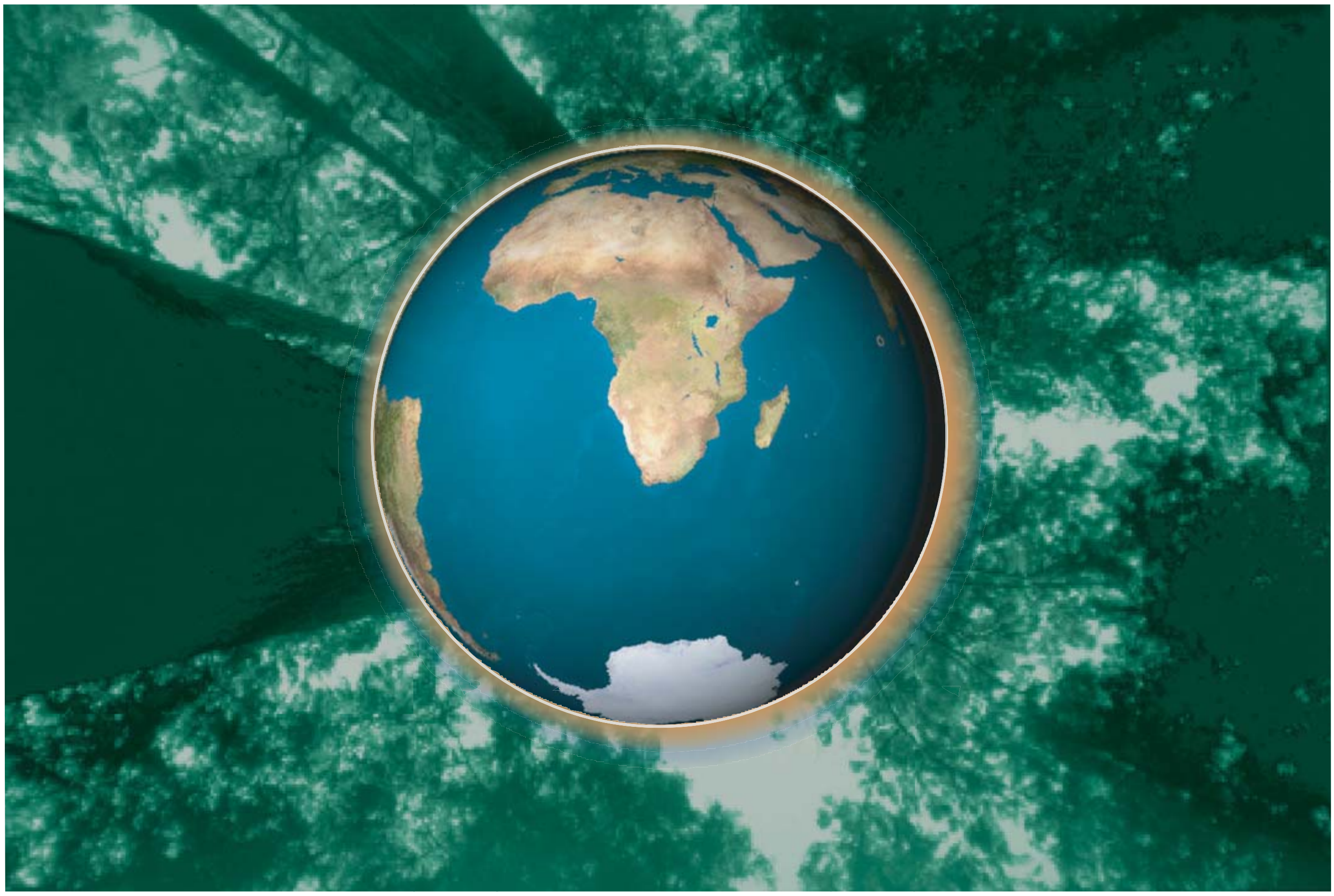
Forests and Climate Change Working Paper 4



Choosing a forest definition for the Clean Development Mechanism

FORESTS AND CLIMATE CHANGE WORKING PAPER 4

CHOOSING A FOREST DEFINITION FOR THE CLEAN DEVELOPMENT MECHANISM

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Abstract

Developing countries must define "forest" before they can host afforestation and reforestation projects under the Clean Development Mechanism of the Kyoto Protocol. To do so, they must chose country-specific values from a range provided in the Marrakech Accords for minimum area, crown cover and tree height. Good practice involves choosing also a minimum strip width. Definitions in the Marrakech Accords and in the 2003 IPCC Good Practice Guidance leave some ambiguities.

Existing country definitions of "forest" do not contain all or, sometimes, any quantitative parameters; simply adopting them for the CDM is not an option. Therefore, all developing countries vying for forestry projects under the CDM will have to choose parameter values. Only few have done so up to now.

Parameter values affect land eligibility for the CDM, feasibility of project types and match with national policy goals. Choosing parameter values that maximize eligibility and feasibility may conflict with those that match economic and socio-environmental expectations. Given a multitude of goals and project types, a large spectrum of sites, current land-uses and ownership patterns, there are no generally valid, optimal choices. A stepwise decision process and simple graphical techniques provided here may aid NAI countries in choosing optimal parameter values for the forest definition.

Forest, afforestation and reforestation as defined for the Clean Development Mechanism

The Kyoto Protocol limits carbon sequestration projects under the Clean Development Mechanism (CDM) during the first Commitment Period to afforestation and reforestation (A&R). The Marrakech Accords define:

"Afforestation" is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources; "Reforestation" is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989 [FCCC/CP/2001/13/Add.1].

Most projects are expected to involve reforestation (Dutschke 2002), necessitating prove that forest land was converted to non-forest land use before 1990. Therefore, the definition of "forest" is crucial for the prior and contemplated future state of the land within the prospective project boundary.

For the CDM, developing countries must choose the parameter values from the ranges[1]:

"Forest" is a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential to reach a minimum height of 2-5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest; [FCCC/CP/2001/13/Add.1]

Alternate values for definition parameters can have significant impacts. When FAO redefined forest between the 1990 and 2000 Forest Resource Assessments, reducing minimum height

[1] The IPCC Good Practice Guidance stipulates selecting in addition a minimum strip width for "linear forests". (IPCC, 2003). FAO defines a threshold of 20 m. However, since the Marrakech Accords only list crown cover, tree height and area, the UNFCCC records only these parameters.

from 7 to 5m, minimum area from 1.0 to 0.5 ha and crown cover from 20% in developed and 10% in developing countries to a uniform 10%, global forest area increased by 300 Million ha or approximately 10% from that cause (FAO, 2000a). The selection of the forest definition is binding only for the first Commitment Period, 2008-2012. Even countries with very diverse ecosystems must choose *one* set of parameters for their entire territory[2].

"Forest" is not defined by land use, but rather by the current or expected physical properties of vegetation cover (Verchot et al. 2005). Even land cover systems that are not intuitively perceived as forests may qualify, e.g. orchards, oil palms, trees planted as shelter belts in fields, along riversides or highways, as well as urban tree plantings (Dutschke 2002). Therefore, a wealth of possible projects arises beyond usual forest plantations.

As of September 15, 2006, nineteen NAI countries had reported their forest definitions. In many other countries, discussions have begun. Given that CDM projects can start anytime and that competition among host countries will be intense, countries must decide as soon as possible.

Remaining ambiguities of definitions

The definition of a tree: The Marrakech Accords do not define a tree. According to FAO, a tree is: "a woody perennial with a single main stem, or, in the case of coppice, with several stems, having a more or less definite crown; includes bamboos, palms and other woody plants meeting the above criteria" (FAO 2005). Banana plantations would not qualify as forests, even though the constraints of minimum height, area, crown cover might be satisfied. Conversely, oil-palm plantations, bamboos, or fruit orchards may be eligible if they match the definition.

Potential vegetative cover: The forest definition refers to potential features of trees, leaving space for a wide range of possible interpretations. Even temporarily unstocked or under-stocked areas could be forests, as long as they are "expected" to attain the thresholds for crown cover or tree height at maturity. The definition probably does not refer to long-term potential natural vegetation, since this would render most lands forests. On the other hand, continuous suppression of natural regeneration due to grazing, or the reduction in size of trees due to pruning in some agroforestry systems, would render these permanently "non-forest". Trees established on a degrading site may also never reach the predicted threshold for height. Reforestation occurs only on "lands that did not contain forest on 31 December 1989". If forests regenerated naturally after 1990 on such land, a potential must already have existed before 1990.

Measures of stand height and crown cover: The MA do not define which measure of tree or stand height among those commonly used in forestry, e.g. mean height, top height, is to be applied. The differences between these measures can reach several meters (Prodan, 1965). Crown cover, as used in the MA forest definition, is correctly defined as the percentage of the ground covered by a vertical projection of the outermost perimeter of the natural spread of the foliage of plants, which cannot exceed 100%. It is synonymous with canopy cover (IPCC,

[2] In some countries where landscape is highly variable, this might not be adequate (Dutschke 2002). Therefore, countries have discussed the introduction of biome-specific forest definitions, however, there are technical challenges (Rakonczay 2002). For now, the issue was deferred to be considered as an option for later CPs only (FCCC/SBSTA/2004/L.26).

2003). However, *crown density* as applied in the MA forest definition, or *crown closure* as used at times in the IPCC GPG refer to different concepts (Helms, 1998).

Size of spatial assessment units: The MA contain minimum forest area as a parameter, but for developing countries no spatial assessment unit for crown cover. Consistency with the chosen minimum forest area is not required[3]. By choosing the assessment area sufficiently large, an area could conceivably contain a significant number of trees without being considered a forest, as long as the mean crown cover remains below the minimum value. Pre-existing patches of trees could be cleared before establishing a project without formally undertaking deforestation (Neeff 2005).

Human-induced promotion of natural seed sources: While planting and seeding represent accepted forestry terminology, the term "human–induced promotion of natural seed sources" does not. It could be misunderstood and appears to reflect intended ambiguity about the eligibility under the Kyoto Protocol of natural succession to trees. Very many tree species propagate, naturally or assisted by humans, not from seed, but by rhizomes, runners, suckers or rooting of living branches in contact with the soil (Bellefontaine, 2005*).* Taking the definition literally, any assisted natural succession to trees on non-forest lands by these mechanisms would not constitute afforestation or reforestation. FAO defines "natural expansion of forest" as "expansion of forests through natural succession on land that, until then, was under another land use". In using this term and requiring human intervention, e.g. by fencing against grazing or browsing or via site preparation, the intent of the KP would be expressed unambiguously.

Temporarily unstocked lands: Temporarily unstocked areas form part of a forest. However, "temporary" remains undefined in the Marrakech Accords. FAO has at times considered an unstocked area non-forest, if it is not expected to revert to trees within a period of 10 years (FAO, 2000).

Considering existing national definitions

In many cases, national forest definitions reflect specific biophysical and social conditions of countries; they are anchored in history, law and forestry practice. Applying such a national definition to the CDM would be simple, consistent, assure the legal status of project areas and link them to existing databases. However, while some national forest definitions resemble or equal those of the Kyoto Protocol or FAO[4], most countries' definitions do not quantify some or any parameters. Therefore, national definitions can not be transposed in most instances.

Types of national forest definitions in NAI countries

Of the 122 NAI countries which also reported their definitions to FAO, 44 countries employ functional definitions only, referring to ecological zones, forest types and land use. Forty countries used at least one quantitative threshold to define forest nationally. Twenty-one countries applied the FAO forest definition. Seventeen did not define forests nationally and none of the NAI countries had a complete set of forest parameter values that could directly be

[3] The Annex I countries have to choose and report spatial assessment units for application in the context of 3.3/3.4 activities (22/CP.7), which have to be consistent with the minimum forest area (4.2.2.3, GPG-LULUCF).

[4] FAO definitions and parameter values in this text are used merely as a reference, not as a recommendation.

used for the CDM[5]. Therefore, all NAI countries opting for forestry CDM projects will have to define a set of values.

For the Global Forest Resource Assessment 2005, most widely used parameters were, in descending order, minimum canopy cover, minimum height and minimum area. Values used most often correspond to values employed in the FAO forest definition i.e., minimum height 5 m, canopy cover 10%, and minimum area 0.5 ha (Figure 1).

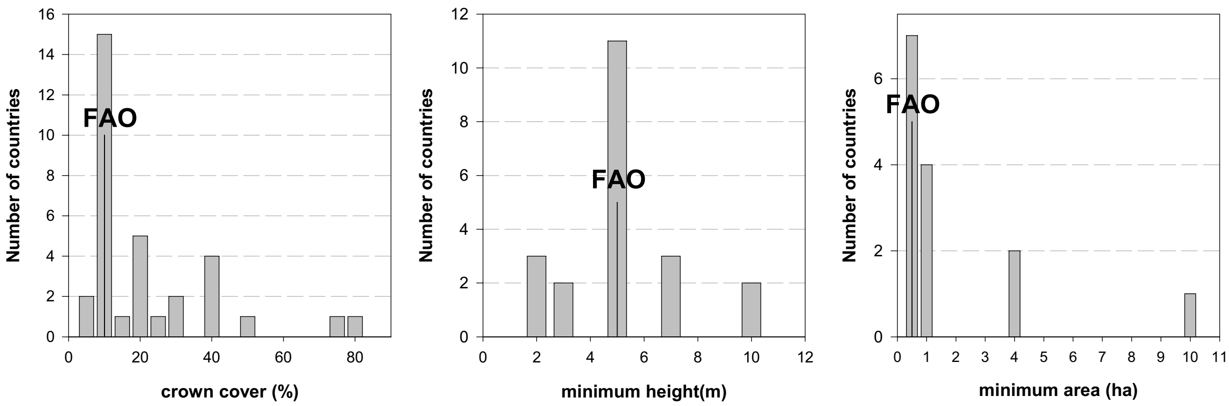


Figure 1: Distribution of parameters values for crown cover, height and area in national definitions of NAI-countries and FAO parameters as reference.

Choosing parameter values

The following ten steps may facilitate the choice of parameter values for the forest definition:

1. Formulate country-specific policy objectives for the CDM in forestry;
2. Identify project types, e.g. planted forests, agro-forest practices, urban tree plantations that match these policy objectives and rank by priority;
3. For all contemplated project types, identify a range of feasible and optimal parameter values for height and crown cover;
4. From local knowledge or geographic information systems, delineate project areas that appear promising ex ante;
5. For these areas, collect relevant data, e.g. land-use patterns, characteristic height and canopy cover values for classes of prior vegetative cover; ownership sizes, sequestration potential, opportunity costs, product markets, social and environmental conditions and local stakeholder attitudes;
6. Based on this assessment, identify prime areas for afforestation and reforestation CDM projects and rank land cover classes to be converted by priority;
7. For these classes, identify parameter values that would preclude the existing vegetative cover from being considered as "forest" ex ante;

[5] In many cases, there were several differentiated definitions for specific forest types, e.g. dense forests, open forest, forest-grasslands, or degraded forests. In these cases, thresholds were combined following personal judgement.

8. Step 7 and 3 will indicate infeasible combinations of prior conditions and desirable project types; general guidelines (Appendix I) and methods for this crucial step are described below;
9. Establish feasible prior conditions-project type combinations and chose optimal parameter values for height and crown cover which maximize eligibility;
10. In a separate step, select minimal area of a “forest”, based on parcel size distribution of ownerships

Currently, detailed information on the prior state of vegetative cover, such as canopy cover, tree heights, forest fragmentation or parcel sizes is missing for large parts of the world (Indonesia, 2002). Remote sensing with a resolution necessary for quantifying such measures is economically infeasible (Dutschke 2002). Information on growth, yield, wood density, biomass functions and sequestration potential is also lacking for many prospective project types (Rakonczay 2002). Hence, expert judgment may have to substitute for firm data; decisions will often have to be taken under uncertainty.

While mathematical decision models for an optimal choice of minimum parameter values in the forest definition exist, e.g. linear or dynamic programming, Bayesian decision analysis or simulation, data requirements for these models are unlikely to be met, and the effort of establishing them might be disproportionate to prospective benefits for countries.

The following elaborates individual steps in the decision process described above, illustrates some policy objectives, prior land cover classes, and common project types and simple graphical techniques to arrive at an optimal solution.

Furthering national policy objectives with the CDM

International climate change agreements and the CDM will not be a panacea for funding problems in land use and forestry, but they can provide new incentives to employ afforestation and reforestation as a tool to further sustainable development. In this context, countries may see a role for the CDM in achieving a wide range of policy goals. They might seek to maximize eligible area for the CDM to expand the resource base for domestic forest industries through plantations or rehabilitation, or for renewable wood energy. They might perceive CDM forestry projects not only under the aspect of climate change mitigation, but also as a means for adapting to climate change, enhancing development and food security for smallholders or rural communities. Under the rules for the CDM, afforestation could well serve the goal of increasing livelihoods and human well-being in urban centres or agricultural landscapes. The protective function of new forests for biodiversity, soils and water might be as important in some landscapes as the carbon they accumulate.

Accommodating prior site conditions

The Global Forest Resource Assessments 2000 (FAO, 2001) provides a distribution of prior land cover classes for the pan-tropics and permits establishing actuarial transition probabilities to plantations (Table 1).

Table 1: Transitions to plantations 1990 -2000 for the pan-tropics (FAO, 2001)

Transition to plantation from land cover class	Million ha in the year 2000	%
Closed forest	1.9	37
Open forest	0	0
Fragmented forest	0.2	4
Long fallow	0.2	3
Short fallow	0.4	7
Shrubs	0.2	4
Other land cover classes	2.3	45

In the past, plantations have replaced mostly closed forests or non- forestry land uses. The stringent restrictions imposed by CDM rules and modalities prevent closed forests, and most open forests and long fallows from being converted to plantations. Only the following land cover classes could conceivably furnish sites for afforestation and reforestation under CDM:

Fragmented forests: In 2000, FAO identified a total of 223 Million ha of such forests in the pan-tropics. Individual fragments of the original forest are likely to exceed any threshold for height. Forest fragments in human-dominated landscapes, tend to be below one ha in size (Laurance, 2005), Given a goal to render such lands eligible for CDM projects, e.g. to reconnect scattered parcels of remaining forests, a low minimum area could render interstices between fragments eligible for projects and preserve existing fragments. Alternatively, a large assessment unit combined with a high minimum crown cover might keep average canopy cover over the entire project area below a high threshold value and render the entire area eligible for A&R.

Open forests with crown cover below 30%: FAO defines open forests as having a canopy cover of between 10% and 40% and inventoried 290 Million ha of them by the year 2000 in the pan-tropics. Conceivably, some open forests, e.g. very severely degraded natural forests, could be eligible for A&R projects, if countries use the upper limit of the available range to define a forest and if these lands would not naturally revert to the forest stage.

Short fallows: In 2000, FAO surveyed 147 Million ha of such lands in the tropics. With the short return time to agriculture, the fraction of parcels with woody vegetation is smaller than in long fallow lands, and fields predominate. The system might conceivably not be considered as forest or reverting to forest, if average height of regenerating tree species or average canopy cover over an assessment unit are expected to remain below thresholds. In most cases, however, individual parcels of these lands will have been forest after 1990 and will not be eligible for the CDM.

Shrubs: In 2000, shrub lands made up 151 Million ha in the tropics alone and 1300 Million ha globally. Such lands are dominated by woody perennial plants, generally more than 0.5 m and less than 5 m high at maturity without a definite crown. Land may contain scattered and clustered trees. To exclude the risk that such lands could be forests under the Protocol, thresholds for crown cover of trees and minimum height should be at the upper boundary. Clearly, shrub lands on better sites could present a large potential source of lands for the CDM.

Other land cover with less than 10% woody vegetation: Irrespective of the minimum parameter values chosen for area, crown cover, and height, there is no risk that land under this category might be forests ex ante. Parameter value choice can focus on prerequisites for desirable project types instead. In 2000, such lands amounted to 1017 Million ha in the pan-tropics.

Facilitating project types

Major potential project types include those listed below (see Figure 1).

Agroforestry

Agroforestry practices are diverse in their woody and herbal components, management and biophysical settings (Montagnini and Nair, 2004; Appendix II), but total system productivity will depend strongly on *crown-cover* (Kant 2005).

Introducing a small tree component into denuded, purely agricultural landscapes to establish some agroforestry practices (Pancel, 1993), such as protein banks for animal fodder, multipurpose trees on croplands, trees on rangelands, estate crop trees with pasture, or trees for soil conservation and reclamation would necessitate a relatively low canopy cover threshold in order to avoid productivity losses for the agricultural components of the systems. Other agroforestry practices with a more substantial woody component, such as Taungya systems, tree gardens, or some estate crop combinations operate optimally with higher tree stocking and would be feasible as afforestation projects even under prior conditions that include scattered trees with a crown cover at or above 10%.

Agroforestry practices that produce fodder through browsing, fuel wood through coppicing, or hedgerows and alley cropping practices employing smaller trees all require a low threshold for *height* to qualify ex post as forests. Choosing a small minimum forest area would facilitate smallholder participation.

For living fences, shelterbelts, windbreaks, woody hedgerows selecting a low strip width would maximize eligibility, unless minimum crown cover requirements are met at the assessment unit level.

Urban forestry

Urban forestry can take very diverse forms and shapes; possible project types for the CDM could range from afforestation on relatively large surfaces, where the choice of the forest parameters is not critical, to small scale plot, strip- and alley planting. To reach “forest” status for the latter type of urban greening, thresholds for crown cover, minimum area and height should be at the lower end of the ranges.

Productive plantations

In the most typical case, large productive plantations are established with fast-growing tree species on shrub lands, short fallows, cropland or grazing land of good site quality. Fragmented and severely degraded forests with low height and sparse crown cover which are not expected to revert to high forests might also be converted. After conversion, the planted forest will typically quickly attain 30% crown cover, and 5 m height. A high value for crown cover (30%) and height should be chosen for the land to be eligible ex ante (Kant 2005).

Protective plantations

On the other hand, choosing a minimum crown cover and low heights at maturity might be optimal for protective plantations close to the natural timberlines in mountains, under boreal conditions (Köhl 2000), or in dry lands, where timber quality is not the concern. Such protective plantations could be effective even if small; a low area threshold may therefore be indicated.

Permanent tree crops and wood-energy plantations

A low value for minimum height may be necessary to ensure that bio-energy plantations or agricultural systems involving crops from small tree are eligible. Oil-producing tree species are often cut back severely in order to increase yields and to facilitate harvesting of the fruits.

Small-scale afforestation and reforestation

Projects under this special category, created by Parties specifically for low income individuals and communities in support of rural livelihoods, could comprise a total area of from less than 100 ha up to 4000 ha and any project type described above. However, in order to facilitate "bundling" of small-holder plots, minimum area needs to reflect prevailing parcel size distributions. In many regions, small-holder farms could only participate if low area thresholds are chosen.

Integrating prior site conditions and project types

Figure 2

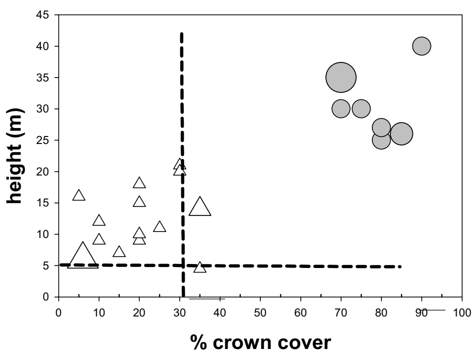
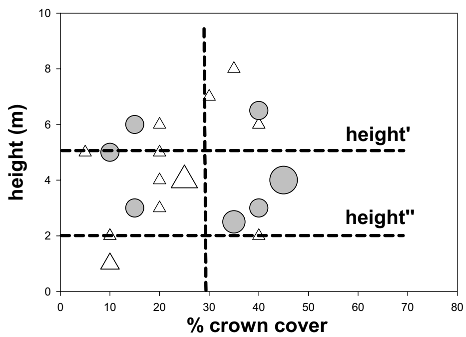


Figure 3



△ prior stand and priority
○ posterior stand and priority

Figures 3 and 4: Comparing prior and posterior stand parameters; see text for explanation

Contrasting prior land cover characteristics with feasible parameter values for contemplated project types helps to eliminate infeasible options and facilitates the choice of the lower boundaries for crown cover and height, as illustrated in Figures 2 and 3.

Paired values of crown cover and height of typical existing stands for a hypothetical landscape are plotted. Feasible values for height and crown cover of the contemplated plantations are also plotted. Plot symbols express by their relative size the rank, value or utility of prior and posterior stand types for policy goals. Vertical and horizontal dotted lines represent minimum values. Numbering the quadrants formed by these intersecting lines clockwise, lines should be chosen as to maximize the number (or area / utility) of existing stand types in quadrants one, three, and four, while simultaneously maximizing the number (area, value, utility) of contemplated stand types in quadrant two.

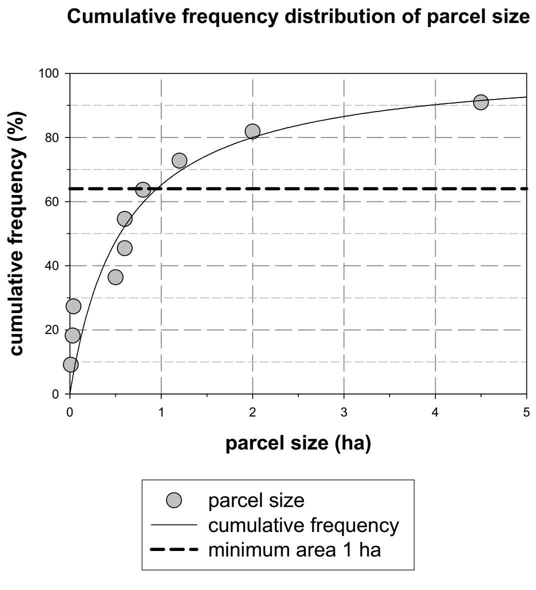
Figure 2 depicts prior stand characteristics of hypothetical heavily fragmented, degraded remnants of a forest, and stand characteristics for productive plantations. A crown cover of 30% and a minimum height of 5 m would be the optimal choice maximizing available area All plantations considered are feasible as forests.

Figure 3 represents a hypothetical intensively managed very short fallow landscape to be utilized for sustainable agroforestry practices with a low component of trees. A minimal crown cover of 30% and the largest possible value for height of 5 meter (height') maximizes eligibility of existing lands for the CDM. However, with those parameter values, only a single agro forest practice, which is also not the most desirable (Quadrant 2), could be established on eligible land. Selecting a lower thresholds for height of 2m (height'') would not affect land availability, but would increase availability of agroforestry options, include project types of greatest utility and, therefore, represent a better choice.

Integrating parcel size distribution

Figure 4: Establishing parcel size distribution by the scarce data method

ordered parcel size	rank	percentile of the distribution
0.01	1	9.09
0.03	2	18.18
0.04	3	27.27
0.50	4	36.36
0.60	5	45.45
0.60	6	54.54
0.80	7	63.63
1.20	8	72.72
2.00	9	81.81
4.50	10	90.90



The parameter value for the definition of minimum area may strongly influence participation by rural people in areas where small-holders prevail. However, in many developing countries records to establish a distribution of the size of individual holdings may not be readily available. Expert estimates may substitute for objective data. An easily applied and quite reliable sampling method is the "scarce data method" (Snedecor and Cochran, 1978; Schoene, 1983).

According to this method, the "k" th observation in a random sample of "n" values which have been ordered by size is an estimator of the "k/n+1" th percentage of the underlying cumulative frequency distribution. Even relatively few observations suffice to estimate the underlying population distribution. Figure 4 provides an example using the distribution of parcel sizes to decide on minimum forest area. For a minimum area of 1 ha, 62% of small-holders could not participate in the CDM; obviously a lower threshold should be chosen if smallholders are to benefit from the CDM.

What parameter values have NAI countries selected up to the present?

Figure 5 provides the distributions of values reported for these parameters to the UNFCCC (UNFCCC, 2006), with FAO values given as a reference.

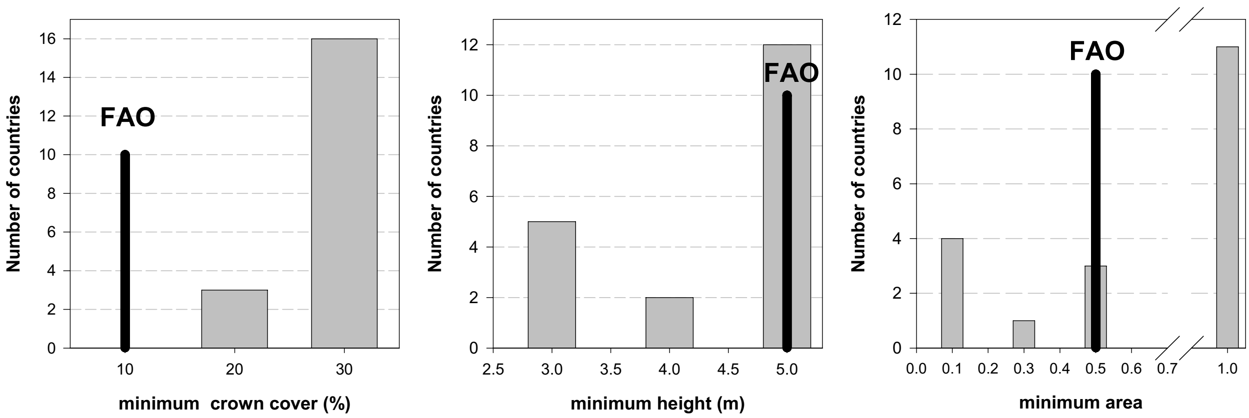


Figure 5: Distributions of minimum parameter values chosen by NAI countries by October 2006, compared to the FAO definition as a reference.

By choosing the minimum crown cover at the upper end of the range, reporting countries have tried to eliminate the risk of prior vegetation being considered as forests and ineligible for the CDM. China, the Dominican Republic and Nicaragua are exceptions.

A minimum height of below 5 m indicates that other countries, Albania, China, Vietnam Yemen, Niger, Nicaragua, and Mali, may consider also project types other than highly productive plantations to fulfil their policy goals for the CDM.

Less than half of all reporting countries, among them India or China, chose a small minimum area, apparently addressing prevailing ownership patterns and policy goals.

Conclusions

Non-Annex I countries interested in hosting forestry CDM projects must choose parameter values for the definition of forest from ranges given under the rules and modalities of the CDM. Minimum crown cover, minimum height, and minimum area are required. Good practice calls for also selecting a minimum strip width. Some terms, such as “tree”, “height”, “temporarily unstocked state”, “expected return to forest”, and “promotion of natural seed sources” remain ambiguous. Together with the significant role of spatial assessment units these issues might be clarified by the Executive Board of the CDM.

Neither transposing existing national definitions of forest, nor resorting to the FAO definition will alleviate the need for a rational national choice. The selection will affect eligibility, extent, prospects, and impacts of forestry CDM projects. Parameters should match prior site conditions, allow for desirable project types, and facilitate national policy goals. Optimal values will usually vary by country.

Available data on existing country definitions, historic transitions to planted forests, and details of possible project types provide a decisions background. A stepwise decision algorithm and relatively simple graphical techniques may facilitate the urgent choice of optimal parameter values for the forest definition by NAI countries.

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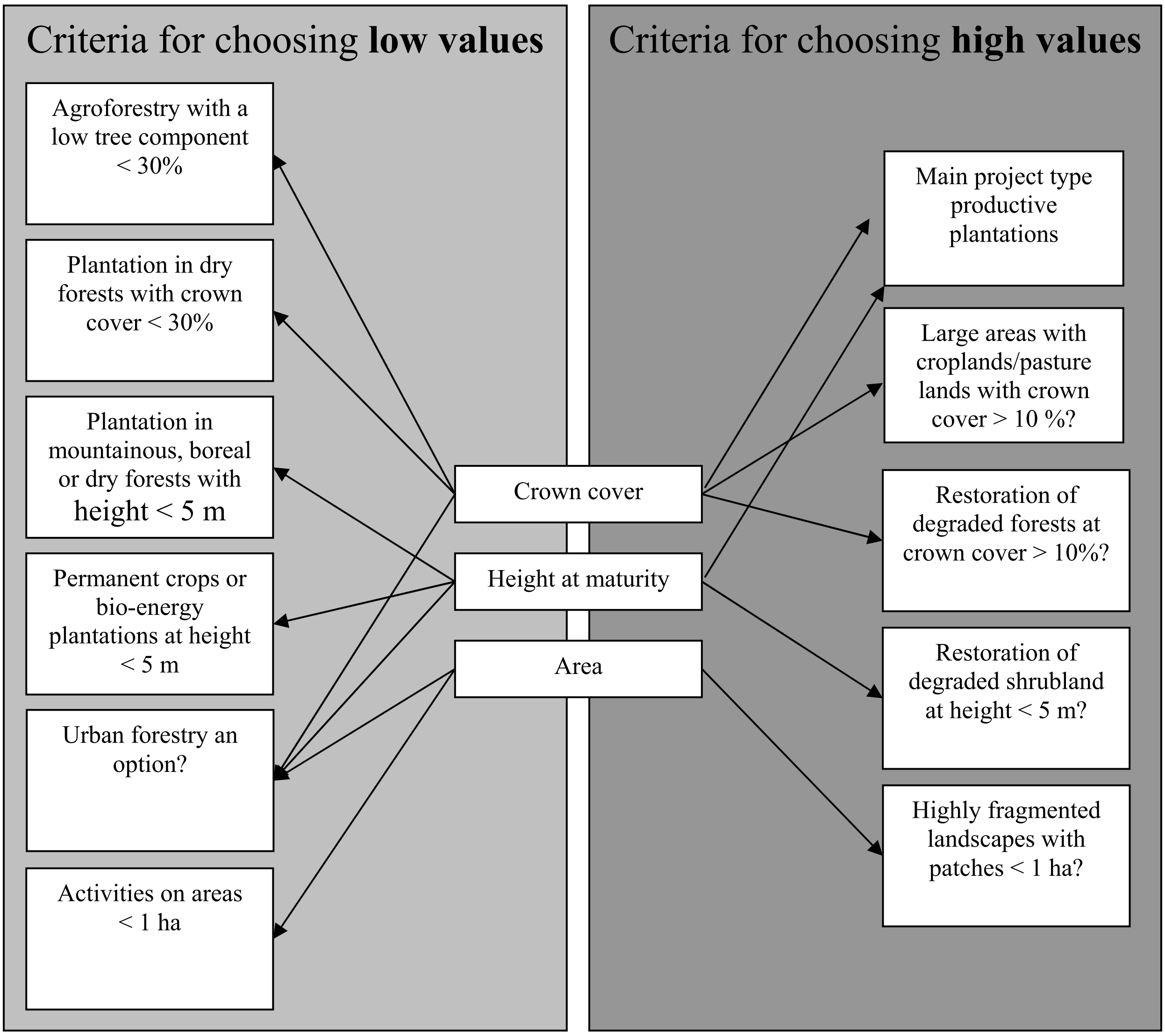
Appendix I

Criteria for the choice of high and low parameter values for the CDM forest definition.



Appendix II

Agroforestry practices[6] in small-scale A&R[7]

System	Practice	Combination	Components
Agrisilvicultural systems	1. Improved fallow	trees planted during non-forest phase, if land not expected to revert to forest	w: fast growing h: agricultural crop
	2. Taungya	crops during tree seedling stage	w: plantation species h: agricultural crops
	3. alley cropping	trees in hedges, crops in alleys	w: coppice trees h: crops
	4. tree gardens	multispecies, dense, mixed	w: vertical structure, fruit trees h: shade tolerant
	5. Multipurpose trees on cropland	trees scattered, boundaries	w: multipurpose trees h: crops
	6. estate crop combinations		w: coffee, coconut, fruit trees h: shade tolerant
	7. Homegardens	multi-storey mixes around homes	w: fruit trees h: crops
	8. trees in soil conservation, reclamation		w: multipurpose fruit trees h: crops
	9. shelterbelts, windbreaks, live hedges	around farmland plots	w: trees h: crops
	10. Fuel wood production	firewood species around cropland plots	w: firewood species h: crops
Silvopastoral systems	11. Trees on rangelands	scattered trees	w: multipurpose, fodder f: present a: present
	12. Protein banks	trees for protein-rich cut fodder	w: leguminous trees h: present a: present
	13. Estate crops with pasture	Example cattle under coconut palms	w: estate crops F: present a: present
Agrosilvopastoral; systems	14. Homegardens with animals	around homes	w: fruit trees a : present
	15. Multipurpose woody hedgerows	trees for browsing, mulch, soil protection	w: coppicing fodder trees a, h: present
	16. Aqua forestry	trees lining ponds	w: leaves forage for fish

[6] Pancel, 1993

[7] W: woody species; a: animals; h: herbaceous(crop) species