Some examples for increasing intensity within the R_{rot} domain are:

System	I_{LUI}	Total yield Mg ha-1 yr-1	t_c yr	t_f yr
Shifting Cultivation - no inputs, no harvest from fallow	0.03	0.13	2	30
Shifting Cultivation - no inputs, some harvest from fallow	0.03	0.31	2	30
Shifting Cultivation - no inputs, fallow products harvested	0.03	1.06	2	30
Long Fallow - no inputs, no harvest from fallow	0.07	0.33	2	10
Long Fallow - no inputs, some harvest from fallow	0.07	0.50	2	10
Long Fallow - no inputs, fallow products harvested	0.08	1.17	2	10
Short Fallow - no inputs, no harvest from fallow	0.11	0.46	2	5
Short Fallow - no inputs, some harvest from fallow	0.12	0.60	2	5
Short Fallow - no inputs, fallow products harvested	0.14	1.17	2	5
Permanent cropping - no inputs	0.40	1.20	4	0
Permanent cropping - low fertilizer rate	0.48	1.60	4	0
Permanent cropping - idem, higher harvest index	0.73	2.40	4	0
Permanent cropping - idem, higher fertilizer rate	0.85	3.60	4	0
Permanent cropping - idem, pesticide use	1.47	4.20	4	0
Permanent cropping - idem, fully mechanized	2.09	4.20	4	0
Permanent cropping - idem, double cropping + irrigation	4.00	6.00	4	0

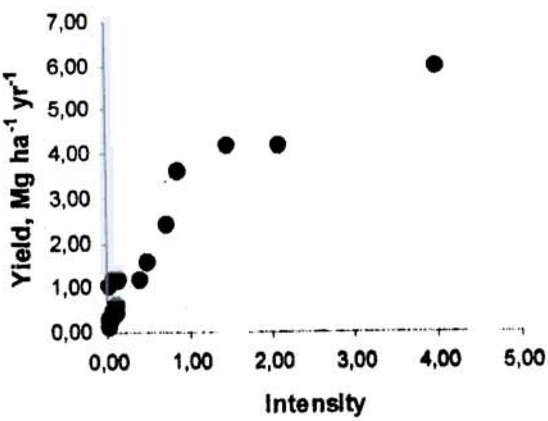

Figure 9. Relationship between total harvested yield and 'intensity' index LUI for a number of cropping systems.

In this equation variations in the amount of biomass harvested in 'no input' systems can lead to the intensity indices of 0 - 1, while the use of fertilizer will double the result for nutrient application rates up to 'balanced nutrient budget' level and more for higher rates, and the use of pesticides, fossil energy and irrigation can lead to higher values. The index is 'open ended' on the right hand side, and values above 10 are possible.

To utilize this index for a particular cropping system, we will thus need to collect data on the typical duration of crop and fallow, the amounts of biomass harvested from both phases of the cycle, the amounts of fertilizer (N + P + K expressed as nutrient application rates) and irrigation water. The total use of fossil energy may be derived from fuel use for tractors and the like. Pesticides should be recorded as amounts of active ingredient, and we will need to get some expert advice on half life times and the index of overall biological impact of the active ingredient.

A number of the further conversion factors needed, such as typical nutrient content of harvested products and water use efficiency of the crop may be derived from existing databases.

If indeed we want to use this index, we have to make sure we have protocols (questionaire) to measure, assess or estimate

t = length of cropping or fallow period in a typical rotation [year] (interview the farmer for plot history)

B = (final) total biomass of a crop or fallow vegetation [Mg ha^{-1}] (destructive biomass sample, use of allometrics for woody perennials)

B_h = (cumulatively) harvested part of the biomass of a crop or fallow vegetation [Mg ha^{-1}] (interview the farmer for plot history)

$N_{fertilized}$ = the amount of plant nutrients (N + P + K) added to the field as external fertilizer (in inorganic or organic form, the key is that it is derived from outside of the 'system' under consideration) [kg ha^{-1}] (interview the farmer for plot history)

n_c = typical nutrient (N + P + K) concentration [kg Mg^{-1}] (for crops there are databases that we can use, occasionally we may need to sample ourselves)

$W_{irrigated}$ = amount of water provided by irrigation during one cropping year [mm] (interview the farmer for plot history)

w = water use efficiency of the crop, or biomass production per unit of water transpired [kg / l] (the factor 10 is required to make the term dimensionless) (database to construct lookup table for local climate and C_3 versus C_4)

$E_{utilized}$ = sum of fossil energy used for all soil tillage and mechanized harvest operations [MJ ha^{-1}] (interview the farmer for plot history)

e = typical energy content of crop biomass [MJ Mg^{-1}] (database for look-up-table based on harvested product)

P_{used} = total amount of active ingredient of pesticides used [kg ha^{-1}] (interview the farmer for plot history)

$T_{1/2}$ = half-life time of the active ingredient [year] (database)

p = a biological impact rating of the various active ingredients [kg year ha^{-1}] ('expert' rankings?)

The Sampling Scheme For Indonesia

The sample design for Indonesia was discussed at a number of global workshops, to ensure that it will fit well within the overall data set, and can contribute to the global evaluation of our key hypothesis.

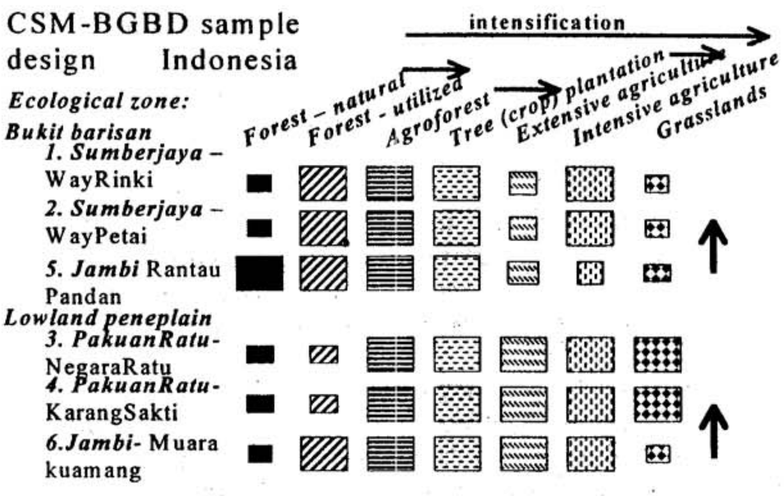

Figure 10. Expected presence of the 7 land use types across the 6 sampling windows for Indonesia.

Table 2. Indonesia's sample design

Aspects of land use intensification	Level in the sample design
Tropical countries: Brasil -> India	7 countries (5 – 350 persons km^{-2})
Benchmarks (windows) within country: e.g. Jambi versus Lampung	3 benchmarks (range of 'forest cover'), 2 windows each
Forest – grasslands continuum	4 main land use types
Intensity of use within the 'forest', 'tree crops' and 'food crop' land use classes	2 levels in 3 land use types (all together 7 land use types)
Sample-point level 'Index of land use intensity' characterized by I_{LUI}	3 replicates per land use type per window: in Indonesia: 6 * 7 * 3 = 126 sample points, sampled on two occasions (wet, dry)

Not all windows may contain good representation of all 7 land use types, but across the 6 windows we should be able to obtain a fair spectrum of situations.

The selection of sample points within the windows will be essentially based on a grid sampling, but on the basis of an *a priori* classification of land use, we will add points to ensure all land classes are represented, and we will randomly select among points that appear to be similar in the dominant land use categories. The final result will be similar to a 'stratified random' sampling scheme, but differ in maintaining a minimum distance between sample points (thus ensuring 'independence' from the perspective of the dispersal distance of most soil biota).

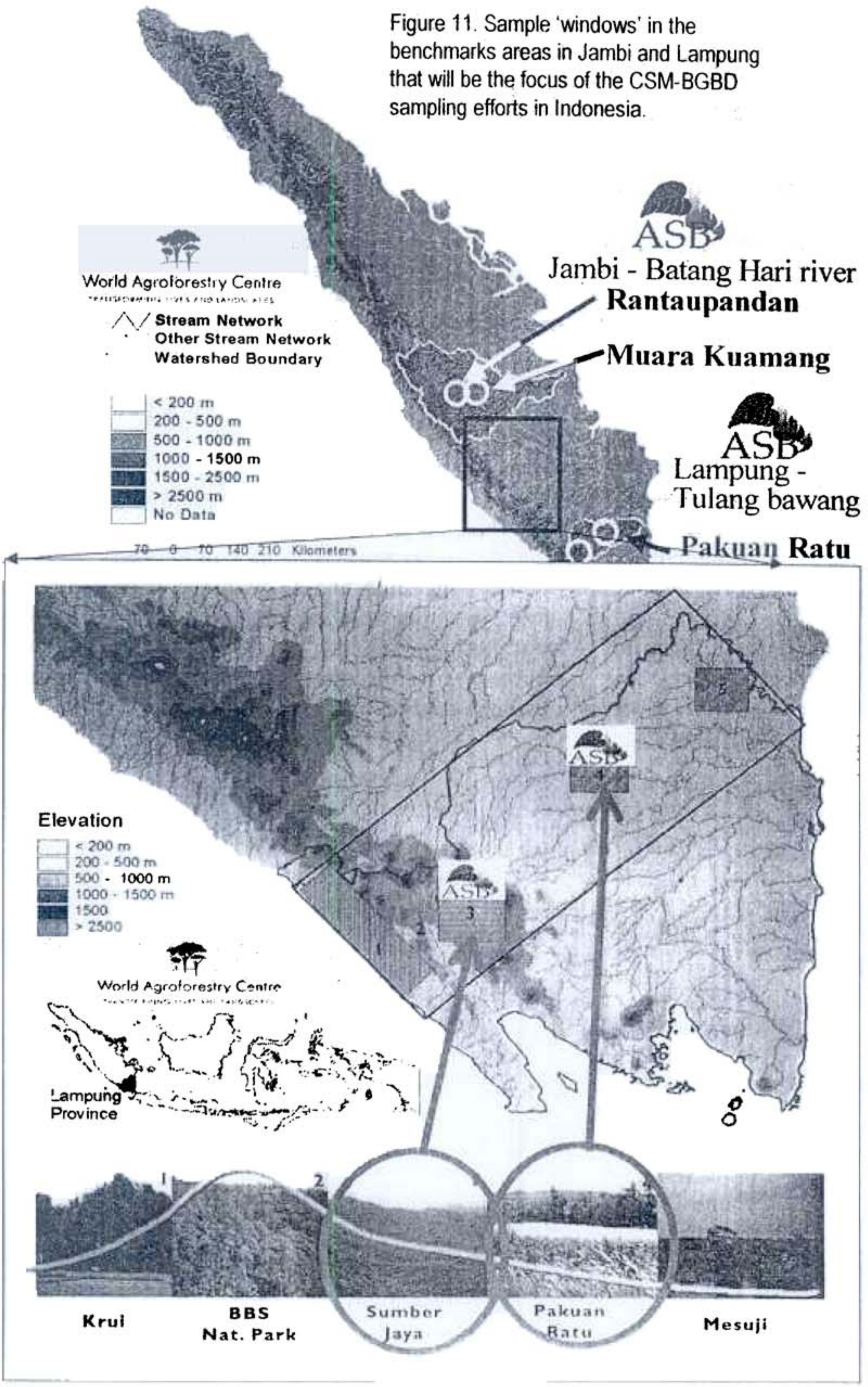

Figure 11. Sample 'windows' in the benchmarks areas in Jambi and Lampung that will be the focus of the CSM-BGBD sampling efforts in Indonesia.

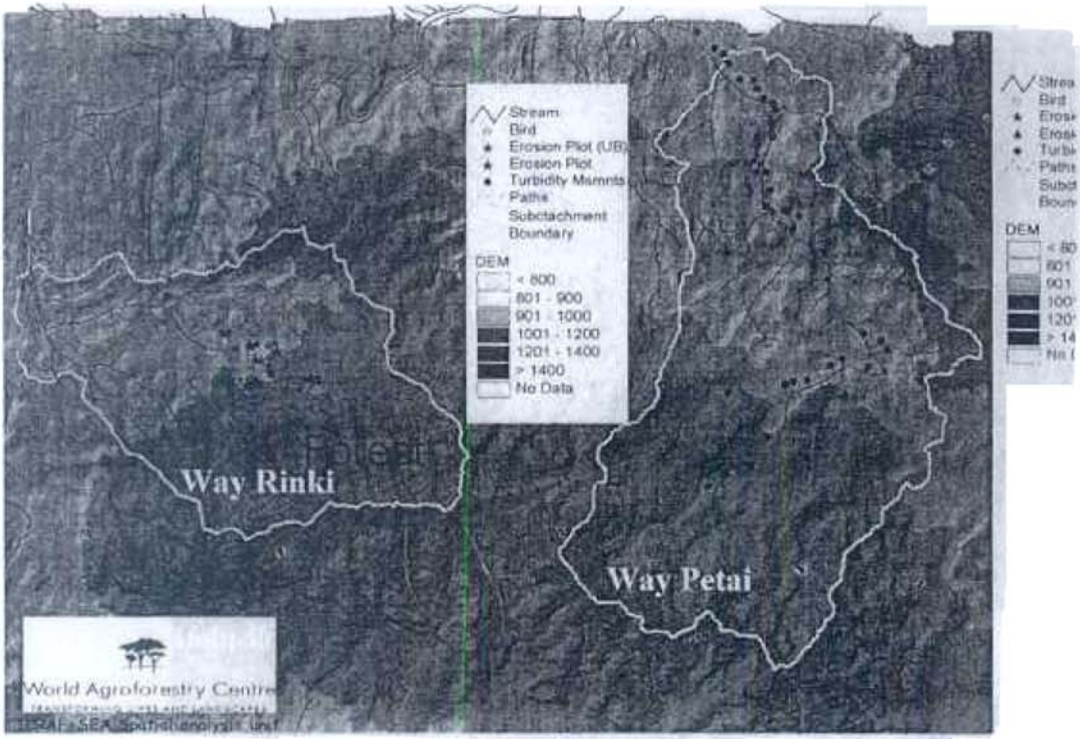

Figure 12. Two 'windows' will be sampled in the Sumbarjaya benchmark, both of which are a 'subcatchment' of about 20 km^2 that include a part of the remaining forest on Bukit rigis (with a gradient of human use intensity starting from the edge of the forest), a range of coffee gardens ('sun coffee' and 'shade coffee), intensive crop production (horticulture) and some temporarily abandoned land (*Imperata* grassland). These windows are also instrumented for hydrological research by another project.

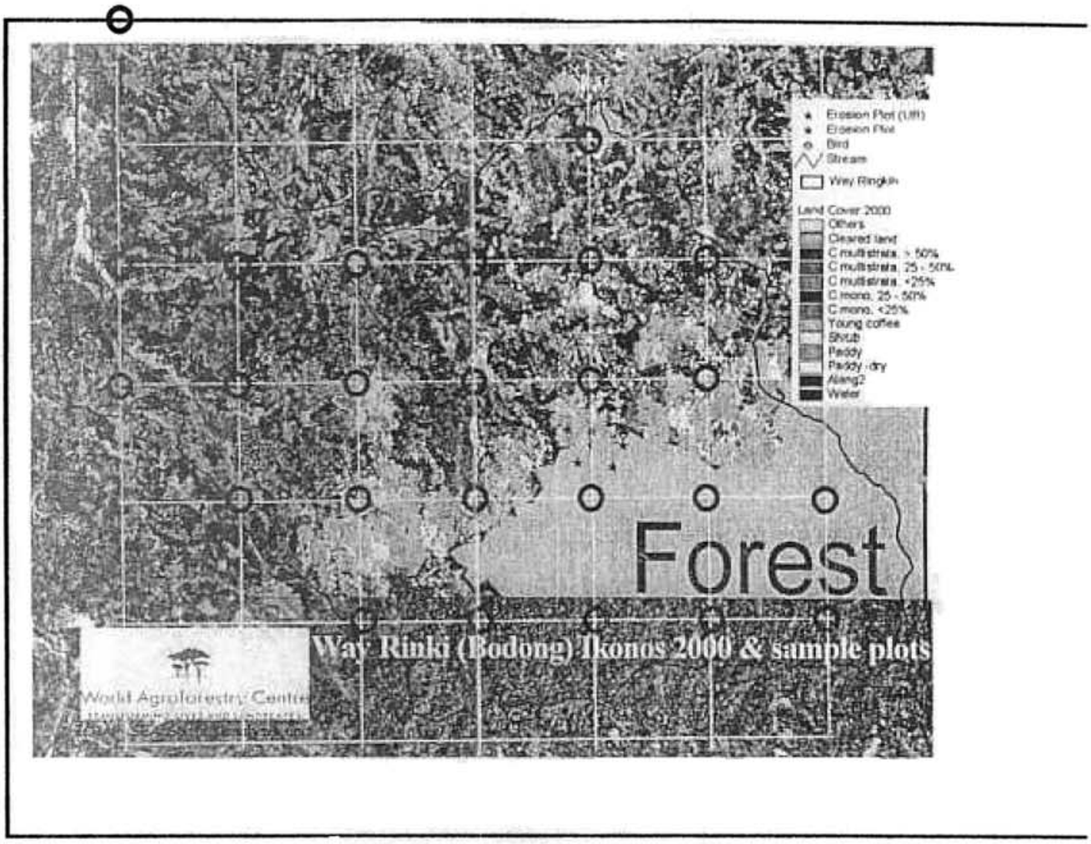

Figure 13. Application of the grid-based sampling scheme to the Way Rinki 'window' as example of how the sample points will be identified in practice.

From Data on Soil Biota To 'Sustainable Management' of Belowground Biodiversity

While the sampling scheme is primarily geared to answer the questions about the impacts of land use intensification on soil biota (question 1 and 2), the project aims to go further and discuss both the relevance of such changes for the farmer managing the land (question 3) and the economic values involved (question 4) both on-farm and off-farm.

Beyond measuring those values, we want to contribute to a better understanding of the management options, at the level of the farmer, as well at the level of society (at least those parts that care about the full story of biodiversity).

The index of land use intensity is based on a listing of the factors that are likely to be a 'threat' to soil biota (at least those of the natural forest domain). By focusing on the various components of the Index of land use intensity, rather than the index as a whole, we may be able to derive a ranking of the threats per benchmark: which ones are prominent in the farming systems of the area, which one appear to have major effects on the belowground biota. Various multivariate analysis techniques can help us distill this from the data of the biodiversity survey plus point-level data on the threat factors. So beyond a test of the general hypothesis, we may identify the components of 'land use intensity' that have the main impact on various indicators of biodiversity. We should not be surprised if the key components of intensification differ among the different group of soil biota studied.

In the mean time, household and community level survey and discussions can help us understand ***who*** is applying the various 'threat factors' on their farms, and ***why*** they do this. This may help to recognize the various trade-offs involved.

Subsequently a more direct empirical approach can quantify the role of the various threats (e.g. effects of pesticide use or reduction of surface mulch), and discussions with farmers can lead to identification of possible entry points for more biodiversity-friendly farm management practices.

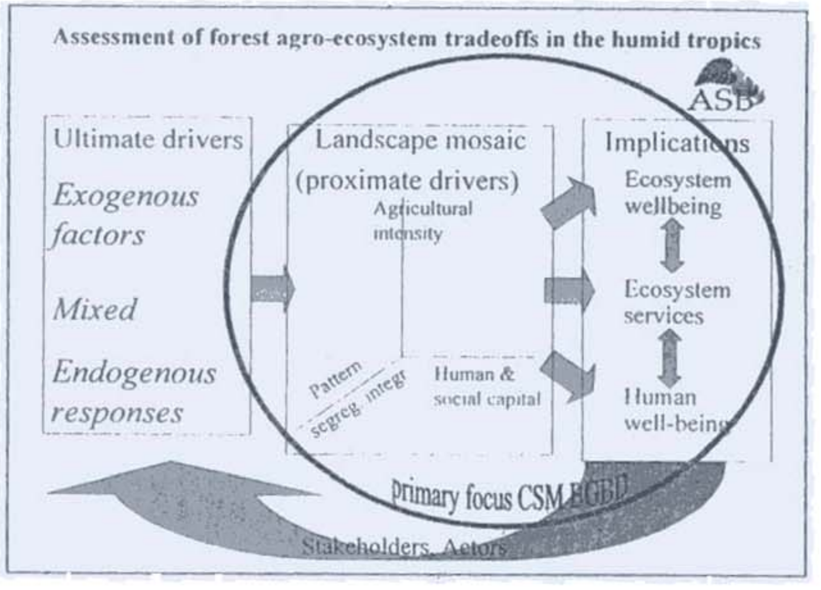

Figure 14. Components of the wider 'land use system' that are assessed in the current Millenium Ecosystem Assessment on the forest-agriculture interface.

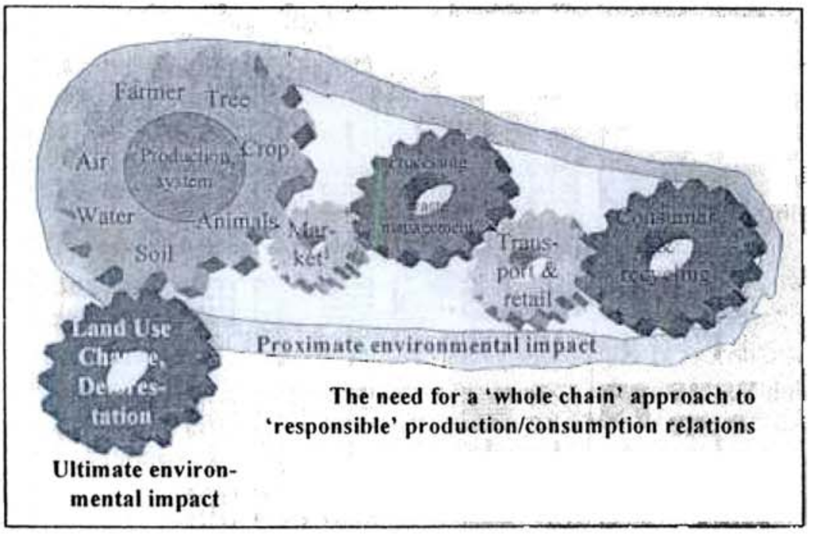

Figure 15. Sustainable management of belowground biota will require efforts within the agricultural production chain (including the feedbacks between (responsible) consumers and (sensible) producers that are grouped under an 'ecolabel' approach, as well as clarity and solutions for the 'ultimate' drivers of further conversion of remaining forests for agricultural use.

Organizational Matters

To achieve its ambitious overall goal the CSM-BGBD project will focus on five primary outcomes, namely:

1. Internationally accepted standard methods for characterization and evaluation of BGBD, including a set of indicators for BGBD loss.
2. Inventory and evaluation of BGBD in benchmark sites representing a range of globally significant ecosystems and land-uses and (b) A global information exchange network for BGBD.
3. Sustainable and replicable management practices for BGBD conservation identified and implemented in pilot demonstration sites in representative tropical forest landscapes in seven countries.
4. Recommendations of alternative land use practices, and an advisory support system, for policies that will enhance the conservation of BGBD.
5. Improved capacity of all relevant institutions and stakeholders to implement conservation and management of BGBD in a sustainable and efficient manner.

These outcomes can only be reached if the project has a strong organizational framework, with a balance between activities at national scale (where the 'sites' provide a logical level of integration) and internationally, where the global exchange of ideas, methods and databases that started during project initiation will have to continue.

To achieve both these 'national integration' and 'thematic global coherence', the project operates with a 'matrix' structure of 'thematic working groups' and 'national teams'. The various thematic working groups are led by scientists from CIAT-TSBF, the project implementing institute, and have international advisors as well as team members from each of the 7 country teams.

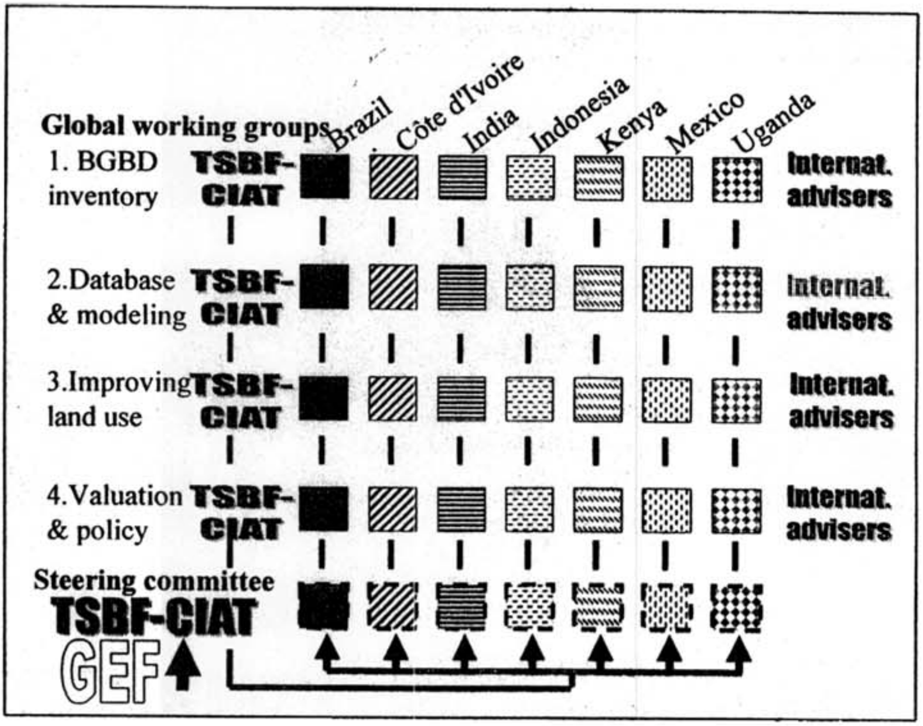

Figure 16. Organizational structure of the CSM-BGBD project.

At the national scale, the CSM-BGBD Indonesia team may consider to start with four working groups for the initial stage of the project where the focus is on the survey:

Group A will focus on the selection of sampling windows and sample points, use GIS tools for describing land use history of the sites and establish the relations with the farmers managing the plots where we want to sample; this group will also conduct the interviews that help in deriving the I_{LUI} index at plot scale. A 'window master' will ensure that local contacts are maintained in an appropriate way, and that sampling efforts in the field are coordinated well

Group B will focus on the soil biota (with macro and micro as tentative subgroups, requiring different sampling methods)

Group C will be responsible for all other basic descriptors of the sampling sites: soil profile data, soil physical and chemical characterization, carbon stocks, greenhouse gas emissions and aboveground vegetation and biodiversity indicators

Group D will focus on the economical analysis of land use options in the windows and benchmarks, and on attempts to define the 'value' of BGBD for local land users linked to this value of land use per se.

Policy dialogues will start early on, to sensitize the public debate on issues of CSM-BGBD, as soon as data from the survey will come in.

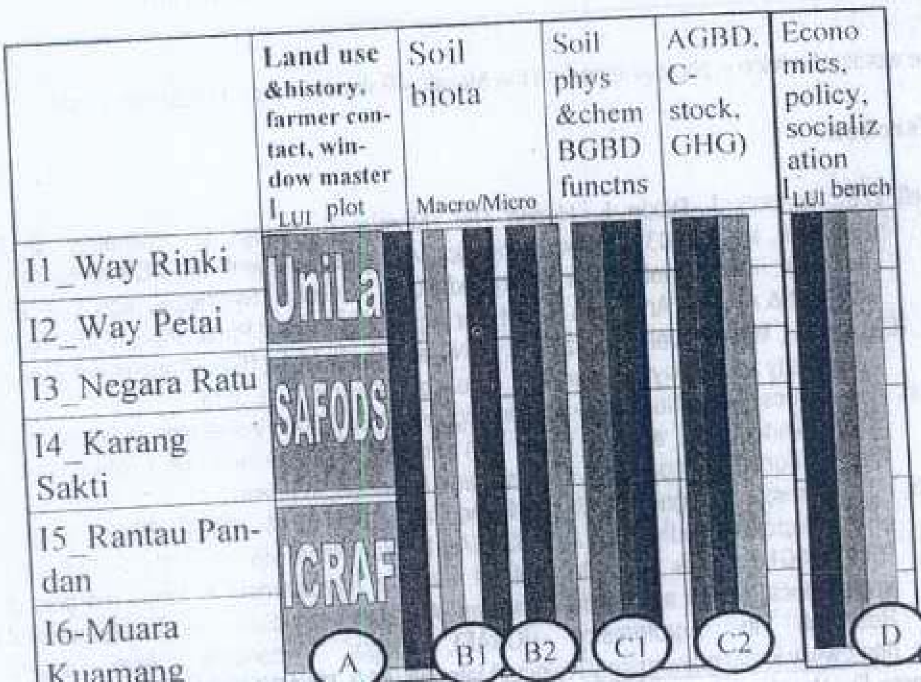

Figure 17. Diagram reflecting the responsibilities of the various groups for coherent sampling across all windows and sites, in order to allow subsequent data analysis to focus on the 'intensification hypothesis' rather than variations in method; for group A, however, the concept of 'window masters' is introduced to have a coordination level between all BGBD researchers and the local farmers.

Finally, before we embark on the fieldwork, we need to ensure that all our protocols for sampling are clear enough and well understood by all involved.

In an emergency

- **In an emergency, keep your head and follow the crews inducements. Confusion makes the situation worse. On leaving ship, give prefe rence to ladies, children and olds and tidy up yourself to have yor hands free with only valuables as possible.**
- **The life jackets are stored in each cabin kindly confirm the sto- red place and how to wear it by "How to put on the life jacket" and check the leaving route by the map on leaving route**

Captain

Wise words of advice – photographed on the Merak – Bakauheni ferry by Laxman Joshi.

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