Questionnaire for soliciting public inputs on the draft revised tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"

QUESTIONNAIRE

Part I: Overall assessment of the draft document

Please indicate if you have had any experience with the use of this methodological tool in any A/R CDM project activity (Yes/No).

Yes, we are verifying and validated projects applying such tool

Please provide general suggestions for improvement and editorial comments on the draft document. For example, is the document:

(a) Well written;
(b) Simple and accessible;
(c) User-friendly;
(d) Well-organized, with flow of logic that is clear;
(e) Exemplified;
(f) Complete?

The tool is well written and well organized.

Part II: Input on specific and technical issues

Two methods for estimation of change in tree biomass using sample plots are provided in the draft (see pages 2–9 and 10–15). Please provide your answers, including relevant explanation/analysis/simulation to substantiate your answers, to the following specific questions related to these methods:

(a) The stock change method and the increment method are two options for project participants to account and monitor carbon removals in living biomass. Are these two methods sufficient? If not, can you recommend an alternative method?

This seems sufficient.

(b) In the stock change method, tagging, marking or mapping of individual trees is not required. If you are using the stock change method:

(i) Would you tag or mark the trees anyway?

The common practice in the industry is to tag or mark trees, even if temporal plots are used, however the tagging system may not always be sufficient to remain recognizable beyond a certain length after tagging.

(ii) If yes, then why? Or If no, then why not?

Usually it is required in order to: 1) in permanent plots, re-measure the same trees where high positive correlation it is expected to exist between both measurements in order to increase the precision; 2) in any case, even in temporary plots, to be able to re-locate the plots for QA purposes.

(c) In the increment method, is tagging, marking or mapping of individual trees and tracking these trees across successive measurements necessary?

(i) If so, why; and if not, why not?

In the case of the increment method, tagging or marking trees might be even more important as it is important to locate the exact tree. However, it is worth noting, that it should not be a requirement since in some cases only the center of the plot is marked and trees are found using bearing and distances. However, we are also aware that increasingly methodologies are applied that relay on statistical methods that do not require re-measuring the original trees, in order to tag away any incomplete data sets due to loss of tags/marking.

(ii) Would the requirement to tag, mark or map individual trees be a barrier to your using the increment method? It could be, since in some case trees are identified using bearing and distances instead of direct identification.

(d) What are the cost implications, if any, of attaching unique identifiers to individual trees and tracking these trees across successive measurements, while keeping both the plot location and the tree markers hidden from the persons managing the plantation?
(i) Will the monitoring and verification cost increase or decrease because of this requirement?
If plots are marked, of course it would make the verification more transparent and easier since plots could be re-visited and the DOE would be able to confirm whether the SOPs have been correctly implemented and tentatively confirm the reasonableness of the monitored values. Although this would facilitate the work for the verifier, it represents an additional cost for the project participant as they would have to have in place provisions for maintaining the tagging systems.
(ii) How significant will be the increase or decrease in the monitoring and verification cost?
Marking and tagging might have a high cost in the monitoring. For verification, it would be difficult to re-visit the same sample plots in order to confirm the implementation of the SOPs; therefore, in order to reach the required level of assurance in order to arrive to a conclusion, the DOE would have to look for other types of evidences.

(e) What are the other advantages or disadvantages of attaching unique identifiers to individual trees and tracking these trees across successive measurements, for example, relevant to accuracy, transparency, etc?
We think it should not be required to identify individual trees, but probably just the location of the plot; in the end the important thing is to confirm whether plots have been established and whether the carbon density of the monitoring and the verification are more or less consistent. The tree-by-tree comparison is useful to understand sources of error if there is a large variation in the carbon densities measured and re-measured, but it is not critical. As also identified earlier this would also allow more flexibility in developing statistical modules that do not rely on permanent sample plots.

Part III: Other comments/inputs
Please provide comments/inputs on any other general or specific issue that you identify with the draft, using the commenting table on the next page.
a) Use of regression estimators: Regression estimators can be used to increase the precision or efficiency of a sample by making use of supplementary information about the population being studied. For instance, if the basal area of a population is known, the relationship between volume and basal area obtained through the information of the volume-basal area relationship obtained from sampling plots can be used in order to estimate the total volume of a certain stand.
b) Use of double sampling: Double sampling can be used in order to estimate volumes. A large sample is taken in order to obtain a good estimate of the mean or total for the supplementary variable (2). On a subsample of the units in this large sample, the y values are also measured to provide an estimate of the relationship of y to x. The large sample mean or total of x is then applied to the fitted relationship to obtain an estimate of the population mean or total of y. An example of this application would be the use of double sampling in order to update inventories or using a supplementary variable that can be measured intensively at low cost. This would be a way of achieving high precision levels and keeping costs down as it would not be necessary to conduct a new full inventory or the estimation of volumes would be done through supplementary variables.
c) Other cruising methods: In the industry there are many cruising methods in order to evaluate the volume of certain stands (i.e. 3P, two-stage, etc.); in many cases these alternative methods are more interesting, efficient and less costly than using stratified random sampling with fixed area plots or point samples. You could reach the same level of precision of your estimate at the same confidence using these alternative methods; this in the end is the important thing. A suggestion would be to accept these alternative methods in future version of the tools.

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Template for comments **Date: Document:**

TABLE FOR COMMENTS

Name of submitter: Andres Espejo, Edwin Aalders
Affiliated organization of the submitter (if any): DNV Climate Change Services AS
Contact email of submitter: Andres.Espejo@dnvkema.com

0	1	2	3	4	5	6
#	**Para No./ Annex / Figure / Table**	**Line Number**	**Comment ge** = general **te** = technical **ed** = editorial	**Comment (including justification for change)**	**Proposed change (including proposed text)**	**Assessment of comment (*to be completed by UNFCCC secretariat*)**
1	13	79-85	te	Other methodologies such as AR-AM0005 Version 5 include specific provisions for the estimation of below ground biomass in coppicing systems, i.e. the below-ground carbon stock estimated in the year before each harvest and it is assumed to be constant until a year before the next harvest, when it shall be estimated again. It could be interesting to include this in the provisions of the tool.	13. Under this method volume tables or volume equations are used to convert tree dimensions to stem volume of trees. Stem volume of trees is converted to above-ground tree biomass using basic wood density and biomass expansion factors. Below-ground biomass is estimated by applying root-shoot ratios to the above-ground biomass. Total tree biomass is estimated adding both the above-ground tree biomass and the below-ground biomass. Thus, biomass of trees of species *j* in sample plot *p* is estimated as: $B_{TREE,j,p,i,t} = B_{TREE,AB,j,p,i,t} + B_{TREE,BB,j,p,i,t}$ where: $B_{TREE,j,p,i,t}$ Biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $B_{TREE,AB,j,p,i,t}$ Above-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $B_{TREE,BB,j,p,i,t}$ Below-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. x. Above-ground biomass of trees of species *j* in sample plot *p* is estimated as:	

					$B_{TREE,AB,j,p,i,t} = V_{TREE,j,p,i,t} \cdot D_j \cdot BEF_{2,j}$ where: $B_{TREE,AB,j,p,i,t}$ Above-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $V_{TREE,AB,j,p,i,t}$ Stem volume of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*, estimated by using the tree dimension(s) as entry data into a volume table or volume equation; m^3 D_j Basic wood density of tree species *j*; t d.m. m^{-3} $BEF_{2,j}$ Biomass expansion factor for conversion of stem biomass to above-ground tree biomass, for tree species *j*; dimensionless j 1, 2, 3, … tree species in plot *p* p 1, 2, 3, … sample plots in stratum *i* i 1, 2, 3, … tree biomass estimation strata within the project boundary t 1, 2, 3, … years counted from the start of the A/R CDM project activity x. Below-ground biomass of trees of species *j* in sample plot *p* is estimated as: $B_{TREE,BB,j,p,i,t} = B_{TREE,AB,j,p,i,t} \cdot R_j$ $B_{TREE,BB,j,p,i,t}$ Below-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $B_{TREE,AB,j,p,i,t}$ Above-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. R_j Root-shoot ratio for tree species *j*; dimensionless j 1, 2, 3, … tree species in plot *p* p 1, 2, 3, … sample plots in stratum *i* i 1, 2, 3, … tree biomass estimation strata	

					t — 1, 2, 3, … years counted from the start of the A/R CDM project activity In the case of coppicing rotations (i.e. where a) roots of the harvested trees are not be removed from the soil and b) these will lead to a new forest) the below-ground biomass estimated in the year before the harvest may be assumed to be constant until a year before the next harvest.	
2	18	111-115	te	Other methodologies such as AR-AM0005 Version 5 include specific provisions for the estimation of below ground biomass in coppicing systems, i.e. the below-ground carbon stock estimated in the year before each harvest and it is assumed to be constant until a year before the next harvest, when it shall be estimated again. It could be interesting to include this in the provisions of the tool.	18. Under this method allometric equations are used to convert tree dimensions to above-ground tree biomass. Below-ground biomass is estimated by applying root-shoot ratios to the above-ground biomass. Total tree biomass is estimated adding both the above-ground tree biomass and the below-ground biomass. Thus, biomass of trees of species *j* in sample plot *p* is estimated as: $$B_{TREE,j,p,i,t} = B_{TREE,AB,j,p,i,t} + B_{TREE,BB,j,p,i,t}$$ where: $B_{TREE,j,p,i,t}$ — Biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $B_{TREE,AB,j,p,i,t}$ — Above-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $B_{TREE,BB,j,p,i,t}$ — Below-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. x. Above-ground biomass of trees of species *j* in sample plot *p* is estimated as: $$B_{TREE,AB,j,p,i,t} = \sum_{l} f_j(v_{l,t})$$ where: $B_{TREE,AB,j,p,i,t}$ — Above-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $f_j(v_{l,t})$ — Allometric function applicable to species *j* returning total above-ground tree biomass on the basis of tree dimensions (v) as	

					entry data in time *t* per individual tree *l*; t d.m. j — 1, 2, 3, … tree species in plot *p* p — 1, 2, 3, … sample plots in stratum *i* i — 1, 2, 3, … tree biomass estimation strata within the project boundary t — 1, 2, 3, … years counted from the start of the A/R CDM project activity l — 1, 2, 3, … trees of species j in plot p Alternatively, other approaches allowing estimation of tree biomass per hectare (e.g. using a relascope) may be applied to calculate the total above-ground biomass of trees of species j in sample plot p of stratum i at a given point of time in year t x. Below-ground biomass of trees of species *j* in sample plot *p* is estimated as: $B_{TREE,BB,j,p,i,t} = B_{TREE,AB,j,p,i,t} \cdot R_j$ $B_{TREE,BB,j,p,i,t}$ — Below-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $B_{TREE,AB,j,p,i,t}$ — Above-ground biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. R_j — Root-shoot ratio for tree species *j*; dimensionless j — 1, 2, 3, … tree species in plot *p* p — 1, 2, 3, … sample plots in stratum *i* i — 1, 2, 3, … tree biomass estimation strata within the project boundary t — 1, 2, 3, … years counted from the start of the A/R CDM project activity In the case of coppicing rotations (i.e. where roots of the harvested trees are not be removed from the soil and these will lead to a new forest) the below-ground biomass estimated in the year before the harvest may be assumed to be constant until a year before the next harvest.	

3	34	111-115	te	Other methodologies such as AR-AM0005 Version 5 include specific provisions for the estimation of below ground biomass in coppicing systems, i.e. the below-ground carbon stock estimated in the year before each harvest and it is assumed to be constant until a year before the next harvest, when it shall be estimated again. It could be interesting to include this in the provisions of the tool.	34. Biomass of an individual tree l of species j in sample plot p is estimated as follows:: $B_{TREE,l,j,p,i,t} = B_{TREE,AB,l,j,p,i,t} + B_{TREE,BB,l,j,p,i,t}$ where: $B_{TREE,l,j,p,i,t}$ Biomass of individual tree l of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $B_{TREE,AB,l,j,p,i,t}$ Above-ground biomass of individual tree l of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $B_{TREE,BB,l,j,p,i,t}$ Below-ground biomass of individual tree l of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. x. Above-ground biomass of an individual tree of species *j* in sample plot *p* is estimated as: $B_{TREE,AB,l,j,p,i,t} = V_{TREE,l,j,p,i,t} \cdot D_j \cdot BEF_{2,j}$ Or $B_{TREE,AB,l,j,p,i,t} = f_j(\nu_{l,t})$ where: $B_{TREE,AB,l,j,p,i,t}$ Above-ground biomass of individual tree l of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t d.m. $V_{TREE,AB,l,j,p,i,t}$ Stem volume of tree l of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*, estimated by using the tree dimension(s) as entry data into a volume table or volume equation; m^3 D_j Basic wood density of tree species *j*; t d.m. m^{-3} $BEF_{2,j}$ Biomass expansion factor for conversion of stem biomass to above-ground tree biomass, for tree species *j*; dimensionless $f_j(\nu_{l,t})$ Allometric function applicable to species *j* returning total above-ground tree biomass on the basis of tree dimensions (ν) as	

					entry data in time t per individual tree l; t d.m. l 1, 2, 3, … trees of species j in plot p j 1, 2, 3, … tree species in plot p p 1, 2, 3, … sample plots in stratum i i 1, 2, 3, … tree biomass estimation strata within the project boundary t 1, 2, 3, … years counted from the start of the A/R CDM project activity x. Below-ground biomass of trees of species j in sample plot p is estimated as: $B_{TREE,BB,j,p,i,t} = B_{TREE,AB,j,p,i,t} \cdot R_j$ $B_{TREE,BB,j,p,i,t}$ Below-ground biomass of trees of species j in sample plot p of stratum i at a point of time in year t; t d.m. $B_{TREE,AB,j,p,i,t}$ Above-ground biomass of trees of species j in sample plot p of stratum i at a point of time in year t; t d.m. R_j Root-shoot ratio for tree species j; dimensionless j 1, 2, 3, … tree species in plot p p 1, 2, 3, … sample plots in stratum i i 1, 2, 3, … tree biomass estimation strata within the project boundary t 1, 2, 3, … years counted from the start of the A/R CDM project activity In the case of coppicing rotations (i.e. where a) roots of the harvested trees are not be removed from the soil and b) these will lead to a new forest) the below-ground biomass estimated in the year before the harvest may be assumed to be constant until a year before the next harvest.	
4	Table	297	ed	We have noticed in the past that project developers tend to use oven dry densities (i.e. t.d.m/dry volume) or specific densities D_{12} (i.e.	Under description we would suggest: "Source of data: Basic density or wood specific gravity is referred as the t.d.m. per unit of green volume in m^3 as the green volume in	

				the mass over volume at 12% moisture) which are not the same thing as basic densities (t.d.m./green volume), and have higher values since the dried volume is lower due to contraction and as this is in the numerator it has an effect in the density value.	m^3 has to be converted to t.d.m when applying it in the BEF method. In the case the value used refers to a density with mass or volume at a different density, this may be corrected following accepted methods such as those described in Sallenave (1971)". Sallenave, P. 1971. Proprie´ te´ s Physiques et Me´caniques des Bois Tropicaux. Deuxi-egrave-me Supple´ment. CTFT, Nogent sur Marne, France.	
5	Table	304 305	ed	The two parameters DBH and H are requested to be monitored as they are used in the allometric equations showed in equations 2 and 15 of the tool. However, as already clarified in several occasions by the A/R WG, the allometric equation may use other tree dimensions for data entry. Therefore, in order to avoid confusion (project developers tend to understand that they have to include DBH and H anyway), we would suggest changing these parameters by a generic vector of potential independent variables that we could name V .	We would suggest replacing DBH and H by V , and keeping all the information. **Data/parameter**: V **Data unit**: m cm, depending on the variable. **Used in equations**: x,x **Description**: Tree dimension to be applied in allometric equation **Source of data**: Field measurements in sample plots. For ex ante estimations, values should be estimated using a growth curve, a growth model, or a yield table that gives the expected tree dimensions as a function of tree age. **Measurement procedures (if any):** Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In the absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, are applied **Monitoring frequency**: Every five years since the year of the initial verification **QA/QC procedures**: Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied	
6	Table	306	ed	Parameter T should be deleted since this is not obtained through field measurements as required by EB63 Annex 26.	Parameter T should be deleted since this is not obtained through field measurements as required by EB63 Annex 26.	
7	27	157-158	general	We have checked appendix III, paragraph 9, of decision 20/CMP.1. and it is not clear whether the uncertainty ranges provided in that table refer to the uncertainty as such ±% or to an interval x%. For instance, for a project with an uncertainty of ±15%, it is not clear whether	Changes are required if applicable.	

				±15% represents the uncertainty range or it is 30% that represents the uncertainty range.		
8	43	230-234	general	We have checked appendix III, paragraph 9, of decision 20/CMP.1. and it is not clear whether the uncertainty ranges provided in that table refer to the uncertainty as such ±% or to an interval x%. For instance, for a project with an uncertainty of ±15%, it is not clear whether ±15% represents the uncertainty range or it is 30% that represents the uncertainty range.	Changes are required if applicable.	