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Moving from Measuring, Reporting, Verification (MRV) of Forest Carbon to Community Mapping, Measuring, Monitoring (MMM): a case in Mexico

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COVER LETTER

In this Special Issue devoted to community involvement in MRV, this paper examines what are the drivers and constraints facing communities and individuals in their interests to be involved in forest carbon monitoring activities.

Most research in this area, both conceptually, and in practice-oriented community-based MRV actions, is concerned with: how community MRV could function cost-effectively, how the data outputs could mesh with national REDD+ data requirements , the data quality issues around non-professional surveyors, and so on. There is also field research on new tools and techniques appropriate for communities to use.

The literature is scarce however on the fundamental question of the interests of local communities and individuals to participate in MRV. This paper is concerned with their motivations, and the benefits and costs to communities of participation in monitoring - 'what's in it for them'?

We review first, external factors including: whether community-based MRV is required or optional in current REDD+ frameworks, and, for what reasons REDD+ agencies would find it desirable. We then enter the motives and drivers for local communities if they are considering involvement.
We focus on cases in México because the country has an unusually high proportion of forests under community communal ownership. In particular, we make use of a recent REDD+ initiative – LAIF, in which local communities select and approve local people to participate in community-based monitoring activities. From these local initiatives we identify the specific and the general drivers for communities to be involved in mapping, measuring and monitoring (MMM) of their own territories and their natural resources. We term this, a replacement of (community-based) MRV by MMM.
We support this categorisation of drivers of MMM with particular examples from other rural communities in Mexico.

We do not propose specific academic editors for this paper, because we are informed that the SI editors are already doing this.

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TITLE

Moving from Measuring, Reporting, Verification (MRV) of Forest Carbon to Community Mapping, Measuring, Monitoring (MMM): a case in Mexico

SHORT TITLE

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ABSTRACT

There have been many calls for community participation in MRV (measuring, reporting, verification) for REDD+. This paper investigates whether community involvement in MRV is a requirement, why it appears to be desirable to REDD+ agencies and external actors, and under what conditions communities might intrinsically be interested in participating. It asks the research questions: *What do communities recognise that they can gain from such an involvement? What do they identify that they can lose?* The study embraces a broader approach which we call community MMM which involves mapping, measuring and monitoring of forest and other natural resources and territories for issues which are of interest to the community itself. We focus on cases in México because the country has an unusually high proportion of forests under community communal ownership. In particular, we make use of a recent REDD+ initiative – LAIF, in which local communities select and approve local people to participate in community-based monitoring activities. From these local initiatives we identify the specific and the general drivers for communities to be involved in mapping, measuring and monitoring of their own territories and their natural resources. We present evidence that communities are more interested in this wider approach than in a narrow focus on carbon monitoring. Finally we review what the challenges to reconciling MMM with MRV requirements are likely to be.

1. Introduction - is community monitoring a requirement for MRV for REDD+?

In REDD+, there are five components which are compensatable at the national level, and whose performance therefore, would need to be measured for the national level: i) reducing emissions

55 from deforestation; ii) reducing emissions from degradation; iii) conservation for forest carbon
56 stocks; iv) enhanced forest carbon stocks; and, v) sustainable management of forests.
57 Measurement is in terms of changes in carbon stocks over time, and should take into account any
58 leakage. In their calculations, most countries rely on satellite data and Tier 1 estimates of typical
59 standing stock levels in different forest types, as few have forest inventories which can provide
60 comprehensive, time-series ground level data. In addition, measurements are needed for a range
61 of safeguards which include (internal) social distribution; biodiversity; transparent and effective
62 national forest governance structures; respect for the rights (and the knowledge) of indigenous
63 peoples and local communities; full and effective participation of stakeholder actors; (national
64 forestry) policy compatibility; and human rights (1, 2, 3, 4, 5. cf. Table 1).
65
66 The involvement of communities - indigenous, forest-dependent and local – in MRV was
67 addressed in the Cancun Agreement COP16 2010 and at COP15 in Copenhagen, in Decision 4/CP
68 15 , which states that "COP encourages as appropriate, the development of guidance for effective
69 management of indigenous peoples and local communities in *monitoring and reporting*". This
70 followed the earlier SBSTA30 conclusion in Bonn 2009 that there is a "need for full effective
71 engagement of indigenous peoples and local communities in, and potential contribution of their
72 *knowledge to, monitoring and reporting of activities* relating to .. REDD+..". This however stops
73 short of saying that communities have to monitor; it is clearly not a requirement, but an option
74 open to countries (2, 3, cf. 4).
75
76 Whether monitoring at community level is useful to a country depends on the protocols deployed
77 for setting up its national forest information system, particularly the choice of scales. Under
78 UNFCCC-compliant REDD+, national performance will be assessed relative to an agreed national

baseline. However, the country can choose to construct nested baselines with separate baselines for each state/province, or a three level system with baselines at local, state and national level. Creating baselines for every landholding would be too expensive. The choice of whether or not to engage communities in monitoring also depends on how countries expect to distribute the compensation which they receive at national level. In-country distribution to communities could be based on their individual performance, clearly requiring data on performance (outputs) assessed against a local baseline, for each participating community; however this is very difficult to implement in practice (6).

However, the term *community-based MRV* (measuring, reporting, verification) as used in the context of REDD+ could in many ways be considered a contradiction in terms. MRV is not community-based; the M is driven by external needs according to externally determined parameters relating to measurement and precision and the data are intended for national-level carbon accounting processes; whilst the R and V refer to specific processes by which the country reports its achievements to UNFCCC. We propose that *Community-based MMM* (mapping, measuring, monitoring) where the processes are specifically aimed towards local purposes and local users, is the more apposite.

2. Methods

The initial methodology employed is the review of literature on community participation principles and experiences in, not just REDD+ forest carbon projects, but, natural resource management in general. There is considerable research in community involvement in biodiversity monitoring and, citizen science overall (7, 8, 9, 10, 11, 12, 13). In parallel, we assess the policy requirements for

102 incorporating community monitoring in MRV, and, where there are no absolute requirements,
103 then the expectations of external agencies in terms of efficacy, economic efficiency and other
104 benefits of community monitoring (e.g. 2, 3, 14).
105 The second methodology is an assessment of community responses in a pilot REDD+ programme
106 in Mexico called LAIF, in four ejido communities in western Jalisco state. We observed and
107 investigated the communities' initiatives and reactions to the REDD+ programme, and in particular
108 their stated, observed and derived rationales for local MMM. The methods employed were
109 workshops, focus groups, community mapping activities, and formal community presentations.
110 Anyone participating in the community *asamblea* could volunteer to form a REDD+ monitoring
111 committee which the *ejido* would then officially recognize and sanction. In total, 30 community
112 members joined the monitoring committees, their selection criteria being the responsibility of
113 each specific community. There was thus an average of seven self-selected, but community-
114 approved, experienced people on each committee, in *ejidos* ranging from 50-100 individuals.
115 Additionally we have included inputs and observations about community interests in MMM from
116 some other fieldwork areas in Mexican communities.
117 Finally from a qualitative analysis of these grounded findings and consideration of the literature,
118 we identify five challenges to reconciling communities' desires for MMM with REDD+ interests in
119 MRV.
120
121 We first examine the motives of external actors to support and encourage community monitoring
122 for REDD+ MRV, before moving to an analysis of what communities themselves are seeking and
123 employing in community-based MMM.

3. External rationales for community participation in monitoring.

Participation slows down any planning or management process - monitoring or otherwise, and therefore has costs, and it can frequently be confrontational and disturbing. Therefore, we need to consider the framing in which planners and decision-makers encourage local community actor participation in monitoring. The frames range from participation being promoted by policy-makers and carbon surveyors as a matter of principle because they believe a participatory effort will strengthen empowerment and devolved planning, to the other extreme that it is simply to 'grease' community acceptance and therefore uptake of a REDD+ or other environmental management project.

Even where community monitoring is not essential for either the national forest information system used for REDD+ reporting (as we see below for Mexico) or as a basis for benefit distribution, we can identify reasons why policy-makers choose to involve communities in forest surveys for REDD+. These reasons fall into two essential categories related to the two framings above – (i) community-based MRV for improving the content and quality of the monitored information, and (ii) beyond that, for capacity-building towards community empowerment. Firstly we consider three aspects related to content, and then two empowerment motivations.

3.1 Input to national databases.

The value of community participation in monitoring for REDD+ in terms of boosting national data quality has been argued by, e.g. Balderas Torres and Skutsch (6) and Herold and Skutsch (15). Data from community-based forest surveys have a more intensive collection scale. Detailed information on carbon stock changes at the community scale can densify and strengthen the national database and provide higher levels of credibility to data from remote sensing, since

changes in biomass density cannot be reliably established without ground level measurements. It can provide ground level data against which to calibrate remote sensing, and for identifying different forest types difficult to distinguish in satellite imagery.

3.2 Greater range and quality of indicators.

Community-acquired information has speed in real time, currency (up-to-dateness) and is therefore more appropriate for early warning, relative to external expert measures. There is local specific knowledge of species, land and forest qualities, ecosystems, indicators, threats, degradation, drivers, etc.; and of process knowledge (forest management decision-making processes), especially in comparison with measurements and judgements from periodic visits by external experts. Community monitoring is also able to supply valuable historical information on the drivers of deforestation and degradation (D&D) and on the impacts of projects and programmes intended to mitigate these. For external funders such as voluntary markets, local information on performance and safeguards might be considered more credible and authentic than data based only on national level assessments.

3.3 Cost efficiency.

It has been shown that community monitoring reduces transaction and operational costs of setting up REDD+ projects (9, 16, 17), and there is the positive outcome of local employment generation. Costs of community forest inventory have been estimated at between $1 and $4 per ha. p.a. (17), including day wages for the community members involved and intermediaries, and a factor for 'rental' of the equipment (PDA, GPS). Partly because standard forest mensuration procedures have been well developed for decades, whereas community forest inventory is still an infant procedure, start-up costs are higher given the substantial inputs (training, project

development) by intermediaries in training community members and establishing the sampling plots. Average costs are also much lower in large, homogeneous forests.

3.4 Identification of local interests.

External agencies recognise that they do not really know what local priorities are, and stronger participation will give local values more prominence in the design of projects, thus making them more likely to succeed and be sustained. Engagement in monitoring strengthens communities´ forest management practices by providing feedback to themselves and agencies on management outcomes (18).

3.5 Commitment and ownership

In terms of supporting empowerment, there is a belief among many development agencies that, when communities monitor, this encourages a more general participation in improved natural resource management. Community (or individual) involvement in a participatory process supposedly leads to more local acceptance, local understanding, and 'ownership' of an externally-driven activity such as a REDD+ or PES (payment for environmental services) project (18, 19). Overall, there is improved governance, including more transparency in procedures. Empowerment develops social capital and local capacities, and builds self-confidence in the community, specifically in handling technologies, processes and procedures.

4. Communities' rationales for monitoring

The significant question we address is how communities themselves are likely to benefit from such participation. We seek to identify the motivations behind members of local communities

becoming engaged in externally-driven measurement and monitoring activities which are relevant to national MRV. The effectiveness, value added, and benefits to the community lie both in the specific products of the participatory activities, and in the processes of participation.

4.1 Territorial claims.

Communities already monitor their territories, the resources within them, and changes in these. The significant driver behind most monitoring of community territory and forest areas is their own concern with ownership and entitlements, thus in relation to claims for customary territorial rights and entitlement to lands and land resources, and for making claims for lands lost or being invaded (20, 21, 22).

4.2 Stresses and vulnerabilities

Another rationale for checking is stresses of different kinds which are affecting customary and traditional local forest management, or NRM in general, for example, degradation locations and causes, livestock pressures, woodfuel, damage to non-timber forest products (NTFP), extraction of construction materials such as sand and gravel, and any land use change. Locations and impacts of natural hazards - notably forest fires, water pollution sources, forest pests and diseases, flooding, or landslips are monitored; as is forest and vegetation management aimed at improving supply and quality of water. Expanding rapidly in Mexico and elsewhere are communities' economic stakes in ecotourism. They find it essential to monitor threats to the ecological status or aesthetic quality of the landscape, as well as seeking new opportunities.

4.3 Requirements of external environmental programmes.

Many communities are already involved in formal natural resources management programme such as PES for hydrological services, erosion control, biodiversity services, endangered species, pollenisation, or landscape aesthetics. PES projects for environmental services, notably biodiversity services, require reliable, detailed measurements of environmental indicators at community level, and communities have been engaged by projects to gather data, usually on a paid basis or in return for services.

Similarly, if the community already has forest lands which are under certification schemes for timber, or forest products and forest quality, they are usually required to carry out intensive monitoring and verification (e.g. Forest Stewardship Council, Global Canopy Partnership). The motivation here is the increased value of the products in national or international markets. There are also non-timber products already economically and commercially valuable to the community, e.g. bamboo, honey, medicinal plants, which can require monitoring and verification.

4.4 Staking claims for political recognition.

There are political-institutional reasons, for example a need felt by the community to be 'on the stage where things are happening', in order to build a position for negotiation and benefit-sharing, or to spot opportunities in public programmes (23). Communities increasingly are recognising that ownership of information on carbon stocks is crucial to establish their rights over carbon and their access to REDD+ rewards.

5. Community monitoring data tasks for REDD+: MRV versus MMM

In the literature the focus on community monitoring for REDD+ tends to be on the immediate forest inventory tasks (measuring dasometric variables such as DBH, identifying species etc.) but in

241 fact monitoring requires much more than this. Prior to making tree measurements, there is a
242 need to map and classify types of forest and other woody vegetation to be included under REDD+,
243 and to lay out a sampling frame to ensure the data gathered are unbiased statistically and
244 sufficient to reach levels of certainty. These tasks are generally considered too technical and
245 difficult for local people to carry out themselves, and are commonly done by external agencies.
246 Moreover, depending on the nature of the national REDD+ programme or project procedures,
247 there are requirements to gather data on socio-economic variables, including on achievement of
248 safeguards (5, 14, 24; see Table 1). For consistency across a whole country, and if data are to be
249 entered into a national database, MRV requires pre-prepared protocols which define to a high
250 level of detail what data are to be gathered and how.
251

252 **Table 1 Information for Community Forest Management and Carbon Sequestration**

A. Spatial information for establishing the initial management scenario (project year 0)	**Key Characteristics** - Reliability of Source / Scale and Extent / Precision / Timeliness and Frequency / Replicability
• Boundaries of the community and its forest areas intended for carbon payments project. • Community's land claims • Community forestry management systems & approaches, Land-use plans • Location and sources of forest degradation - (illegal) logging, grazing, marginal agriculture, (illegal)	High precision Essential local spatial knowledge, and of neighbours; Sensitivity Essential local spatial knowledge

settlements, hydrological adjustments • Locations potentially affected by hazards (e.g. fires, erosion, ecosystem damage, flood, storm) • Conflict areas	Timeliness Essential local spatial knowledge; Sensitivity
B. Information for forest biomass inventories (project year 0 and later)	**Key Characteristics**
• Delimitation of forest ecotype strata (zones) • Location and geo-referencing of sampling plots • Geo-referencing trees and features for future locating of sample plots • Field measurement and storage of tree data: DBH (diameter at breast height), tree heights, species, status, etc. in databases. • Assessing leakage	High precision Very high precision; replicability Very high precision; replicability Sensitive. Leakage extends outside the community, so is monitored at a higher spatial scale still using local data
C. **Monitoring of Safeguards, and monitoring of social and environmental variables.**	**Key Characteristics.** Some do not have spatial indicators
• Conservation of natural forests and biological diversity, • Human Rights - especially indigenous & forest communities	Essential local spatial knowledge Reliability of sources Sensitivity

• Transparency & effectiveness of national forest governance structures, • Respect for knowledge and rights of indigenous peoples and forest communities, • Full and effective participation of actors. • Equitable internal distribution of benefits	Spatial precision and timeliness are not high priority

253

254 The question is whether communities are interested in producing such standardised data, and
255 under what conditions. We propose, as a general principle, that the concept of community-based
256 MMM (measuring, mapping and monitoring) is more apposite than MRV. Under MMM,
257 measuring, mapping and monitoring are specifically for local purpose and for local users, and
258 activities are essentially designed by communities themselves to meet local requirements,
259 interests and priorities.

260

261 Measuring, mapping, and monitoring are interrelated components of spatial information
262 acquisition, three dimensions of information relating to an object of interest. *Measuring* is the
263 dimensional component, the description of the item itself. *Mapping* refers to the spatial
264 dimension, knowing where the object is in space and its spatial relations with other objects.
265 *Monitoring* is the temporal dimension of the object over time, i.e. changes in the measurement of
266 the object over time. The three components together add up to a full description of an object,
267 examples of which are the biomass and carbon dimensions, species, indicators of types of
268 degradation, (or causes of deforestation), biodiversity, watershed management indictors, forest
269 management practices, forest tenure, measures of social welfare and equity.

6. MRV and MMM: a case in Mexico

6.1 Community Territories, Forests and Carbon in Mexico

In Mexico, 55-59% of all forests fall within the territories of autonomous agrarian communities (25, 26); these form the basic rural landholding units of the country, together with private properties, which account for at least 40% of the forests. Mexico´s REDD+ strategy involves a broad approach to sustainable rural development, in which communities and private property owners are heavily involved.

In terms of MRV, a national reference emissions level (NREL) has already been proposed by the Comisión Nacional Forestal (National Forestry Commission) (27) against which the country´s REDD+ achievements as a whole will be assessed and compensated, (in the immediate future, through the World Bank´s Carbon Fund). Each state will develop its own baseline, with the idea that the fund will be divided between states according to their relative performance, although the carbon saved is considered to be property of the nation (28), not of the states or the individual communities. It is envisioned that the funds will not be shared within the states on the basis of performance, but rather on the basis of investment required. Importantly, this implies that there is no immediate need for baselines or for monitoring sound forest management at the community level, nor for leakage assessment as this would be tracked at the state or national level. The NREL is formulated only in terms of reductions in emissions (reduced deforestation and degradation).

As currently conceived (mid-2015), any increases in sequestration (forest enhancement, growth in forest stocks) that communities achieve are intrinsically the property of the community. This means that in principle communities would be allowed to sell credits for any such carbon on any

voluntary market. For this, both a local baseline and local monitoring would almost certainly be required. There is ample room for many communities to ´grow more carbon´ in this sense and this strategy is both sensible and convenient since (1) it is much less likely to result in leakage, which is difficult for communities to measure (the state/nation will take care of all the leakage for D&D since it aggregates all losses and gains over the national territory), and (2) because communities cannot measure changes in D&D in any case, because they do not have stock assessments for previous periods - what they can do is measure stocks today and in subsequent years.

Community monitoring is not currently essential for the national forest information system supporting REDD+ in Mexico, nor for distribution of benefits from the national REDD+ programme. Nevertheless, CONAFOR, the national forest agency responsible for REDD+, is developing community monitoring protocols, not only for carbon, but for a variety of indicators. The objective is to develop a standard framework broad enough to cover communities´ own interests, and, in the long run, to strengthen the national database and national carbon estimates for use in REDD.

6.2 The LAIF Project

CONAFOR partnered with the Latin American Investment Facility (LAIF) http://www.conafor.gob.mx/web/temas-forestales/bycc/acciones-de-preparacion-para-redd/gobernanza-local-para-implementacion-de-atredd-laif/ to channel international development funds to implement a pilot project to install *Juntas Intermunicipales* in priority forest areas of Mexico for developing management plans for local watersheds and to act as the principal agent for REDD+ pilot implementation in *ejido* communities. For a century since the land redistribution of the Mexican Revolution, a central feature of the legal structure of land tenure has been a communal governance structures (*ejidos*) built around shared land and democratic

decision-making processes. *Ejidatarios* are legal landowners and all decisions made regarding land use and development take place within the *ejido* Assemblies. This creates in principle, a transparent political system open to all community members, which feature is fundamental to the community MRV pilot project spearheaded by LAIF. It is from within these local decision-making structures that we can identify what communities prioritise as their locally-specific benefits of monitoring. Every *ejido* operates according to a unique and locally-specific set of livelihood and cultural practices, and each approaches its forest resources with different skills and knowledge bases and uses them for specific purposes.

CONAFOR-LAIF approached four priority *ejidos* in the state of Jalisco, and later, one in Quintana Roo. Since then, the concept has been replicated by Alianza MREDD in the states of Oaxaca, Chihuahua, Yucatan and Campeche (29). The framework allowed for the endogenous identification of key resources for monitoring that could increase local capacity for decision-making and forest management. Internally, the *ejido* decides which resources are of most importance and what tangible benefit are to be gained by collectively monitoring these. Requirements for the pilot LAIF program were the identification of members of the monitoring committees, consistent interaction of these committees with the Assembly, and inclusion of forest resource monitoring into the legal architecture of the community. The process by which committee members identified the resources significant for monitoring emphasized the need to tailor the framework according to the specific community context. Carbon was never explicitly mentioned, but the resources chosen by the community groups are all related to reducing forest degradation and improving forest health, which is the fundamental tenet of REDD+.

6.3 Community Motivations for MMM

Group brainstorming activities, key informant in-depth discussions and field visit observations in the *ejidos* of the LAIF project revealed the following priorities for forest monitoring. We also take note of fieldwork findings in other ejidos in Jalisco and Michoacán states, and from external literature. The names of all ejidos are kept confidential.

Before examining the positive motivations, it is necessary to note that, apart from the cost and time involved, there are other sound reasons why a community may choose not to monitor, at least not to share its information with the outside world. The protection and conservation of valuable and sacred places and artefacts can be a concern, with a fear that monitored data will be appropriated and used for the benefit of outsiders, such as the community being robbed of resources or control over them, a process popularly known as eco-piracy (30). Sometimes there are deliberate attempts to hide information, for example the location of secret places or of rare plants and of minerals.

6.3.1 Requirements for external Certification:

For example, Rainforest Alliance and FSC certification for sustainable harvest stipulate that a monitoring program must be in place and actively contributing to timber management plans. This *ejido* pays a third-party consulting company to develop this plan, execute its implementation and generate reports. *Ejidatarios* state that developing the capacities internally to carry out the monitoring plan provides new skills for additional community members who participate, increases land-user familiarity with new management techniques, adds a second layer of verification to any information generated by consultants, saves money, and places more authority in the hands of the community at large.

6.3.2 Forest health and ecosystem benefits:

Two of the participating *ejidos* in LAIF identified forest pathogens as the main threat to their communal lands, specifically the rapid and uncontrolled spread of dwarf mistletoe (*Arceuthobium spp.*). Both stated that their local timber-based economies were threatened without a comprehensive plan to monitor the spread of the pathogen and the outcomes of interventions. In another timber-intensive ejido in Chihuahua, wildfire monitoring was the main motivation; and in the same state, an indigenous Sierra Taramuhara community monitors edible, medicinal and other usable wild plants in their landscape as part of traditional ecological management (31).

6.3.3 Wildlife habitat and forest aesthetics for ecotourism

Ecotourism opportunities were identified as direct reasons for establishing a local monitoring program. In places, this constitutes community-based MMM of rare butterfly and bird and plant species, e.g. specifically in a non-LAIF *ejido* in Michoacán, an endemic mole salamander *Ambystoma ordinarium*. This ejido is also motivated to monitor and track damage from off-road motorbiking and quads, in part because of its impact on ecotourism income.

6.3.4 Water supply and quality:

Many LAIF *ejidos* selected water as the main monitoring priority and identified many ways in which water supply and quality is related to forest health. One coastal *ejido* unanimously voted water as the most critical resource to monitor, because of its diminished supply due to cattle grazing. This committee was interested both in collecting information on current water supply and monitoring the effects of reforestation projects. They specifically wanted to ensure that their communal funds were being invested in successful replanting projects, and saw monitoring as a way to observe changes in land cover and landuse to inform community spending. Another *ejido* chose to monitor water quality in areas with ecotourism opportunities. Committee members

stated the importance of the knowledge and tools to keep track of water quality to guarantee eco-tourist visits. The information generated from water quality monitoring informs discussion and local decision-making at the Assembly.

6.3.5 Monitoring Land Invasions and Threats

These mainly involve actual and perceived threats to the territorial integrity of ejidos by neighbours – whether those are other ejidos or rural communities, or private land owners - who are directly invading and utilising the land, or potentially will do so. Other cases relate to land grabs by external powers such as mining companies, but usually these are too big a scale to be the concern only of the local community. In some cases, the threat is internal, i.e. some community members may be appropriating for themselves what are supposed to be communal land resources. Currently the monitoring undertaken by community members mainly consists of direct observation and photos, but the communities express interest in using more technological tools including GPS, video, tracking apps, GIS and reporting apps with text messages or web platforms.

6.4 Tools of the trade: training communities in MMM in Mexico

The CONAFOR-LAIF project worked with experience in forest mensuration and resource management to develop hands-on field trainings specifically designed for rural property holders. Mapping techniques played a critical role in all training activities, and included community-led resource mapping exercises and identification of priority monitoring areas, ground-truthing with field visits and photo documentation, GPS training and field exercises and GPS data visualization using free online software. Usually, young adults are proposed to participate in monitoring, owing to their generational familiarity with technology.

In addition to resource mapping and locating priority sites, participants gained exposure to natural resource monitoring with field measurements for specific resources, i.e. estimating timber stocks and growth, area infected by mistletoe, water flow rates, water chemistry and contaminant loads; and also sample design, data recording; data sheet creation for monitoring, and basic data analysis and techniques for presentations to the Assembly.

Technological potential for this kind of exercise lies in the ubiquity of mobile IT devices and apps, which have rapidly increased functionalities, at lower cost, and are becoming easier to handle. Hardware such as rugged Tablets and Smartphones with large memory for imagery or maps, with GPS capability, camera, video, and internet connectivity are replacing the PDA set-ups used in the first trials for carbon monitoring (21). Geo-referenced images as bases for mapping forest are easily available at very low cost or free, from Google Earth, Virtual Earth or other 'virtual globes'. The cost of LIDAR which provides very high precision imagery is dropping. There is big potential in UAVs / drones for communities to acquire their own dedicated imagery from air-borne sensors, and their own capacity for real-time monitoring of forest threats, fires, invasions, etc. Apps with user-friendly interfaces are being adapted for forest and tree measurement with simplified data recording and interfaces in Mexico, in particular, CyberTracker, Plataforma eREDD, and Google's ODK (Open Data Kit) and GeoODK (14, 23, 29, 32).

7. Five challenges to reconciling community MMM and MRV needs in REDD+

The five issues discussed below are in increasing order of complexity in terms of socio-cultural and political situation in communities, and the relations between communities and REDD+ demands, and are therefore also increasingly complex in terms of seeking solutions or amelioration.

7.1 Quality control and timely supply of data in measuring carbon stocks

Quality of carbon data is essential from a REDD+ MRV perspective but much less so from the perspective of communities themselves. It is clear that if data are to be used in external systems – a national database, or to satisfy conditions of particular donors or carbon purchase systems – communities will have to accept standardised protocols of one sort or another. Moreover, punctual reporting of outputs of community monitoring MMM will be demanded by whoever is acting for the REDD+ agencies, and sufficient detail and precision will be required. Because the data are needed at regular but infrequent intervals, there will also have to be training exercises and processes will have to be set up and repeated over time.

The frequency and regularity of data supply are more likely to cause friction between external agencies and communities than the quality of the data itself. In the few studies specifically examining the performance of local measurers following pre-determined protocols, the results are generally positive (9, 11, 17). Although some have expressed doubts whether communities will be able to provide reliable, unbiased, good quality data (33), the evidence is that they can. In the K:TGAL project, independent professional forest companies carried out surveys in order to test the reliability of the communities' estimates of carbon stock. In every case, there was no more than 5% difference in the estimate of mean carbon stocks between the professionals and the community (14)

That field measurements are made equally well by community teams as by professional surveyors, does not necessarily mean that the accuracy is high. Measurements are often made rather rapidly,

by both groups, with a variety of errors entering the process. The main challenge is the precision of DBH measurements which can be compromised by measuring DBH at the incorrect height, using the tape too slackly, or missing some trees. This matters less for an initial survey, but more if the same trees are re-measured in permanent plots to estimate very small growth parameters.

Using field data recorders and apps to record and store the data probably reduces errors - the data are thus recorded only once, meaning only one opportunity for error in transmission, unlike in recording on paper in the field. It is possible to introduce filters into the software, such that if an unlikely figure is entered e.g. for a DBH of a particular tree, the computer prompts a query and the error is correctable at source. But it is always recommended to keep a hard copy of the data in the field as well, and accuracy of the data and their analysis does improve with repetition and training (23).

If permanent plots are set up by the community for their monitoring exercises, there may be a tendency for additional exceptional protection of these, such that they are no longer typical of the forests in that area; for example, protection from cattle grazing, or from NTFP and timber collection. On other hand, the measurement process itself (DBH, height estimates, understory biomass measurement, soil carbon, etc.) creates damage through trampling, disturbance, paths, and therefore measurably reduces biomass and carbon in the target area. Training sufficient trainers for carbon stock measurement could also be a major problem.

7.2 When conflict avoidance hinders monitoring – leakage and degradation

Measuring leakage (which would occur in neighbouring communities or elsewhere in the region) is an issue that has not been carefully thought through. Leakage is like a waterbed, push down on

practices which cause deforestation and degradation in some place, and inevitably they pop up somewhere else. The degradation practices are often in grey areas between external (official) legality and customary practice. They are very likely to be bound up in customary rights, entitlements, and local activities. Monitoring and reporting of leakage can exacerbate or create discrepancies, contestations and outright conflicts within and between communities. Therefore it is not easy to integrate leakage information into community-based MMM. Communities may willingly report leakages from other communities which negatively affect themselves, but they are less happy to report their own leakage into other areas.

7.3 Selection of participants and sustainability

The question of who carries out the monitoring is important. Are participating community members self-selected, or are they chosen by external experts? Do they originate only from involved NGOs? Is it an obligation, or can anyone choose to join in? The idea that community monitoring is advantageous because there is an unlimited labour force pool is questionable. In the pilot projects in Mexico there were plenty of young people(male and female) available and interested in getting out in the field and mapping/measuring the biomass when the team from outside arrived. They were relatively under-employed and willing to learn. But this approach is not necessarily sustainable - these people may not be there on the next monitoring date, and it is highly unlikely they form a permanent cadre of monitors in the village. The ´best´ young people tend to leave – ´best' in the sense of having the technical skills, interest and energy. New youth have to be trained, which implies higher overhead costs, and there is no build-up of a reservoir of accumulated skills in measurement. Working with older community members is more stable, but the drawbacks are a slower learning curve and less energy - it is hard work taking biomass measurements out in the forest. The IGES CCA Project (34) however claims that community teams

505 retain the skills they have learnt. In 2012, they observed a community monitoring team in
506 Cambodia which had received training one year earlier on forest sampling and measurement, and
507 they demonstrated they had retained the knowledge and skills. “Local people who participate in a
508 well-designed training programme can be relied upon for future forest assessments” – if they are
509 still there.
510
511 **7.4 Incentives and cultural frames.**
512 Concerns arise as to whether the monitoring team (e.g. selected by external agents) becomes an
513 elite group which can capture benefits not available to the rest of the community, and whether
514 appointment to such a monitoring group implies favouritism within the village community. If
515 monitoring is a paid activity with monitors receiving daily wage, then there is a risk. Therefore
516 payments instead to a community fund are a social alternative. In moving towards MMM, the
517 community should itself select the ´best´ persons (i.e. those with the most appropriate skills and
518 attitudes), and create a distributive system for monitoring, such as rotating duties. The merging of
519 MRV with MMM is problematic in this area.
520
521 Engaging communities (and individual actors) requires addressing the issue of participation “in
522 breadth” vs. “in depth”. There are plenty of downside difficulties for local community actors who
523 want to enter into MMM activities - involvement in MMM is not easy and people do not choose to
524 do so lightly. There is a limited number of actors who for personal belief reasons engage “deeply”,
525 that is, commit to and meet the challenges of intensive, time-consuming participation, perhaps
526 across many stages of an MMM process. But are these ‘volunteers’ a representative constituency
527 of the relevant community? Alternatively, will an MMM process that involves a larger number of
528 participating actors be sufficiently meaningful in the depth and usefulness of their engagement?

529

530 Big issues of compensation arise here, with many projects expecting that participants in
531 monitoring will be donating their time and effort as well as their knowledge, without direct
532 financial compensation, because ´it is in the long term interests of their community´. Whether
533 people are willing to do this will be much determined by who decides on the types of data to be
534 gathered and where they go to - gathering carbon data to feed a national database with no direct
535 return to the community, or gathering carbon data for some community purpose.

536

537 There are proposals for financial payments to be specifically for CB-MMM (parts of MRV), and not
538 for the carbon enhancement and credits per se. This would be a paid employment, structured by
539 skills training, registration, and independent (re-)testing. The payments could be to the
540 community members doing the work, in fair compensation for labour time and disruption to other
541 tasks (consider, peak labour periods), and for risks. Direct payments for work accomplished are
542 seen as a distinct positive for the community. The intended advantage of such a protocol in terms
543 of data quality and security is that there would be less incentive to tweak the results and
544 exaggerate carbon gains/understate carbon losses. In reality the local community surveyors could
545 be well aware that their measurements would have significance for the continuation of payments
546 to a REDD+ project, and therefore the key is that the local surveyors would need to be convinced
547 that it is the *regularity* and *consistency* of their measurements which have significance for the
548 continuation of payments.

549

550 The idea of paying communities for monitoring has local critiques within communities – 'why be
551 paid for activities which communities are doing anyway?' Some communities even feel that it is a
552 devaluation of their efforts and denigrating. In Mexico, these critical views concerning payments

553 for community-based MMM or indeed for community-based forest management activities in
554 general are particularly heard from indigenous communities, rather than in the *ejidos* where many
555 such changes have already happened. In this vision, financial incentives are seen as driving a
556 monetary attitude towards the environment, and as exacerbating a loss of youth interest in the
557 traditional customary management of forest lands. Elders fear that young people will come to
558 expect direct financial benefit from what was formerly collective and voluntary labour.
559

560 **7.5 Conflict of purpose – mapping land**

561 Communities monitor their territory and forest areas in the context of claims for customary
562 territorial rights or entitlement to lands and land resource, and equally, for making claims for lands
563 lost or being invaded by other people. In REDD+ MRV, there is an underlying sequence of items to
564 be mapped (21, 24), but the bottom line is that the lands need to be defined, identified, classified,
565 measured and mapped - and here the trouble begins. Among many local and especially
566 indigenous communities there is the concern that external drivers behind such mapping exercises
567 go beyond the practical immediate needs and towards deeper political-economic drivers.
568 The stated purposes and intentions behind the mapping needs of REDD+ are found in the
569 recommended good practices and guidelines, and can be summarised as:(a) '*resource mapping'* to
570 simplify, classify, and spatially zone the forest resources and uses of the forest; and (b) '*behaviour*
571 *mapping'* in order to assess different types of management of forest / carbon landscapes and
572 understand the interrelationships between people and their forests. Both are necessary for
573 planning and management and for allocation of payments. But the concern and the risk for
574 affected local and indigenous populations - to whatever degree that is well-founded - is that there
575 is a hidden third driver in REDD+, that is (c) '*appropriation mapping'* as an intentional but un
576 declared step towards the appropriation of local/indigenous territory. As people's perception of

577 the intentionality of REDD+ mapping processes moves along from (a) to (c), the conflict sharpens
578 between REDD's drivers for landscape spatialisation, and the people's own interests in mapping
579 their landscape, as evidenced by the stance of various indigenous groups on REDD+ and NGOs
580 such as Rainforest Alliance (e.g. 35, 36, 37, 38).

581 # 8. Key messages and directions

582

583 ## 8.1 Trust and confidence – credibility and acceptability.

584 Encouraging and facilitating participation depend on confidence-building and trust, especially
585 between the 'professional REDDers' and the local community actors. A critical problem in all
586 participatory methodologies is the contest over the validation or credibility of the people's inputs.
587 Associated with this, is the need to convince higher policy-making levels (i.e. higher levels than the
588 local carbon survey team) of the validity, credibility and scientific 'soundness' of the inputs and
589 products of local 'non-professional' surveyors. This issue of acceptability appears not only within
590 the MMM exercises per se, but ultimately when their results are being assessed and implemented
591 by the REDD+ epistemic community of scientists and national decision-makers, and the general
592 public.

593

594 ## 8.2 Sensitive knowledge

595 MRV carbon surveys for various applications in developing national databases want to collect a
596 large amount of detailed and spatially-specific information, not just on biomass growth rates, but
597 on many topics which are sensitive for legal, social, economic, cultural or even spiritual reasons.
598 Surveys can reveal confidential, sensitive information to outsiders, and can easily raise or
599 exacerbate conflicts with the neighbours, especially stirring up the sleeping dogs of boundary

disputes. There may be reluctance to report negative impacts or activities within the community which are from the official point of views illegal or from the local point of view sensitive. Besides leakage issues, these could include illegal uses of forest land, invasions, drug production, etc. Many more activities are semi-illegal but customary, long established activities such as collecting NTFPs, cattle grazing, hunting, etc. Moreover, in many forest-linked communities, especially indigenous communities, there are places and activities which are considered internal secrets, such as sacred sites or the location of rare plants, e.g. with medicinal and financial value. Whether these are officially legal or illegal, people will be reluctant or absolutely unwilling to divulge them. A simplistic approach to 'community self-monitoring' will not resolve this issue. There are incentives for community surveyors to hide or disperse such information (for the 'communal good' of the community, or for their own safety); alternatively, they are liable to accusations of being a spying unit.

A solution to this could be that the local data transferred to and used by the national REDD+ authorities, should not be geo-tagged to link them to the specific community. Of course they are geo-referenced, otherwise there could be no time series surveys of growth rates, etc. But the data could be treated in an analogous way to population census data, that is, the figures would be used to estimate sequestration and emission rates for particular forest types and regions (and cross-checked by satellite data at a coarser scale). By not routing the specific data measurements back to the specific communities, two challenges are reduced – the incentive for field data figures to be adjusted (so as to present the local situation in a more positive light), and the reasonable fear of communities that they will be held accountable not only for 'negative' changes to carbon, but also for the identification of 'undesirable' activities in their neighbourhood.

8.3 The power of land

Community-based MMM for carbon, biodiversity or other environmental services is potentially significant for communities who are trying to consolidate their claims to places and land (39, 40). Therefore, connecting monitoring to formalising and enforcing local land titling, making it a condition for project entry, is a powerful incentive in many countries, although not such an issue in Mexico where communities already have full rights over their lands.

Community relationships with their land have livelihood, economic, productive, cultural, and often spiritual connotations. Yet most REDD+ interventions remain technical, aloof from outright political movements of this kind, and REDD+ proponents are allergic to ´taking sides´ in what they see as political battles. Therefore a key to encouraging communities to engage in MMM, compatible with REDD+ monitoring, will be collaboration with, and complementary to, claims against loss of territorial rights and entitlements to land resources, as a defence against illegal invasions and legal expropriations of traditional lands. A complicating fear factor is that the discourse and implementation of REDD+ is felt by some groups (see: 41, 42) as a switch from seeing the material land resources of a community as locally-claimed or owned territory, to a vision of 'carbon in trees' being a global 'common property' of landscape values, and thus of value to the world and therefore taken beyond the responsibility of just the people who live there

8.4 The future – MMM in place of MRV

There are plenty of reasons why local community actors may not want to get immersed in MMM activities. Participation is always slow by procedural design. It can be very time-consuming, maybe clashing with peak labour times in people's livelihoods, and may not reach conclusions which can be used by the community itself. On the other hand there are many specific reasons why communities are motivated and are already involved in mapping and monitoring their local

environmental conditions and changes, or have a serious interest in doing so. We need to be clear that carbon is not usually the priority, and to ask who the information is for and why it would be useful for the community. “Communities are not interested in biodiversity and safeguards, but about species they eat, pollinators, pest controllers, and other species that have sacred value. It is exactly the same when we ask them to collect information about carbon.” (32, p.6).

Community-based long-term (carbon) monitoring is more appropriate where local people have other active significant interests in knowing the status (stocks, changes, threats, potentials) of natural resources, environmental services, or other indicators of territorial well-being. Most communities have informal systems of monitoring; they notice changes in forest condition and climatic parameters, they can tell if things have changed over a number of years, and they discuss reasons for this in their Assemblies. However the information is rarely recorded, quantified or systematised, which are the essence of a monitoring system (6, 11, 34, 43).

If the monitoring activities are not for the community’s own interests as above, then a monitoring system based on local people carrying out designated tasks for a higher-level REDD authority will only be sustainable when the data and any benefits of the monitoring are perceived and experienced locally. In the case of REDD+, there must be a clear link of the monitoring efforts to visible benefits to the community, whether in the form of carbon credits, or social infrastructural services, or recognition of land rights, or direct cash payments for labouring in the monitoring. In the LAIF case, *ejido* committee members acknowledged the empowerment experienced when they were able to generate information that is seen as useful and valuable by their community. The combination of hands-on technical training and full, legal backing by the collective *ejido* is

fundamental to sustaining interest within communities in investing time, resources and people in an exercise that does not generate a direct income to its participants.

We see an important distinction between community involvement in MRV for REDD+, and in broader community-based MMM. The local specificity of community monitoring is a key positive factor in making community-based MMM attractive and worthwhile for local people, who use it to raise awareness of, and deal with problems relating to resources, threats and potentials. The MMM of resources, threats, potentials, and problems is precisely what the community is looking for - they are interested in local MMM of local issues, whereas in C-MRV, localness is a negative. National policy needs to recognise distinctions between the tighter demands of the biomass / carbon monitoring data requirements (MRV) of REDD financing instruments, and, the broader, flexible needs to monitor social issues. The design and sustainable operation of monitoring these latter elements needs to be a collaboration between the outside demands for 'hard data', and the rich internal understanding and recognition of local conditions and local priorities.

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