remote sensing

MDPI

Technical Note

Capacity Development for Use of Remote Sensing for REDD+ MRV Using Online and Offline Activities: Impacts and Lessons Learned

Sarah Carter [1,*], Martin Herold [1], Inge G. C. Jonckheere [2], Andres B. Espejo [3], Carly Green [4] and Sylvia Wilson [5]

[1] Laboratory of Geo-Information Science and Remote Sensing, Wageningen University & Research, 6708 PB Gelderland, The Netherlands; martin.herold@wur.nl
[2] NFM Team, NFO, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00153 Rome, Italy; inge.jonckheere@fao.org
[3] Climate Change Group, The World Bank, 1818 H Street NW, Washington, DC 20433, USA; aespejo@worldbank.org
[4] Environmental Accounting Services, 50 Charles Court, Lake Hawea, RD2, Wanaka 9382, New Zealand; carly.green@enviroaccounts.com
[5] USGS-Eastern Geographic Science Center, 12201 Sunrise Valley Drive Suite MS-521, Reston, VA 20192, USA; snwilson@usgs.gov
* Correspondence: sarah.carter@wur.nl

Abstract: Four workshops and a webinar series were organized, with the aim of building capacity in countries to use Earth Observation Remote Sensing data to monitor forest cover changes and measure emissions reductions for REDD+ results-based payments. Webinars and workshops covered a variety of relevant tools and methods. The initiative was collaboratively organised by a number of Global Forest Observations Initiative (GFOI) partner institutions with funding from the World Bank's Forest Carbon Partnership Facility (FCPF). The collaborative approach with multiple partners proved to be efficient and was able to reach a large audience, particularly in the case of the webinars. However, the impact in terms of use of tools and training of others after the events was higher for the workshops. In addition, engagement with experts was higher from workshop participants. In terms of efficiency, webinars are significantly cheaper to organize. A hybrid approach might be considered for future initiatives; and, this study of the effectiveness of both in-person and online capacity building can guide the development of future initiatives, something that is particularly pertinent in a COVID-19 era.

Keywords: capacity building; deforestation; distance learning; earth observation; face-to-face learning; national forest monitoring systems; webinar; workshop

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1. Introduction

1.1. REDD+ Measurement, Reporting, and Verification

Forest management can contribute towards limiting global warming to 2 °C, an internationally agreed target [1]. Reducing emissions from forest loss and increasing removals in forests can be potentially achieved through REDD+: reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries, a results-based payments scheme [2]. One of the major challenges for REDD+ is the provision of reliable estimates of emissions reductions on which payments are based. General guidance from the UNFCCC states that all estimates should be transparent, consistent, and as accurate as possible and should reduce uncertainties, as far as national capabilities and capacities permit, and could be subject to an independent review [3]. Remote sensing technologies, and the use of Earth Observation data in particular, are a central part of REDD+ monitoring systems and can provide objective, practical, and cost-effective information. A number of

countries have low capacity to measure, monitor, and report on REDD+ using these tools, particularly in Africa [4]. Although capacities have been increasing, a capacity gap remains in many countries [5,6] and at the project level, particularly in remote sensing and GIS [7]. Developing capacities as part of South–South and regional cooperation will lead to long term benefits under REDD+ [8].

1.2. Existing Capacity Building Initiatives

Countries and projects have been supported in REDD+ Measurement, Reporting, and Verification (MRV) through a number of initiatives, both online/distance learning and face-to-face/in-person, including many organized by Global Forest Observations Initiative (GFOI) partners. For example, countries participating in the Forest Carbon Partnership Facility of the World Bank (WB FCPF) have benefited from workshops and powerful tools offered through the programme [9], and grants through readiness funds have supported this process [10]. UNREDD have provided training and guidance through many channels including the online UN CC:e-learn platform [11], which hosts a dedicated REDD+ Academy [12]. Short university courses have also been developed [13]. Despite there being a number of capacity building initiatives that are supporting REDD+, there is not a significant amount of literature on the impact of capacity building activities or on the relative benefits of different capacity building approaches. A webinar cross border initiative by the Committee on Earth Observation Satellites (CEOS) does however explore the impact of a webinar series on remote sensing technology for disaster management and SAR data processing and applications [14]. A search for "Capacity" & "Building" & "Webinar" in the title, abstract, or keywords retrieved only 18 articles in Scopus (25 May 2021). This paper will contribute towards filling this gap, and aims to:

1. Describe the GFOI "training the trainers" REDD+ MRV capacity building initiative—both online and in-person events and materials.
2. Provide an analysis of the training methods used in this study, focusing on impact.
3. Based on 1 and 2, make recommendations for future capacity building initiatives and research on this topic.

2. GFOI "Training the Trainers": Collaborative Capacity Building

This project, funded by the World Bank FCPF, provided guidance to countries to implement REDD+ monitoring and measurement in their national contexts. The initiative, led by the Global Observation of Forest Cover and Land Dynamics (GOFC-GOLD), leveraged the Global Forest Observations Initiative (GFOI) network. The GFOI was founded by, and is a flagship of, the Group on Earth Observations (GEO) and aims to support countries to develop systems that can provide monitoring data for REDD+ MRV as well as being useful for other reporting requirements and national needs [15]. This network works on the understanding that no one international partner alone can support all REDD+ countries or has the breadth of expertise required to overcome all the challenges. In addition, GFOI partners aim to provide a more coordinated and consistent package of support where efforts are not replicated but built upon systematically and complement each other. A number of outputs on REDD+ MRV have already resulted from the collaboration including the Methods and Guidance Document (MGD) and its supporting modules [16] aimed at countries wishing to make use of remotely sensed and ground-based data in REDD+ MRV. The MGD complements other guidance published by IPCC and GOFC-GOLD [17] and approaches taken by the UN-REDD Programme, the SilvaCarbon program of the United States, and the Word Bank Forest Carbon Partnership Facility (FCPF) and has been produced in cooperation with these initiatives.

This project centred on the principle of "training the trainers", a common capacity development approach used to reach large audiences. A multiplication effect is achieved, as trainers are trained with the aim that they will then train others (see for example: [18]). A number of different activities, including the production of e-learning materials, webinars, and face-to-face interactive workshops were implemented (Figure 1).

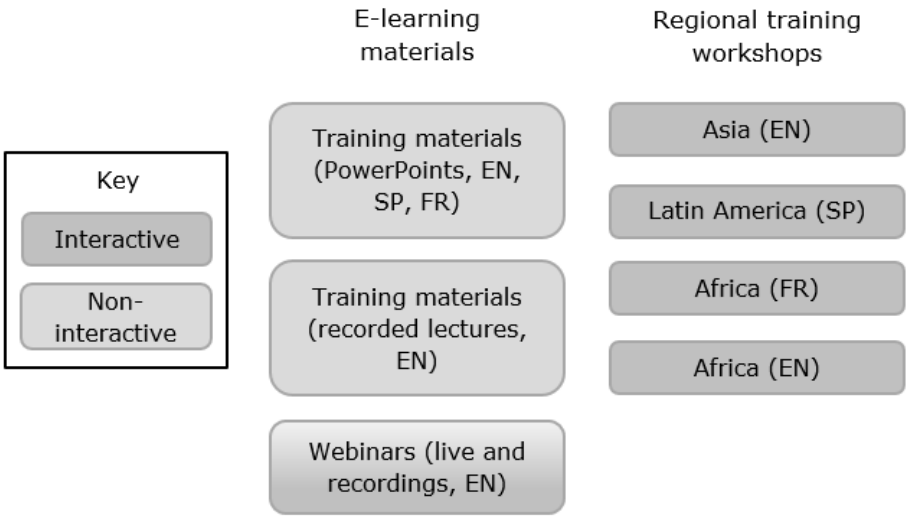

Figure 1. GFOI activities undertaken as part of this project including e-learning (online) materials, interactive events, and languages in which they are available or were delivered (EN = English, SP = Spanish, FR = French).

The initiative provided specific guidance (rather than general advice) [19] on themes related to monitoring forest area and area changes and the associated carbon stocks and changes. The guidance delivered was useful for countries involved with any REDD+ activity that are seeking results-based finance from any of the existing REDD+ initiatives such as the FCPF Carbon Fund [20]. Mainly open-source methods and tools were showcased, as they can be adapted, utilized, and shared by users. A number of materials were introduced in the workshops and the webinars, covering topics from design of National Forest Monitoring Systems for REDD+ MRV through to tools useful for generating activity data, emissions factors, and estimates of uncertainty (Figure 2). In order to deliver a co-ordinated and systematic message, the REDDcompass (www.gfoi.org/reddcompass, accessed on 30 July 2017) was used as a central element for training, as this refers to other tools, documents, and applications throughout.

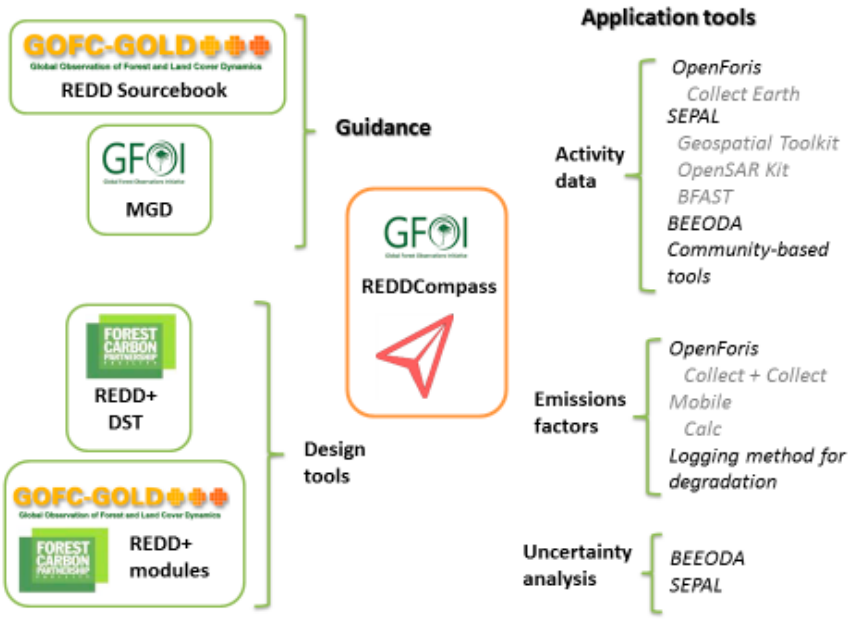

Figure 2. Some of the technical materials/tools covered in the training workshops and webinars. Other tools were included or mentioned, but these are the main tools and methodologies that were covered during the workshops. More information can be found here: http://www.gofcgold.wur.nl/redd/training-materials/ (accessed on 30 July 2017).

2.1. E-Learning: Training Materials

Self-explanatory training materials for use in capacity development were developed and made available online. The materials follow a systematic flow addressing concepts from the background of REDD+ through to technical requirements of REDD+ MRV. Fourteen modules were developed and can be viewed individually or used in sequence as part of the whole training package. Each module includes a lecture (a PowerPoint presentation and also a video lecture), country examples, and exercises. Before the video lectures were recorded (2017), the training materials that had been developed in 2015 were updated, which was essential to accommodate changes to UNFCCC decisions. The video lectures had in total 972 views between March 2017, when they were made available online, and 29 August 2017.

2.2. E-Learning: Webinars

A series of seven webinars were held between April and June 2017. The aim of the webinars was to introduce the latest tools and methodologies for REDD+ MRV (Figure 3). Like the e-learning lectures, webinars were also requested as a follow-up activity by the participants from the workshops. The webinars were widely advertised through the GOFC-GOLD and GFOI networks and through social media channels such as Facebook and Twitter.

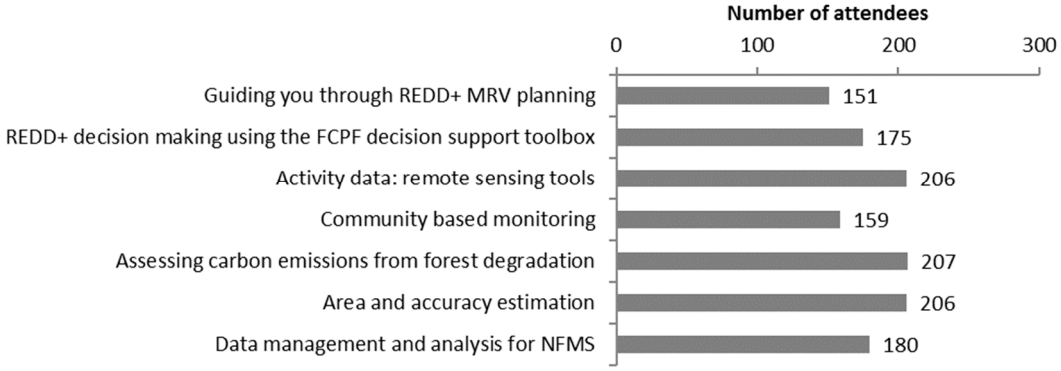

Figure 3. Themes for the webinars and the attendance per webinar.

A total of 578 individuals participated in the webinar series, joining at least one webinar. Some individuals attended more than one webinar (meaning the sum of the webinar attendees is more than this). The mean number of participants per webinar was 183 (Figure 3). Fifty-one attended at least six of the seven live webinars and received a certificate that confirmed their attendance (workshop participants also received a certificate). Participants came from a total of 91 countries, 65 of which were non-annex 1 countries (mainly low-income developing countries, which are eligible to participate in REDD+), including 37 of the 47 FCPF countries (Figure 4). Sixty percent of participants were from (working in) non-annex 1 countries.

The webinars were recorded, and the videos are available to watch again online. Along with the training materials, these tools are also available on a memory stick to allow users without internet to access them (a so-called 'offline version'). Both the training materials and webinar recordings can be accessed online: http://www.gofcgold.wur.nl/redd/training-materials/ (accessed on 30 July 2017).

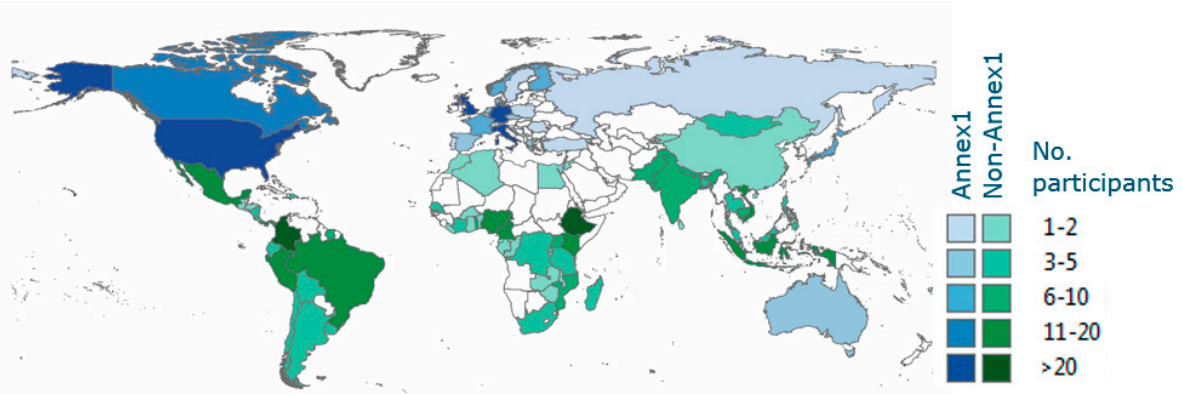

Figure 4. The countries which webinar participants represented.

2.3. Regional Training Workshops

A total of 159 participants (excluding organizers and presenters) were trained from 43 countries in four regional workshops, in three languages (Figure 5). The workshops were funded collaboratively, and each donor facilitated the participation of their priority countries. The training was delivered by experts from the GFOI partners. The lectures and hands-on training sessions included presentations of the training materials and the tools and methods covered in the webinars that can be viewed online.

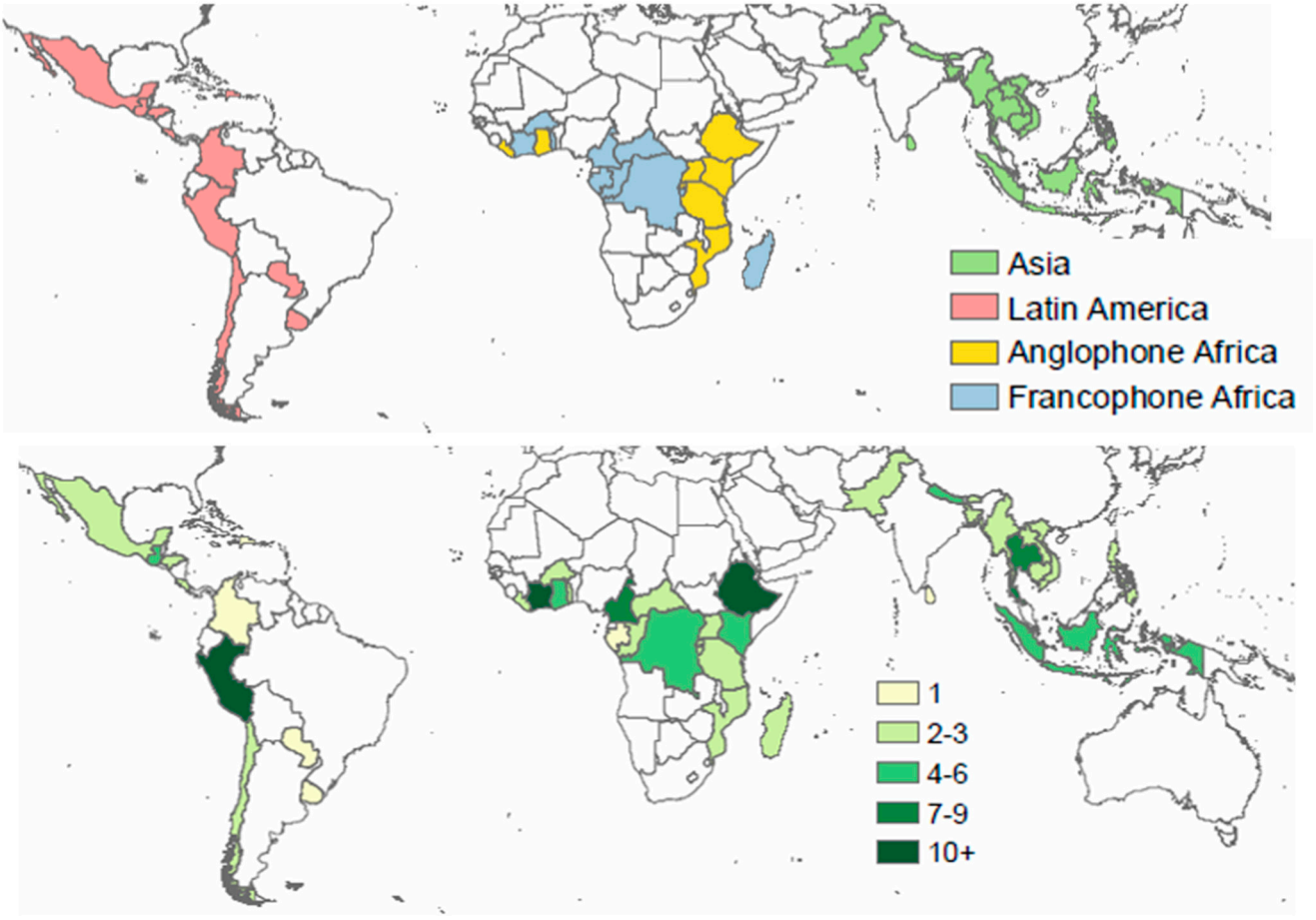

Figure 5. Countries participating in each workshop and number of participants per country. Two of the workshops were in English (Asia and Anglophone Africa), with one workshop in Spanish (Latin America) and one in French (Francophone Africa).

2.4. Monitoring of Impacts: Surveys

There were three types of survey used to evaluate the webinars and workshops. Firstly, data were gathered about all the workshop and webinar participants before the events, which provided information on their needs and the relevance of the training for the participants. Secondly, immediately after the event, participants were asked to rate their satisfaction and provide feedback on the clarify and usefulness of the training. Thirdly, a detailed impact survey was held around six months afterwards to evaluate the success of the initiatives. Six months after each workshop, participants were invited to complete an impact survey, and 63 responded in total. Six months after the first webinar, participants who attended two or more webinars were invited to answer questions about the webinar series, and 70 participants responded. Questions focused on the use of methods and tools as well as training given to others on those tools since the event. Not all participants responded to all surveys, and not all respondees answered every question in every survey, and this is detailed in Section 3.

3. Analysis of the Training Methods Used in this Study

The impact of the main training methods used in this study, webinars and training workshops, was assessed using a number of criteria (Table 1, and further described in this section).

Table 1. An overview of the impact of the two main training methods used in this study: webinars and regional training workshops.

Criteria	Webinars	Regional Training Workshops
Reaching the right participants: targeting participants	Self-selection, but advertisements for the series targeted key institutions. Language was a barrier (webinars were in English)	Selected based on expertise and relevance of position by GFOI partner institutions
Impact of the training: number of participants	578	159
Impact of the training: number of participants who used any of the tools	380 (66%)	154 (97%)
Impact of the training: participant satisfaction	Found to be clear and relevant	Found to be clear and relevant, and for technical work, face-to-face training was preferred
Engagement in training	Only 51 of 578 attendees attended at least 6 of the 7 webinars; however, results from the impact survey indicate engagement	Participants reported their skills increased as a result of the training
Continued engagement after training: with experts	22% engaged with experts after the webinar	46% of respondents engaged with experts after the workshop
Continued engagement after training: south–south collaboration	Not tested, since participant details were not shared among each other	63% engaged in south–south cooperation (see Table 2)
The multiplier effect: number of people trained	60% of participants trained others, which is 2923 people trained, or 5 per attendee	70% of participants trained others, which is 2776 people, or 17 per attendee
Efficiency	1000 EUR for 7 webinars, or 20 EUR per participant (those who completed 6 of the 7 webinars), but a lower impact than the workshop (where impact is considered to be the other criteria in this table). Considering the multiplier effect, 0.34 EUR per person (1000/(51 + 2923))	120,000 EUR for four workshops, or 755 EUR per participant (159, all participants), but a higher impact than the webinars. Considering the multiplier effect, 41 EUR per person (120,000/(2776 + 159))

Table 2. South–south cooperation occurring within the 6 months after the workshops either within the same country, or between countries.

Country	South–South Cooperation with
Pakistan	Pakistan
Bangladesh	Bangladesh,
Nepal	Bhutan, Myanmar, Nepal, Pakistan
Laos	Laos
Bhutan	Bangladesh, Bhutan, Nepal
Vietnam	Indonesia, Thailand, Vietnam
Thailand	Indonesia
Uruguay	Chile, Uruguay
Chile	Chile, Mexico
Guatemala	Chile, Colombia, Costa Rica, Honduras, Mexico
Cameroon	Ethiopia
Ethiopia	Ethiopia
Ghana	Ethiopia, Ghana, Kenya, Liberia, Mozambique
Kenya	Ethiopia, Kenya, Rwanda, Uganda
Liberia	Liberia
Mozambique	Kenya, Mozambique, Tanzania
Rwanda	Rwanda
Uganda	Ethiopia, Uganda
Cameroon	Cameroon, Democratic Republic of the Congo
Central African Republic	Cameroon, Central African Republic
Democratic Republic of the Congo	Democratic Republic of the Congo
Republic of the Congo	Democratic Republic of the Congo, Republic of the Congo
Madagascar	Madagascar

3.1. Reaching the Right Participants

Workshop participants were selected by the GFOI partners working with the relevant agencies in their priority countries (often government agencies responsible for forest monitoring). Participants were selected based on their expertise in the field and their position within the institution. Participants therefore have the potential to influence country MRV strategies and could have the opportunity to train others on what they had learned. In both cases, the workshop offered free-of-charge access to expertise and training, as well as international networks. Six months after the workshop, 62% of respondents were working more on REDD+ MRV than before the workshop and were working on a number of relevant activities (Figure 6). Only three (5%) of the workshop participants were no-longer working on REDD+ MRV six months later. Although participants in the webinars were self-selected, the majority were actively working on REDD+ related tasks, so the training was reaching a relevant audience. Only 6% (n = 64) of those who responded to the impact survey after the webinars were no longer working on any REDD+ related tasks when they filled out the impact survey. In terms of reaching participants able to influence the progress of REDD+ MRV on the ground, the selection process for the workshop participants may be more effective. For example, Laos, Central African Republic (CAR), and Gabon (FCPF and UNREDD countries) did not participate in the webinars, but their participation in the workshops, in contrast, was facilitated by the donors. One barrier for their participation in the webinar may be because they were in English, while the workshop was in French (CAR and Gabon are francophone).

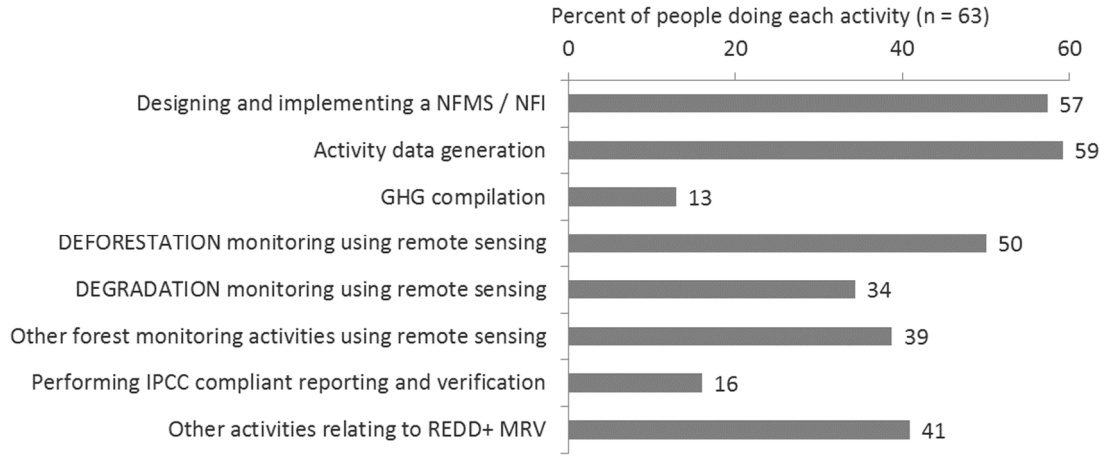

Figure 6. Percent of workshop participants doing REDD+ MRV related activities 6 months after the workshop.

3.2. Impact of the Training

In terms of numbers of participants, webinars had a much greater impact than the regional workshops, in that 578 participants were reached in the webinars and 159 in the workshops (on average 40 were trained per workshop and 183 per webinar). Absolute numbers of participants using tools after the webinars are also larger (154 people from the workshops, and 380 from the webinars). However, participants from the workshops were more likely to use the tools than webinar participants (97% and 66%, respectively), meaning the success rate for adoption of tools is higher for workshops. The uptake of tools differed, which is partly influenced by the fact that not all tools were trained to the same extent (Figure 7). The webinars were found to stimulate interest in those who had never used the tool presented before, and 56% of those people tried it after the webinar. Most (92%, $n = 636$) said that they would be interested in additional education on the specific tool that was introduced in that webinar. Note that $n = 636$ in this case, and this reflects the number of people completing that question in the survey immediately after each webinar (summed from all webinars) and not the number of individuals attending webinars.

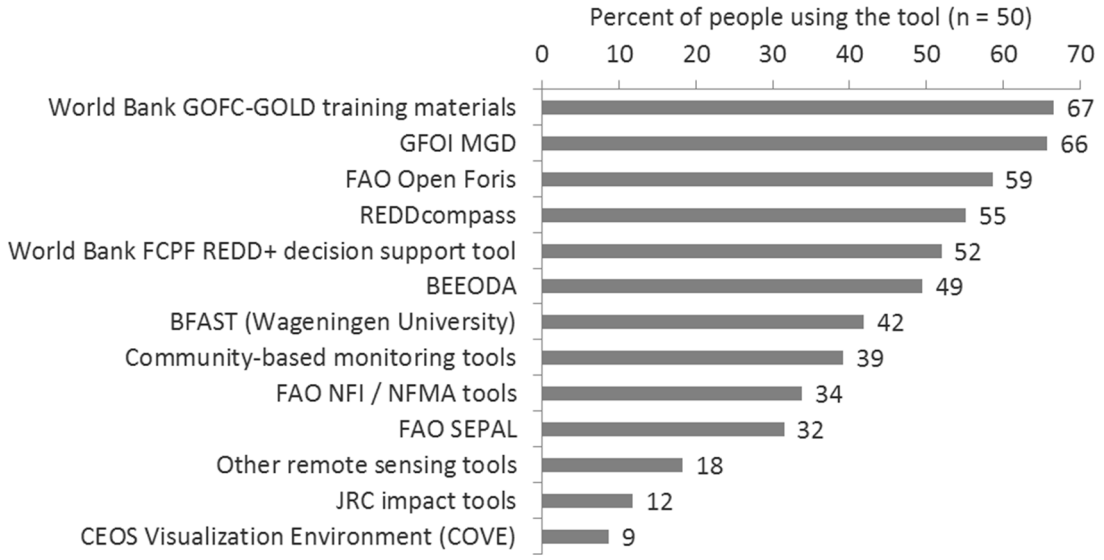

Figure 7. Use of tools six months after the workshop. Not all tools were trained to the same extent (some not at all) at all workshops.

In general, both workshop and webinar participants were satisfied with the training given. This matched findings from [14]. The webinar participants were asked after the webinar if they found the webinars clear and understandable, and scored the webinars 4.2 on a scale of 1 to 5 (n = 634), where 5 is very clear, and 1 is not clear. For relevance, they scored 4.3 (n = 636), where 5 is very useful, and 1 is not relevant. Ninety-five percent of workshop participants rated the workshop as good or excellent overall. However, in the detailed feedback for both the webinars and the workshops, many participants highlighted the technical nature of the work, for which face-to-face interactions better facilitate comprehension. This may also explain why the guidance materials were used the most (World Bank GOFC-GOLD training materials and GFOI MGD), as even in the workshop some participants mentioned that more time is required to be able to fully engage with the more technical tools (Figure 7) in contrast to guidance materials, which are more easily used. Of those participants who participated in one of the regional workshops and also the webinar series, and who responded to our survey (six people), all but one said that they preferred workshops due to the advantages of being able to interact with experts. Having the participants travel to the workshops was a positive experience, as it allowed side-meetings with other countries and organizations to be arranged at the same time, thus increasing the efficiency of the event-saving both time and travel costs.

3.3. Engagement during and after the Training

Most webinar participants participated in the whole webinar. The average time participants spent in the webinar was 66 min, and the webinars lasted in general around 80 min. Although it is not known exactly how engaged the participants were, the impact survey indicated an impact (use of the tools and materials, training others) and thus engagement. Only 51 out of a total of 578 webinar attendees attended six of the seven webinars and were eligible for a certificate that aimed to motivate participation. This indicates a lack of engagement in the whole webinar series; however, it could be that the attendees were interested in specific topics, rather than the whole series, as was also found in a study in Alaska [21]. Workshop participants responded to our survey that both their technical and policy skills had increased, which suggests engagement in the training, and anecdotal evidence from the presenters is that participants were very engaged in the workshop. Technologies are available to increase engagement in e-learning approaches and are much more available and used since COVID-19, even making choice of software difficult [22]. These should evaluated and considered for use in the future (see section: Future research).

Fewer webinar participants interacted with experts after the webinar than workshop participants (22% and 46%, respectively). South–south cooperation was stimulated by the workshop, and 63% of respondents engaged in south–south cooperation with someone from the workshop (Table 2).

3.4. The Multiplier Effect

The participants from the workshops were more likely to train others. The webinar participants were asked more generally about training, and not only whether they had trained others but also if they shared tools and methodologies (informal training). Even so, the percent of webinar participants who trained others was lower (60%) than for workshop participants (70%). Our survey asked participants for the number of people they trained, and workshop participants were asked this for every tool and method individually, whereas webinar participants were asked whether they had trained others on any of the tools and methods, since some had only attended two webinars and so were not exposed to as many tools (see Figure 8). For the webinars, this equates to 2923 people being trained after the webinars, or five per attendee. Most (90%) training was done by those in developing countries who had a master's degree; on average, 53% of developing country participants had a master's degree, also indicating that senior participants are being trained in the webinars. Assuming that different people were trained in different tools by the workshop

participants, 6045 people were trained after the workshops, or 38 per workshop attendee. Assuming that the same people were trained on all the tools, then 2776 people were trained after the workshops or 17 per attendee. For this calculation, the highest number of people trained on any one tool by attendees at each of the workshops was used, whereas the numbers per tool are presented in Figure 8. Figure 8 reflects more accurately the training instances than number of people, as the same person could have been trained twice on two different tools, for example. Additionally, two respondents could have both reported the same training session if they were both training others, but this could occur for reporting from the workshop and webinar, meaning the comparison is less affected.

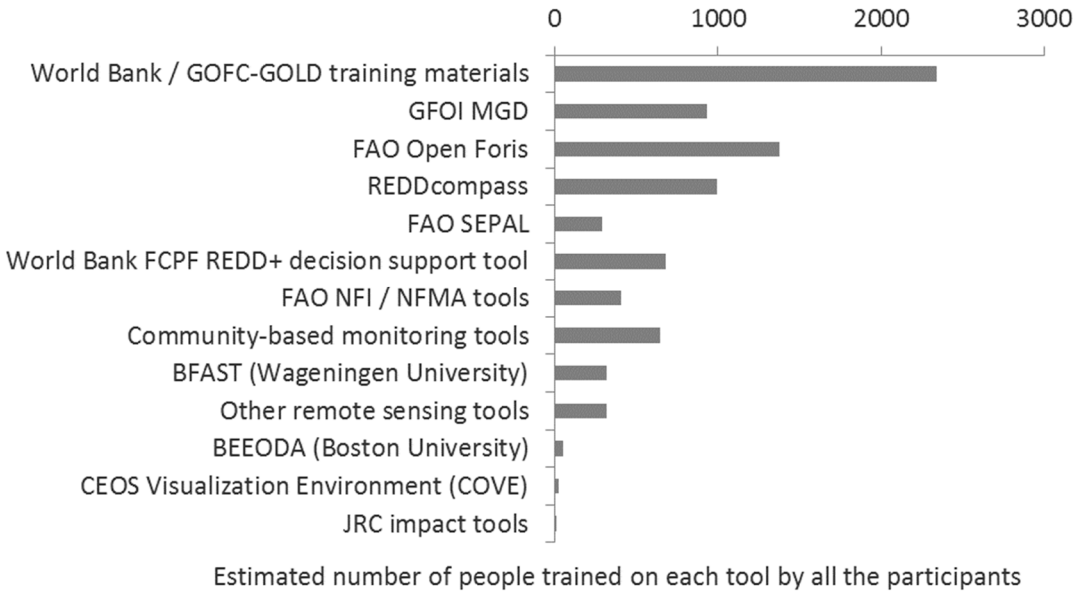

Figure 8. Estimated workshop participants performing REDD+ MRV related training activities 6 months after the workshop. The average size of a training session was assumed to be the mid-point of the reported group size (i.e., if the training session was reported to be between 10 and 20 people, we assumed it had 15 participants).

3.5. Efficiency

A workshop is considerably more expensive to run than a webinar. When considering that a number of costs are present in both webinars and workshops (such as salaries and overheads for staff and presenters, and equipment), then the only cost unique to the webinars was the purchase of webinar software for the duration of the webinar (https://www.gotomeeting.com/webinar/pricing, accessed on 30 July 2017). Costs related to hosting four workshops include travel and costs of participants, presenters and support staff, and hire of venue. The workshops were either 4 or 5 full days and included training on multiple tools, so to make a more even comparison, only those participants who participated in six of the seven webinars (51 people) were included in this analysis. Using approximate costs, which are 1000 EUR for a series of seven webinars, and 120,000 EUR for the four workshops, the cost of each person trained is 20 EUR for the webinars and 755 EUR for the workshops. However, since there was a larger impact of the workshops in terms of the use of tools and numbers trained afterwards and the south–south cooperation, this calculation does not reflect well the efficiency of the training methods. Considering the multiplier effect, the webinars were 0.34 EUR per person (including those trained) (1000/(51 + 2923)), and the workshops were 41 EUR per person (120,000/(2776 + 159)). In addition, this comparison does not account for any differences in intensity of teaching and the teaching hours, which were approximately nine hours of contact time for six webinars of 1.5 h, and 32 h for the workshops. It does, however, give an impression of the relative costs of the two approaches.

4. Discussion

4.1. Future Research and Limitations of the Study

Although this study is unique, as a detailed impact survey was held after all the events, the evaluation could have been improved. For example, a scorecard system can identify where capacities could have increased [23]. To understand better the extent to which the training the trainers aimed for had been achieved, the questionnaire could have included questions to estimate the quality of the training given by participants after the workshop and whether this knowledge was passed on effectively by the trainer. The workshop impact surveys were carried out 6 months after the workshop, but the webinar impact survey was between 2 and 4 months after the webinars, so this difference makes results somewhat difficult to compare. Additionally, only those who attended two or more of the webinars were invited to complete the impact survey. Monitoring longer-term effects of the project would also be helpful, as people who benefited from training can continue to train others and access the online resources. Thus, we expect to underestimate the benefits from this project, which are expected to continue to multiply beyond the duration of the monitoring period. The gender balance of the events could also be explored [14].

4.2. Results from this Study and Considerations for the Design of Future Capacity Building Initiatives

Although to date, progress has been made in terms of the MRV of REDD+ activities, there is still a huge need for further capacity development [24]. The capacity building methods used in our project are by no means exhaustive, and indeed, since 2017 when the training was given, there have been advances, particularly in terms of online training solutions, so other options should be tested and evaluated. The FAO model of employing technical advisors who work in-country and can, for example, provide additional support once a workshop has finished is one such approach. Similarly, technical assistance programs, such as SilvaCarbon, that work with each country by transferring and customizing existing methodologies and tools is another. This is done by either bringing experts to work in countries in a short detail or supporting specialists from the countries to attend trainings overseas. Workshops delivered by SilvaCarbon are followed up with one-on-one technical assistance as needed, sometimes employed remotely and delivered through a long-term collaboration. Regarding online training, webinar-type training initiatives, such as virtual classrooms (see [25] for guidance on how to establish these), should also be explored. However, working with technology can be demanding and stressful and problematic in developing countries, and this could influence the quality of the teaching. In terms of participant satisfaction, however, both webinars and workshops were found to be clear and relevant, although those who attended both had a preference for workshops. Webinars have been found to promote new network connections and further dialogue and network building, including links between scientists and stakeholders [21]; however, in our webinars, participant details were not shared directly, so south–south connections would be more difficult to develop than in workshops. Connections between the experts and participants were also found to be stronger in the workshops than webinars in this study. In light of COVID-19, online solutions would be invaluable, particularly to continue to foster relationships between stakeholders that had been originally developed during in-person meetings. Where finances are limited, online activities should be considered above in-person, as webinars were found to be cheaper than workshops in this study. Overall though, research suggests that the best results might be achieved by the implementation of traditional and e-learning systems together [26]. Follow-up visits (face-to-face) from experts following online training events have also proven to be effective [19], so this should be further tested in the context of REDD+ MRV. Indeed, in the context of impact achieved in this training-the-trainers approach, workshops were found to be more successful in prompting this.

4.3. Recommendations for Future Capacity Building Initiatives

Several recommendations emerged from the implementation and analysis of this project:

- Increase efficiency with collaborative activities among implementing agencies, which allows more participants and countries to benefit from workshops.
- Keep online e-learning materials up to date so that policy changes and new research developments are reflected in guidance.
- Implement a regular and diverse array of capacity building activities (which includes workshops) to ensure that in-depth guidance is given to relevant stakeholders and that sufficient time for training on technical tools is provided.
- Encourage south–south interactions and implement a training-the-training approach to multiply impact, both of which can be best achieved by initial face to face interactions. Develop webinars in a way in which interactions can occur, including exploring the use of social networks to link participants [21].
- Use webinars that are cost-effective and reach large numbers of stakeholders, but continue to improve the way in which they are delivered, for example, by employing new technologies and providing supporting documents to participants such as short written summaries of the presentations [21]. Number of participants need not be limited, and care should be taken to select a software tool and appropriate subscription to ensure all those who are interested can join, i.e., avoiding limitations due to free subscriptions [14].
- Be flexible—the ability to convert an in-person training event to an online format could be useful given uncertainties surrounding COVID-19. Follow existing experiences of how activities can move online as a response to COVID-19 [27].
- Ensure that the right people are reached, for example, by prioritizing key institutions or selecting key individuals who are able to train others or who are directly working on this topic. Senior participants, for example, are more likely to pass on their knowledge (evidence from the webinars). Using appropriate languages for training is also essential (evidence from workshops).

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