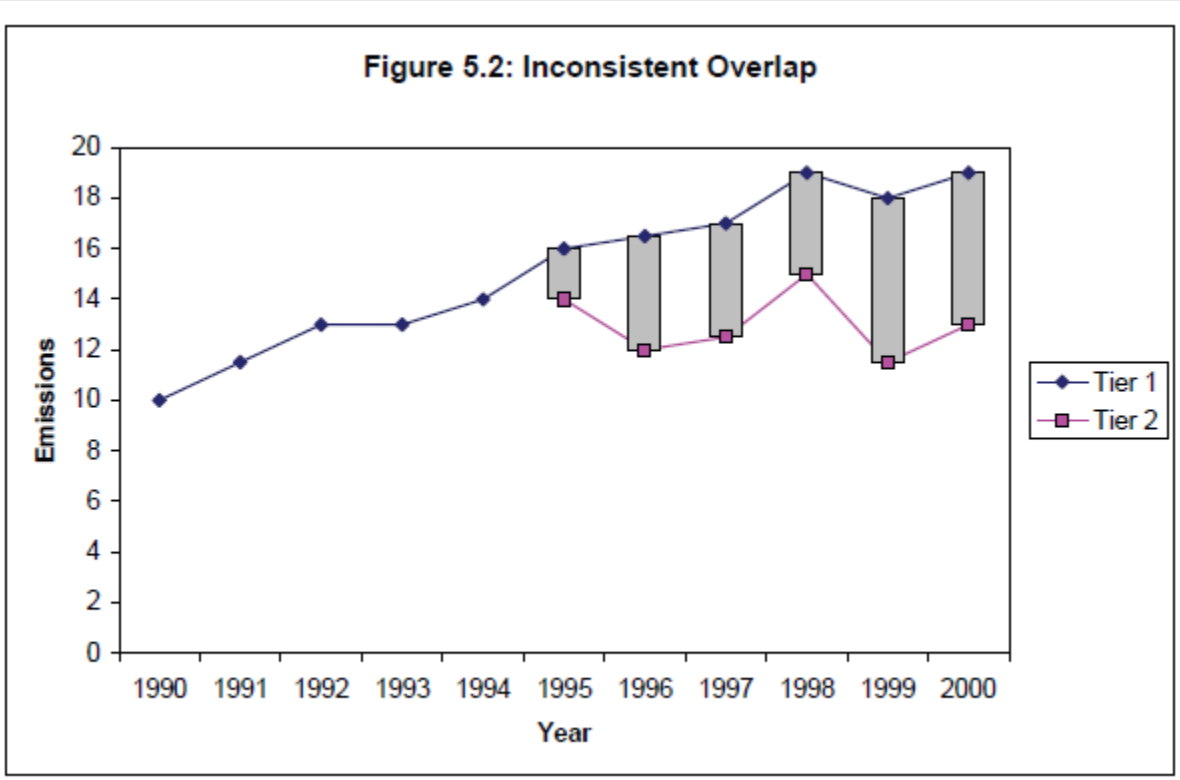
Relationship between results of two assessment systems is used:

Figure 5.1 Consistent overlap



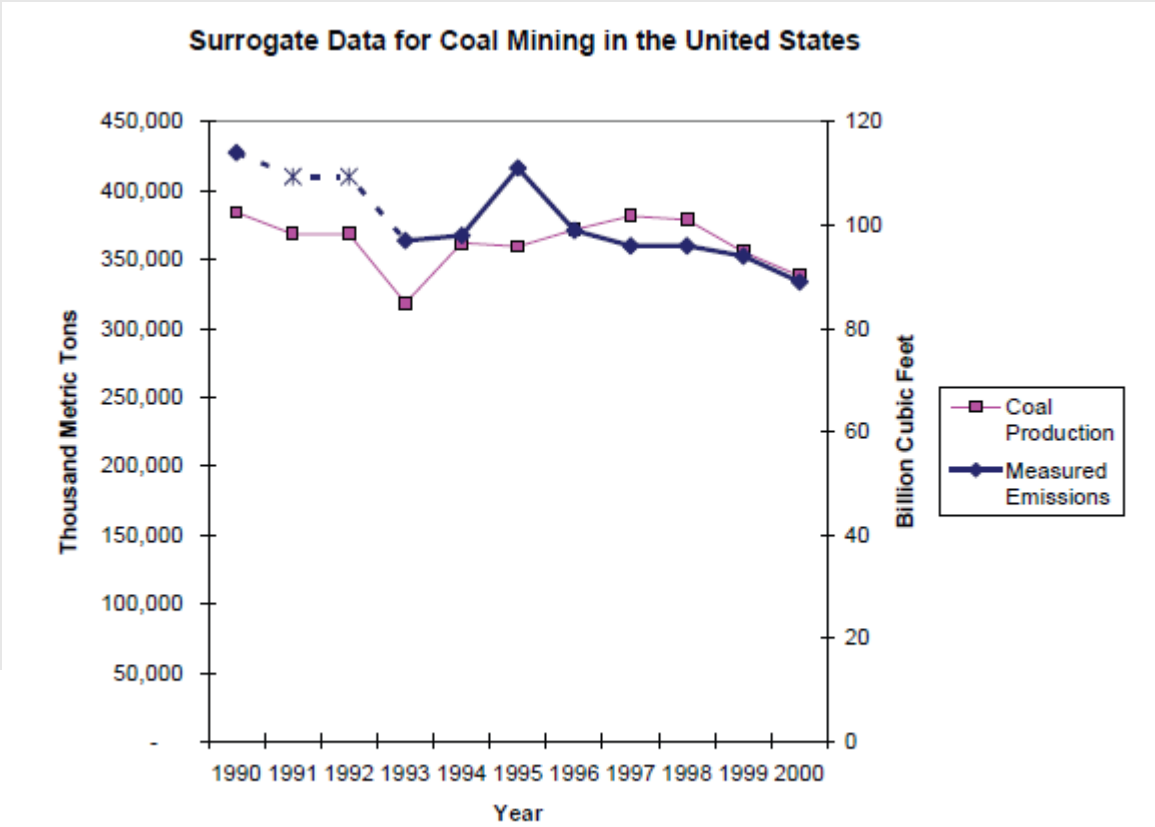
Splicing techniques – Overlap

In case of inconsistent overlap don't use this approach:



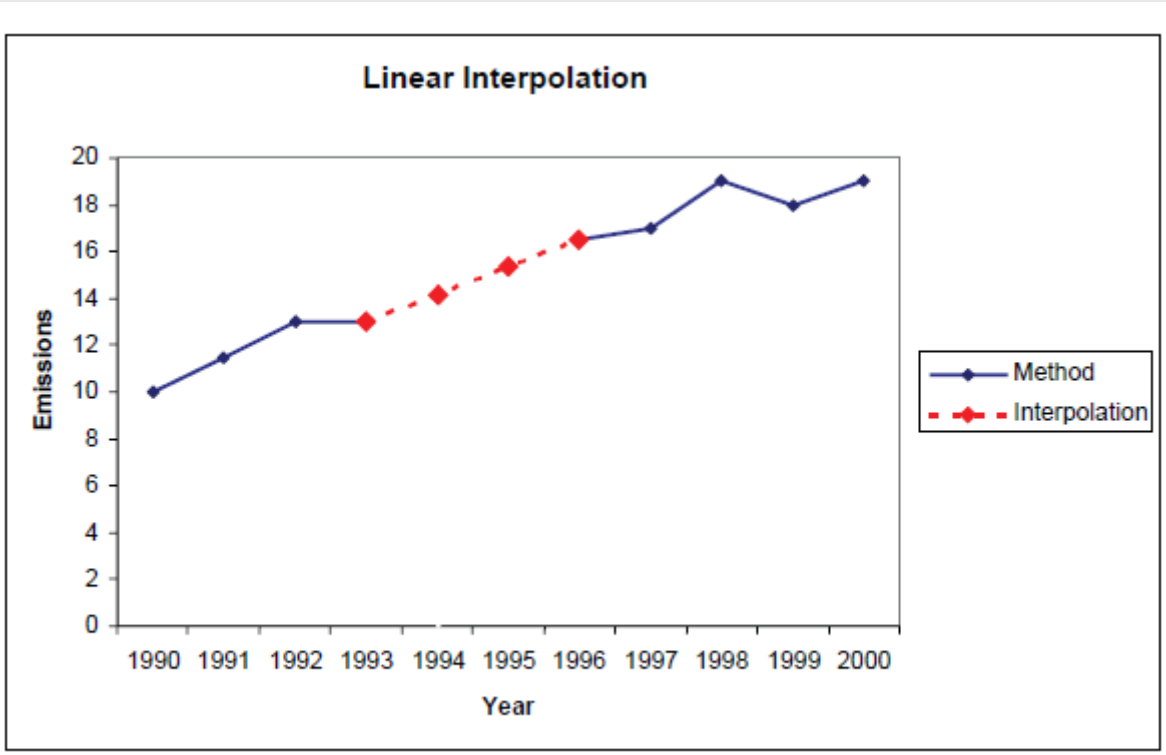
Splicing techniques – Surrogate data

Correlation between the results of two different parameters is used (e.g. yield vs. area):



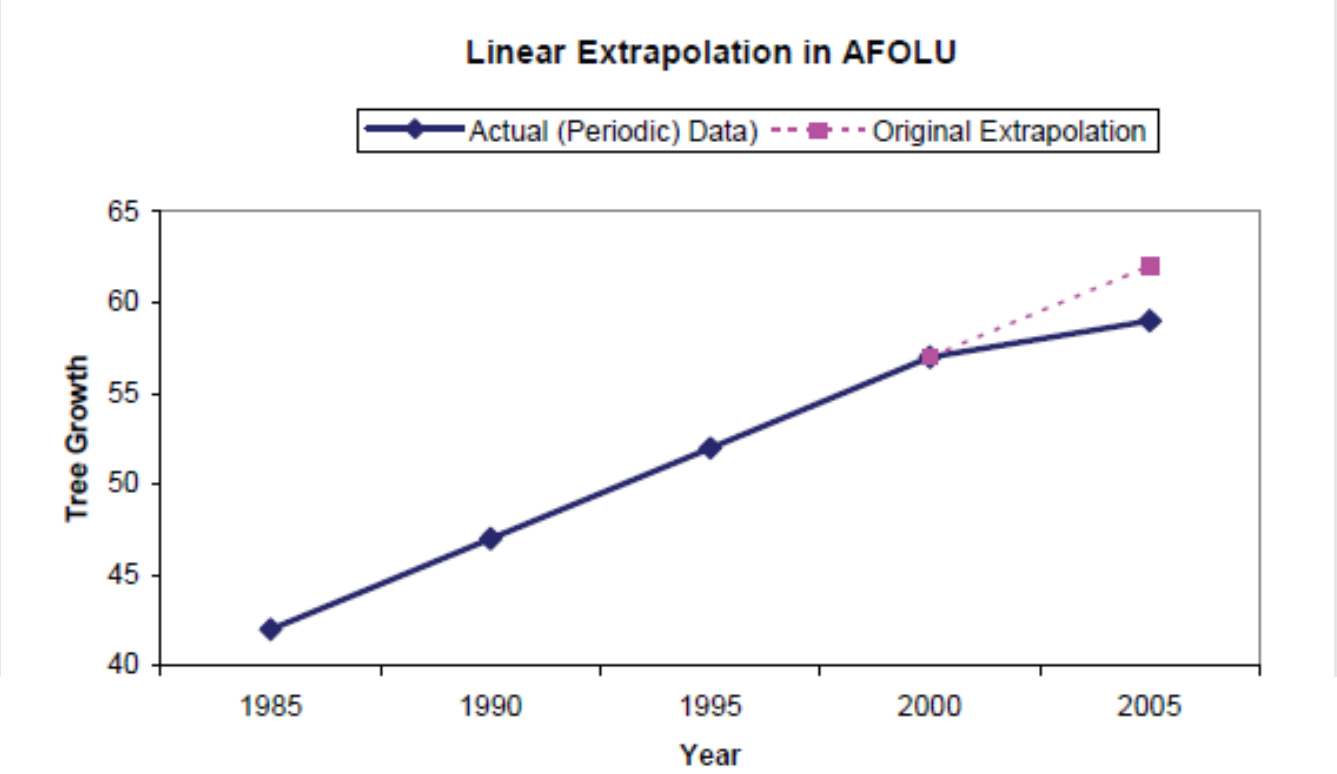
Splicing techniques – Interpolation

e.g. linear interpolation between the results of two assessments:



Splicing techniques – Trend extrapolation

e.g. historic trends are extrapolated to the future or current trends are extrapolated to historic years:



Selecting the most appropirate splicing technique

TABLE 5.1
SUMMARY OF SPLICING TECHNIQUES

Approach	Applicability	Comments
Overlap	Data necessary to apply both the previously used and the new method must be available for at least one year, preferably more.	• Most reliable when the overlap between two or more sets of annual estimates can be assessed. • If the trends observed using the previously used and new methods are inconsistent, this approach is not *good practice*.
Surrogate Data	Emission factors, activity data or other estimation parameters used in the new method are strongly correlated with other well-known and more readily available indicative data.	• Multiple indicative data sets (singly or in combination) should be tested in order to determine the most strongly correlated. • Should not be done for long periods.
Interpolation	Data needed for recalculation using the new method are available for intermittent years during the time series.	• Estimates can be linearly interpolated for the periods when the new method cannot be applied. • The method is not applicable in the case of large annual fluctuations.
Trend Extrapolation	Data for the new method are not collected annually and are not available at the beginning or the end of the time series.	• Most reliable if the trend over time is constant. • Should not be used if the trend is changing (in this case, the surrogate method may be more appropriate). • Should not be done for long periods.
Other Techniques	The standard alternatives are not valid when technical conditions are changing throughout the time series (e.g., due to the introduction of mitigation technology).	• Document customised approaches thoroughly. • Compare results with standard techniques.

Reporting the management activities on cropland and grassland

Potential challenges due to:

- No management information available or explored so far;
- Parameters in the agricultural assessment systems deviate from those needed for reporting;
- Assessment systems do not cover the whole country
- No access to the data of the agricultural assessment systems

Reporting the management activities on cropland and grassland

Possible solutions to these challenges:

1. Use and adjustment of assessment systems for agricultural statistics and for national agricultural subsidy payments
2. Use of existing agricultural statistics and surrogate parameters correlated with types of agricultural management:
   - Crop and grassland types may be correlated with management techniques
3. Use of representative sub-samples for the assessment and extrapolation to the whole country
4. Broad exploration of existing agricultural expertise in the country and bridging to the national units dealing with agriculture

QA/QC issues regarding LULUCF

Same general procedures as for other sectors

LULUCF should be part of the GHG inventory QA/QC system

- Documentation and archiving (full reproducibility of input data/methods/results must be secured), e.g:
  - documentation of methods and rationales in behind,
  - any input data/information to the estimates, epert judgements
  - all estimate sheets,
  - documentation of recalculations,
  - QA/QC plan,
  - outcomes of QA/QC procedures
  - Protection against losses or unintended changes

QA / QC issues regarding LULUCF (2)

- Continuous improvement (e.g. on basis of review findings, identified problems/gaps)
- QC procedures
  - For reporting documents, estimates (activity data, emission factors, calculations)
  - General
  - Sector specific, e.g.:
    - LULUC area consistency across time,
    - correctness and explanation of trends and outliers,
    - comparison of input data results with literature and default values
  - On basis of checklists
- QA (independent review)

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National System for LULUCF

National System for LULUCF

Key functions and components

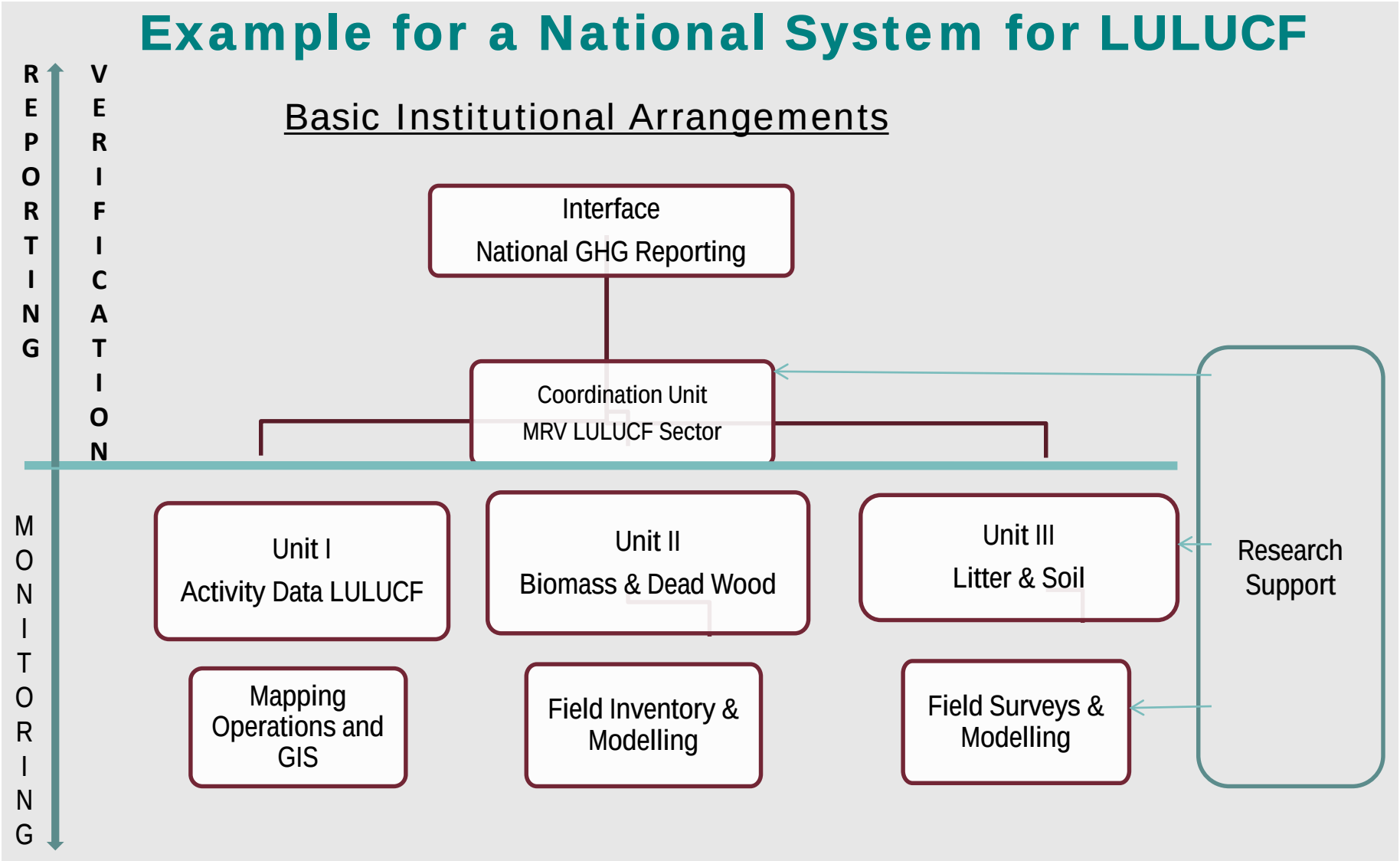
- Part of the National System for GHG reporting
- Designating a single national entity with overall responsibility for the LULUCF GHG inventory
- Establishing and maintaining the institutional, legal and procedural arrangements between the government agencies and other entities involved in the preparation of emission/removal estimates for LULUCF
- Definition of responsibilities and tasks within the National System for LULUCF
- Ensuring sufficient capacity and resources for
  - the timely data collection and monitoring to estimate GHG emissions/removals of LULUCF
  - the technical competence of the staff involved in the inventory process

National System for LULUCF (2)

Specific functions

- Monitoring of activity data (land uses and land-use changes)
- Monitoring and modelling of emission factors (biomass stocks, growth and drain, C stocks and stock changes of dead wood, litter and soil in the land-use-subcategories)
- Estimating and reporting of the LULUCF GHG emissions/ removals
- Defining and implementation of uncertainty analysis, QA/QC plans and verification steps

Example for a National System for LULUCF



National System for LULUCF – some recommendations

- The appropriate institutions should be identified at an early stage of the process and included in the National System
  - This makes it easier for the personnel to be appointed and for specific roles and responsibilities to be allocated
- Building upon existing assessment systems and established institutions with expertise in the relevant scientific fields
- Sufficient human and financial resources in the involved institutions are needed
- Fluctuations in staff of leading experts and key personnel represent a waste of resources and a significant risk for consistent and timely reporting
- A network of associated expert institutions engaged from time to time for providing specific research results and/or tools

National System for LULUCF – some recommendations (2)

- The specific roles, responsibilities and tasks of all relevant organisations should be well defined and made clear to all stakeholders in the process
- Well defined communication channels and approval processes will greatly facilitate the monitoring and reporting work, particularly in meeting reporting standards and deadlines
- The LULUCF GHG inventory work may be integrated with other related tasks/efforts (e.g., climate change impact research, biodiversity monitoring, international reporting obligations for agriculture) to ensure the most effective use of resources and utilize available expertise
- Well defined contractual or legal arrangements

Some proposals on organisational and operational issues

- Exploring and including the national expertise
  - (e.g. forestry, agricultural, soil research institutions, statistical offices, units dealing with land use/cover, forest/agricultural stakeholder organisations and major forest/agricultural enterprises)
  - A successful involvement requires considerable communication efforts at several levels and a broad national identification with the reporting requirements
- International co-operation
  - cost effective and resource saving solutions (e.g. common studies to identify emission factors valid for both countries)
- Resources and cost effective approaches
  - use of synergies with other assessment systems and projects
  - broad dissemination and communication in the country on the data needs

Thank you for your attention

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