# Building capacity for REDD+ planning in Liberia: mapping non-carbon benefits

## Working session report

*Second working session convened as part of Liberia's National UN-REDD Programme*

*Tubmanburg, 23-26 April 2018*

*Monrovia, 30 April-4 May 2018*

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This second working session was organized by the Forestry Development Authority of Liberia (FDA), UN Environment Africa Office and the UN Environment World Conservation Monitoring Centre (UNEP-WCMC) as a contribution to REDD+ national strategy implementation.

The UN-REDD Programme is the United Nations Collaborative Initiative on Reducing Emissions from Deforestation and forest Degradation (REDD) in developing countries. The programme was launched in 2008 and builds on the convening role and technical expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and UN Environment. The UN-REDD programme supports nationally-led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders, including Indigenous People and other forest-dependent communities, in national and international REDD+ implementation.

The UN-REDD Programme provided technical support for this workshop through UNEP-WCMC. UNEP-WCMC is the specialist biodiversity assessment centre of UN Environment, the world's foremost intergovernmental environmental organization. The Centre has been in operation for over 35 years, combining scientific research with practical policy advice.



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**Suggested citation:**

Pollini, B., Gosling, J. (2018) Building capacity for REDD+ planning in Liberia: mapping non-carbon benefits. Working session report. Prepared on behalf of UN-REDD Programme. UNEP-WCMC, Cambridge, UK.

**Acknowledgements:**

With thanks for input and comments from the workshop participants. Thanks also to Thais Narciso (UN Environment) and Lera Miles (UNEP-WCMC) for their review.

UN environment WCMC

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**Acronyms and abbreviations**

| | |
|---|---|
| CI | Conservation International |
| EPA | Environmental Protection Agency, Liberia |
| FDA | Forestry Development Authority, Liberia |
| GIS | Geographic Information System |
| GRASP | Great Apes Survival Partnership |
| HCS | High Carbon Stock forest |
| HCV | High Conservation Value forest |
| KBAs | Key Biodiversity Areas |
| LLA | Liberia Land Authority |
| LISGIS | Liberian Institute of Statistics and Geo-Information Services |
| NFI | National Forest Inventory |
| NGO | Non-Governmental Organization |
| NTFPs | Non-Timber Forest Products |
| PAMs | Policies and Measures for REDD+ implementation |
| REDD+ | Reducing Emissions from Deforestation and forest Degradation; "+" conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks |
| RIU | REDD+ Implementation Unit |
| UNEP-WCMC | UN Environment World Conservation Monitoring Centre |
| WRI | World Resources Institute |

# Executive summary

This report describes a two week long working session on spatial analysis to support REDD+ in Liberia, held in Tubmanburg and Monrovia in April/May 2018. The main goals of the session were to build capacity among key GIS national staff in the use of QGIS and to carry out spatial analyses to support REDD+ planning. This is the second of two working sessions led by UNEP-WCMC, the having been held in February 2018 in Monrovia. This work took place as part of a collaboration between UN Environment Africa Office, the Forestry Development Authority of Liberia (FDA) and UN Environment World Conservation Monitoring Centre (UNEP-WCMC).

The training lasted 9 days spread across two weeks and included a desk and a field component. The main content of the training included the following:

- Overview of REDD+ status in Liberia and of the Liberia Forest Atlas
- Overview of spatial data, scales, limitations and validation using QGIS tools;
- Use of QGIS to prepare field surveys;
- Data collection in the field;
- Forest cover classification using the QGIS tool Dzetsaka;
- Validation of forest cover maps using statistical techniques;
- Identification of REDD+ interventions and development of spatial workflows using QGIS to identify priority areas for the intervention;
- Overview of the Great Apes Survival Partnership (GRASP) and the GRASP web-based mapping tool;
- Development of effective maps for decision-makers;
- Methods to generate map templates and how to share those using QGIS.

The main outcomes from this working sessions were the identification of two REDD+ interventions for analysis, in line with the priorities included in Liberia REDD+ national strategy, development of spatial workflows to identify priority areas where to implement them, production of maps using the matrix style legend and knowledge improvement in using field data to validate forest cover maps. The training session has also been very helpful in identifying further training needs, thanks to several discussions with the participants.

# Introduction

## 1. Overview

*Box 1: What is REDD+?*

REDD+ (Reducing Emissions from Deforestation and forest Degradation +) is an initiative intended to combat climate change by providing incentives for changing the ways in which forests are used and managed, so that emissions of greenhouse gases from forests are reduced and carbon sequestration is increased. REDD+ may require many different actions, such as protecting forests from illegal logging or fire or rehabilitating degraded forest areas.

* The "+" indicates the inclusion of the following activities: conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks.

This report describes the activities and outcomes of the second working sessions planned to provide GIS technical support to Liberia in relation to REDD+ national strategy implementation. A scoping mission to Liberia in May 2017 identified a demand for technical capacity building amongst an existing network of GIS professionals working in and alongside the FDA.

UNEP-WCMC therefore ran two such capacity-building sessions in 2018 inviting colleagues from several Liberian institutions involved in forest mapping and national REDD+ spatial planning. This effort falls under the ongoing technical support provided by UN-REDD Programme, under the project "UN Environment in UN-REDD: Tools and approaches to support countries in incorporating multiple benefits, green economy and green investments in REDD+ planning".

Liberia has approximately 4.3 million hectares of lowland tropical forest, which constitutes 43% of the remaining Upper Guinean Forests of West Africa and is rich in endemic species. Liberia's forest cover provides direct benefits that include wildlife habitat, opportunities for ecotourism and sustainable agriculture, soil conservation, provision of water resources and NTFPs to local communities, 67% of which live below the poverty line. This critical natural capital is threatened by several drivers of deforestation and forest degradation; the main ones are shifting agriculture, pit sawing, charcoal production, palm oil concessions, forestry concessions (mostly for timber sales) and mining exploration (National Strategy for REDD+ in Liberia, 2016).

In order to avoid the loss of Liberia's unique and biodiversity-rich forests and reduce greenhouse gas emissions from deforestation, in September 2014 Liberia and Norway entered into a partnership to support the development and implementation of Liberia's REDD+ strategy, contribute to sustainable development through protecting natural forests, restore degraded lands, develop the agricultural sector, and work to support progress on global efforts regarding climate change, sustainable development and REDD+. In October 2016, the National Strategy for REDD+ in Liberia was released by the FDA REDD+ Implementation Unit (RIU).

This second working session involved a field component held in Tubmanburg (Bomi County) from 23 to 26 April 2018, and a desk component held in Monrovia from 30 April to 4 May 2018. The field session was attended by 17 participants (4 women and 13 men), and the desk session by 15 (4 women and 11 men). The participants were from four different government agencies, FDA, the Environmental Protection Agency (EPA), the Liberian Institute of Statistics and Geo-Information Services (LISGIS) and the Liberia Land Authority (LLA) and from two NGOs, Conservation International (CI) and the World Resources Institute (WRI). The level of GIS knowledge differed among the participants, with some of them having experience in generating maps and developing spatial analyses. The working session agenda and list of participants are provided in Annex 1 and 2 respectively.

## 2. Objectives

The overall objective of the two working sessions was to build technical capacity of key GIS national staff in the use of QGIS and in carrying out spatial analyses to support REDD+ planning, in particular by enabling the integration of benefits beyond carbon in such plans.

Specific learning objectives for the second session were:

1. Understand different types of spatial data (from field to derived datasets), their scale, format, resolution, as well as their limitations, use and validation using QGIS tools;
2. Learn how field data relevant to land cover, biodiversity and deforestation can be collected and analyzed using QGIS;
3. Learn how to develop spatial workflows using QGIS Graphical Modeller, and identify priority areas for the implementation of potential REDD+ interventions;
4. Learn how to design effective maps for decision makers using different approaches to present the data, such as the matrix legend;
5. Learn how to generate and share map templates In QGIS.

# Topics covered

The main topics covered during this session are summarized below (Agenda in Annex 1). Presentations, tutorials and other workshop materials are available online at bit.ly/mbs-redd.

## Field component

### 1. Spatial data and field surveys preparation

The working session started with welcoming remarks by Mr. James Kpadehyea, the National Forest Inventory (NFI) coordinator for FDA, and continued with a first presentation on spatial data, their uses and limitations. The presentation also covered the different aspects of survey design and in particular the approach to be used when the objective is to validate a land cover map.

The study areas to be surveyed during the field exercises were digitized since no shapefiles were available (Figure 1). The participants then learned to generate random sampling points within the study area using QGIS and to upload them in a GPS. The following day these GPS points were used to collect the field data using field datasheets.

Before the end of the day, a discussion was held to agree on the forest cover classification to be used in the field. The classes identified were: Primary forest, Secondary growth forest and Degraded forest.

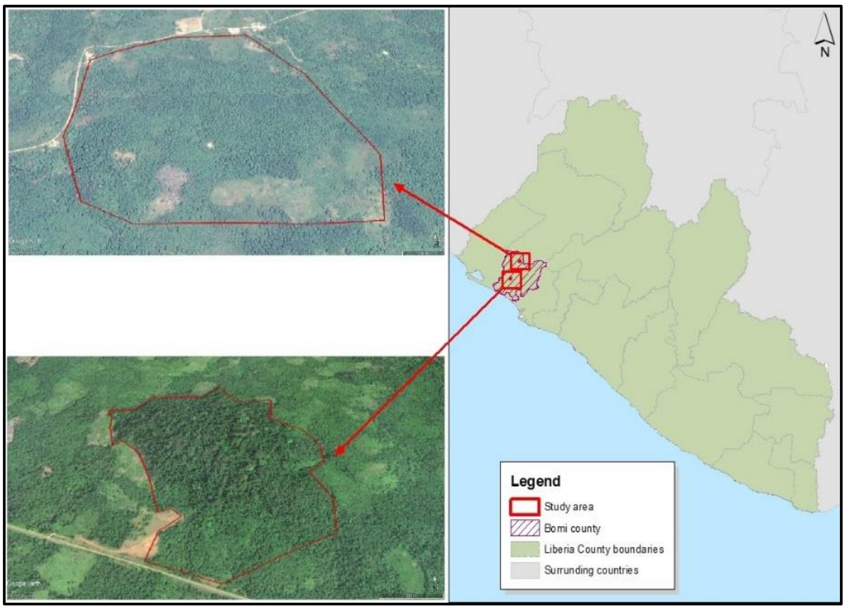


*Figure 1 Map showing the two study areas in*

## 2. Field exercises

The field exercises were carried out for half day the second (24 April) and third (25 April) day in two study areas (Figure 1) of approximately 61 and 66 hectares.

The participants were divided into 3 groups and each team was provided with a GPS, field datasheets, a pencil and a densiometer used to collect canopy cover data. The data to be collected in the field datasheet (Appendix 3) were:

1. GPS ID
2. Coordinates in UTM projection
3. Elevation
4. Forest type
5. Canopy cover (4 measurements to be taken in 4 directions)
6. Wildlife signs
7. Human disturbance

*Figure 2 Participants collecting data in the forest*

*Figure 3 Participants collecting field data*

## 3. Land cover classification and data validation

The data collected in the field were then used to classify Landsat 8 satellite images previously pre-processed. The pre-processing steps weren't carried out during the working session because of the limited time available, but each step was described and guidelines distributed to the participants.

The data were downloaded from the GPSs by the participants and uploaded in QGIS. Since the 21 points collected in the field weren't enough by themselves to generate a land cover map, more training polygons were digitized using GoogleEarth plugin in QGIS. Unfortunately with GoogleEarth is not possible to discriminate among the forest cover classes used in

*Box 2: Pre-processing and processing satellite images*

***Pre-processing***

All the procedures to format, correct the data for the distortion caused by sensor, solar, atmospheric and topographic effects, and enhance the data to facilitate the interpretation.

***Processing***

Classification of targets and features using appropriate statistical models called classifier.

the field, therefore just a general forest cover class was used to perform the final classification using the Dzetsaka plugin in QGIS (Box 3), rather than the three classes originally envisaged.

During the training session were described alternatives to the use of Dzetsaka plugin to perform land cover classifications, such as Collect Earth (FAO), which provides a system for using freely available satellite imagery in Google Earth, Bing Maps and Google Earth Engine to classify land use and assess land use change over time and is widely used in UN-REDD projects (http://www.openforis.org/tools/collect-earth.html).

Dzetsaka was selected for this training to deliver the understanding on use of field data within the available time and with limited Internet availability.

*Box 3: Dzetsaka plugin*

Dzetsaka is a fast, user friendly but at the same time powerful classification plugin for Qgis, developed by Nicolas Karasiak. The name means the objects through which we see the world (camera, satellite images, etc.) in Teko, a Mayan language, spoken in Central America.

Dzetsaka was initially based on the Gaussian Mixture Model classifier, but now supports also the following classifiers Random Forest, Support Vector Machines and K-Nearest Neighbour.

(Source: https://github.com/lennepkade/dzetsaka)

Even though not all the teams were able to generate the final land cover map, mostly because of the limited time available, a good understanding of how the tool works was gained by the participants. In Figure 4 is shown the land cover map and in Figure 5 the confidence map, one of the outputs that can be generated using Dzetsaka tool. A confidence map shows for each pixel the confidence in the assignment of the land cover class to the pixel. The values range from 0 (low confidence) to 1 (high confidence).

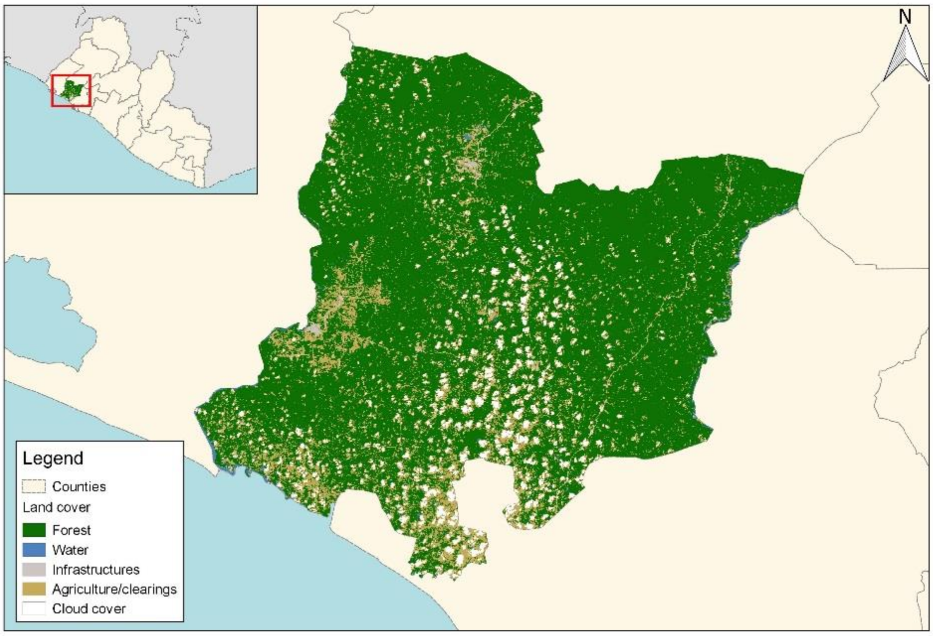


*Figure 4 Land cover map for Bomi County developed using Dzetsaka plugin in QGIS.*


*Figure 5 Confidence map with values form 0.336 to 1 relative to the land cover classification in Figure 4.*

The last day in Tubmanburg was dedicated to the validation of the Geoville land cover map, which is the forest cover dataset currently used in Liberia. The validation was carried out by using a confusion matrix and by calculating four accuracy parameters.

A confusion matrix is a contingency table between the land cover class observed in the field (ground truth data) and the land cover class of the map at the sample sites. The participants after having harmonized the land cover classes collected in the field and the ones used in the Geoville datasets have developed a confusion matrix (Table 1) and calculated the following accuracy parameters:

- Overall accuracy parameters, which represents the proportion of correctly classified land cover;
- User's and producer's accuracy, calculated for each land cover class and which respectively measure the probability that a sample unit in the map belongs to the same class on the ground and the probability that a unit on the ground is classified in the same class in the map;
- Kappa coefficient, which measures the degree of agreement between ground-truth (field) data and the classification to be validated, by compensating for the chance that samples are mapped correctly by pure chance

As explained during the working session, with the limited numbers of field points collected a statistically significant validation of any land-cover map is not possible.  Nevertheless the exercise represented a good overview of techniques that could be used for any future validation work, and communicated the need for field as well as remotely sensed data.

*Table 1 The confusion matrix table prepared by the participants. The columns represent the land cover classes observed in the field and the rows the corresponding values from the map. The diagonal entries, in green, represent the correct classifications and the off-diagonal values the misclassification*

| | **Tree cover > 80%** | **Tree cover 30-80%** | **Tree cover <30%** | **Settlements** | **Water** | **Grassland** | **Shrub** | **Bare soil** | **Classification Total** |
|---|---|---|---|---|---|---|---|---|---|
| **Tree cover > 80%** | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 4 |
| **Tree cover 30-80%** | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 6 |
| **Tree cover <30%** | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| **Settlements** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Water** | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| **Grassland** | 0 | 0 | 1 | 4 | 1 | 0 | 0 | 0 | 6 |
| **Shrub** | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| **Bare soil** | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| **Ground truth Total** | 6 | 6 | 4 | 4 | 3 | 0 | 0 | 0 | 23 |

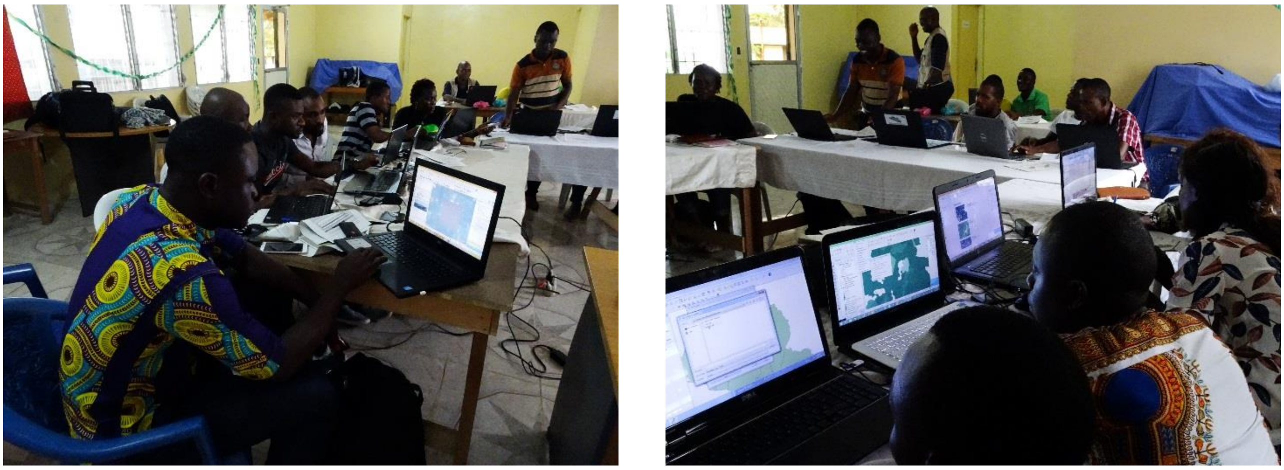

*Figure 6 Participants while carrying out land cover classification and validation at the Forestry Training Institute, after the field activities.*

## Desk component

### 1. Introductory session

The first day in Monrovia was dedicated to the review of the exercises assigned at the end of the working session in February, to provide an overview of the logic to identify potential non-carbon benefits of REDD+ and of the use of spatial workflows to conduct any analyses from simple to very complex. Particular attention was dedicated to the spatial workflows that can be developed to identify priority areas for REDD+ implementation.

The participants were then divided in two groups and were asked to identify two REDD+ interventions based on Liberia REDD+ National Strategy (Box 5) and to draw a workflow including the spatial layers and the technical steps required to identify priority areas where to implement the intervention. The participants continued working on this task also the following day.

*Box 5: The five priorities in the National Strategy for REDD+ in Liberia*

1. Reduce forest loss from pit sawing, charcoal production and shifting agriculture
2. Reduce impact of commercial logging
3. Complete and manage a network of protected areas
4. Prevent or offset clearance of High Carbon Stock and High Conservation Value forest in agricultural and mining concessions
5. Fair and sustainable benefits from REDD+

This activity was interspersed by three presentations. On the first day, Mr. Saah David, National REDD+ coordinator, gave a thorough presentation about the status of REDD+ in Liberia (Figure 7 - Left) and Mr. Joel Gamys (WRI country coordinator) presented on the Liberia Forest Atlas (Figure 7 - Right), an online, interactive forest monitoring tool developed by WRI in collaboration with FDA. The atlas currently includes information on land use, forest cover and forest cover change, and will be regularly updated. On the second day, the GRASP partnership and its web-based tool was presented.


*Figure 7 Mr. Saah David (left) and Mr. Joel Gamys (right) while giving their presentations.*

## 2. Identifying REDD+ interventions and development of spatial workflows

After having identified the REDD+ intervention and drawn the spatial workflow, each group then carried out the spatial analyses to implement the workflow. They used the geoprocessing tool "Graphical Modeller" in QGIS. Each group at the end of the 4th day (3 May 2018) gave a presentation on the workflow rationale, the technical steps and the final maps showing the priority areas where their REDD+ action could be implemented. An overview of the outcomes is provided in Table 2 and 3 and in the following figures (Figure 8 and 9 for Group 1 and Figure 10 and 11 for Group 2).

*Table 2 Group 1 (Jannie Fahnbulleh, Tom Richard Glassco, Teta Bonar, Daniel D. Wleh Jr, Uriah Garsinii, Lucas Knight, Pesoe G. Manscole) REDD+ intervention rationale.*

| ***Priority in the REDD+ National Strategy*** | ***Threat*** | ***REDD+ intervention*** |
|---|---|---|
| ***Priority 2:***<br><br>*"Reduce impact of commercial logging"* | Proposed logging concessions areas with High Carbon Stock forest, close to roads and villages, can be highly threatened by illegal logging. | Protection of forest with high carbon stock likely threatened by illegal logging. |

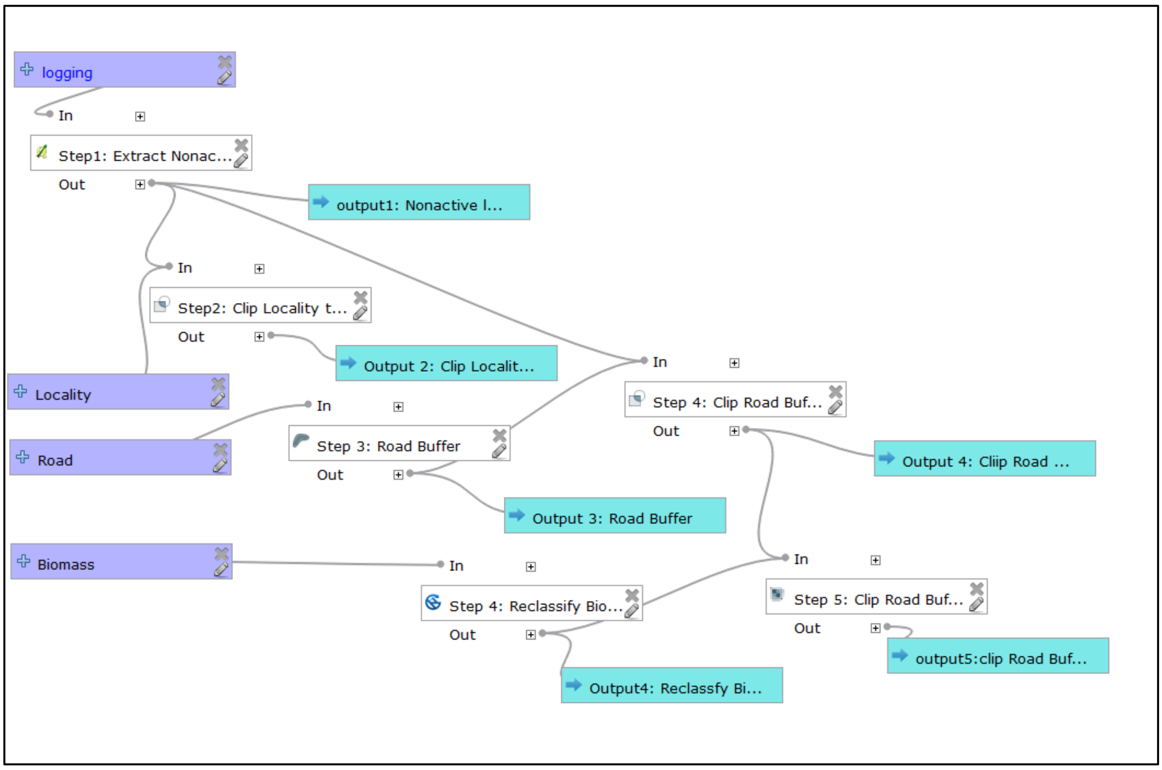


*Figure 8 Technical steps to identify areas high in carbon stocks, included in proposed logging concessions, within 10km from roads.*

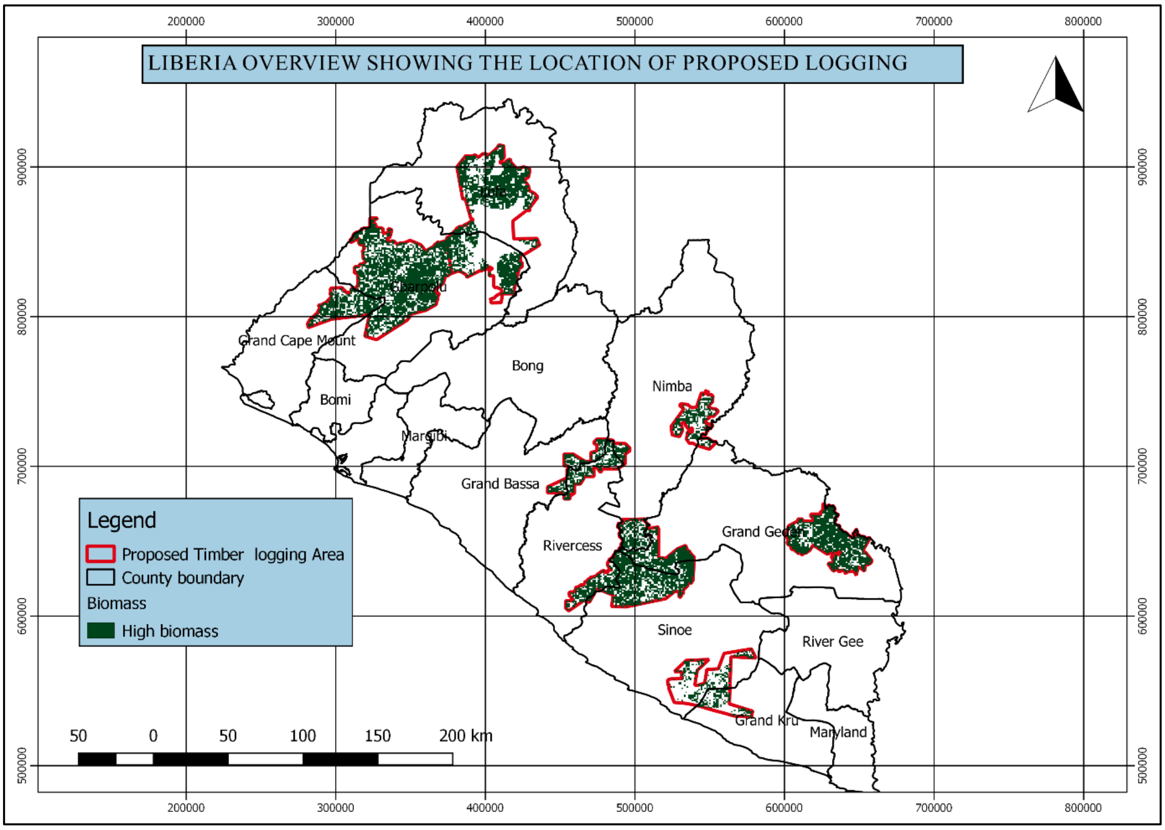


*Figure 9 Map prepared by group 1 showing proposed logging concessions with high carbon stock forest and within 10 km from roads.*

*Table 3 Group 2 (Isaac Nyaneyon Kannah, Kayloe R. Frank, Florence Nyumah, Abraham Saar, , Yekeh D. Howard, Berexford S. Jallah, Solomon C. Carlon) REDD+ intervention rationale.*

| ***Priority in the REDD+ National Strategy*** | ***Threat*** | ***REDD+ intervention*** |
|---|---|---|
| ***Priority 4:***<br><br>*"Prevent or offset clearance of High Carbon Stock and High Conservation Value forest in agricultural and mining concessions"* | Key Biodiversity Areas (KBAs), High in Carbon Stocks located near mining and oil palm concessions, and easily accessible from roads, are likely threatened by illegal logging or poaching. | Protection of forest with high carbon stock in KBAs, likely threatened by mining and palm oil concessions. |

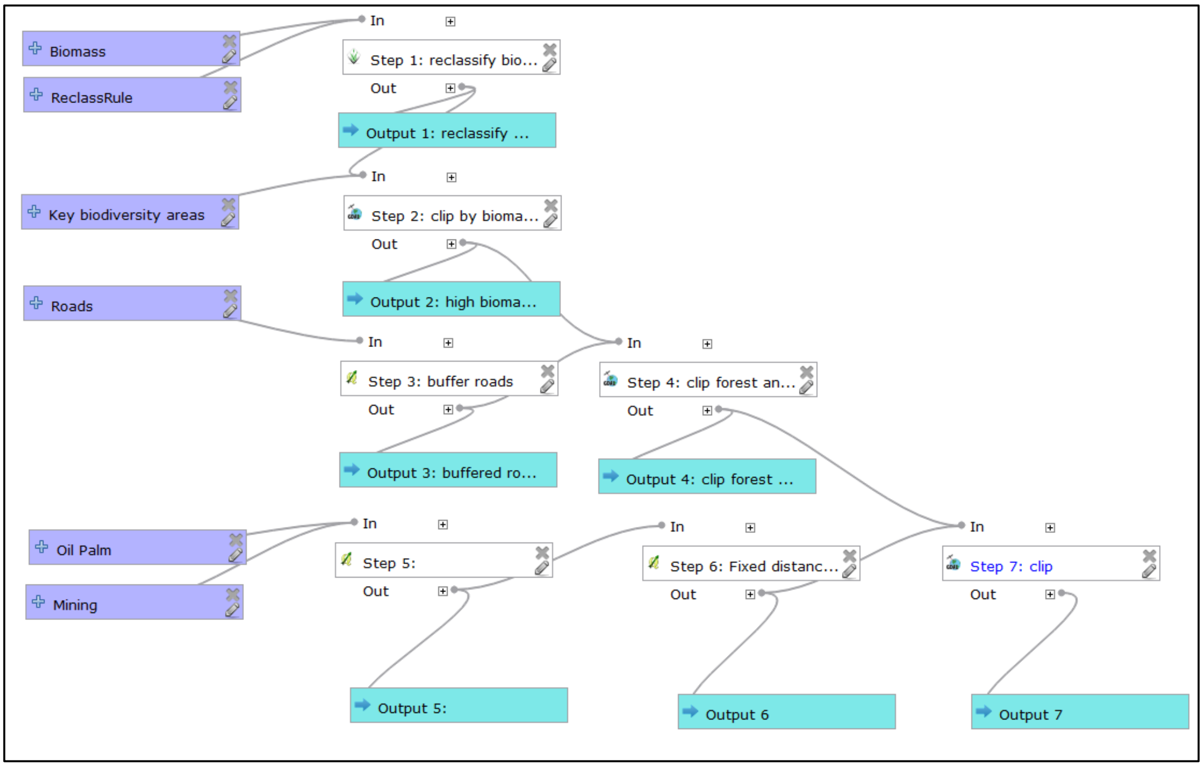


*Figure 10 Technical steps to identify valuable areas highly threatened by the proximity to mining and palm oil concessions as well as by roads.*

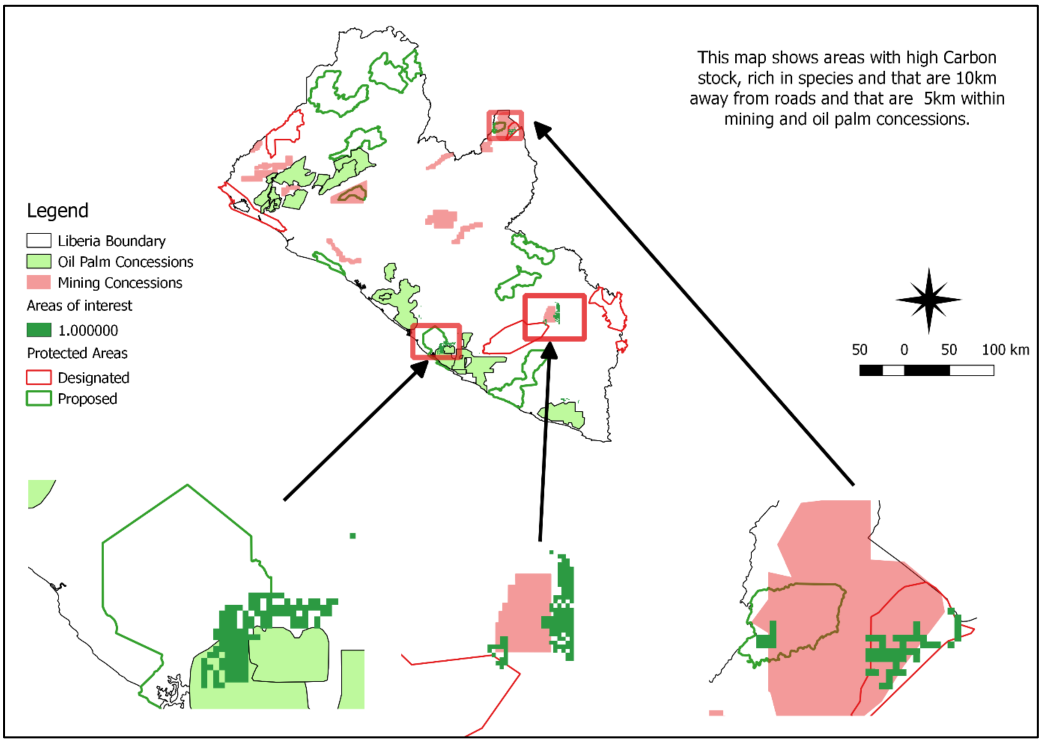


*Figure 11 Map prepared by group 2 showing areas high in carbon stock, within key biodiversity areas, within 10km from roads and within 5 km from mining and palm oil concessions.*

*Figure 12 Participants during the spatial workflow exercise*


*Figure 13 Participants while presenting the spatial workflows and final results.*

## 3. Map layouts and templates

The last 2 days of the training were also dedicated to presenting best practices in designing effective maps for policy makers, including mapping techniques, colours and symbols to be used based on the message the map wants to deliver and on the audience.

The participants worked through a tutorial for producing matrix-style legends in QGIS. A matrix-style legend is a two dimensional legend used to display two thematic wall-to-wall datasets on the same map. This graphical technique can help to visualise the relationships between two datasets and to identify areas where both variables have higher or lower values. In the case of REDD+, this approach supports the identification of suitable areas for REDD+ actions based on two benefits.

The participants were able to produce two matrix-style legend maps, one showing the relationship between deforestation risk and forest biomass (Figure 14) and a second one showing the relationship between sediment regulation and forest biomass (Figure 15).

During the last day of the training the methods to generate project and map layout templates in QGIS were also shown to the participants. The templates can then be shared within the same institution, thus ensuring that the maps produced used the same datasets, symbols and layouts. Guidelines were also distributed.

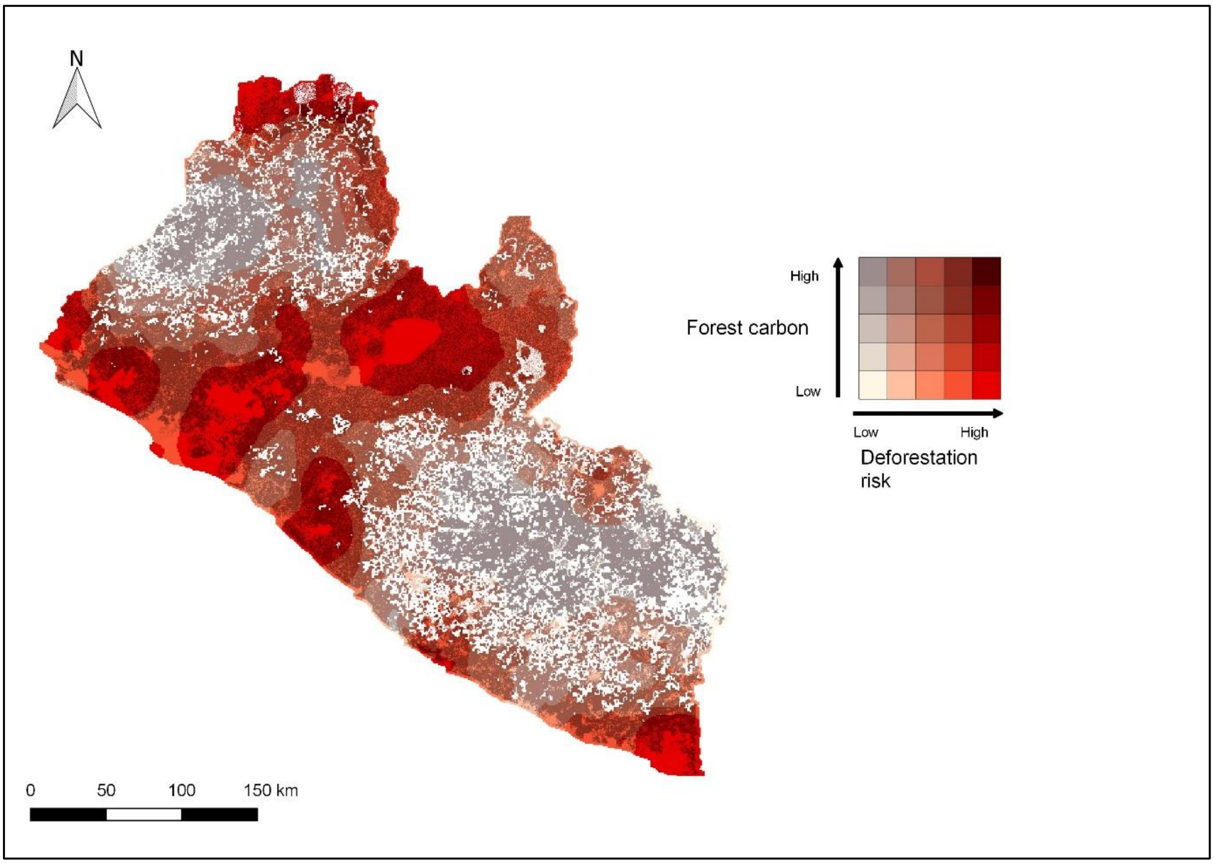


*Figure 14 Map showing the relationship between the deforestation risk and the forest biomass. As shown in the matrix legend (right) in dark red are shown areas high in carbon biomass and high in deforestation risk.*

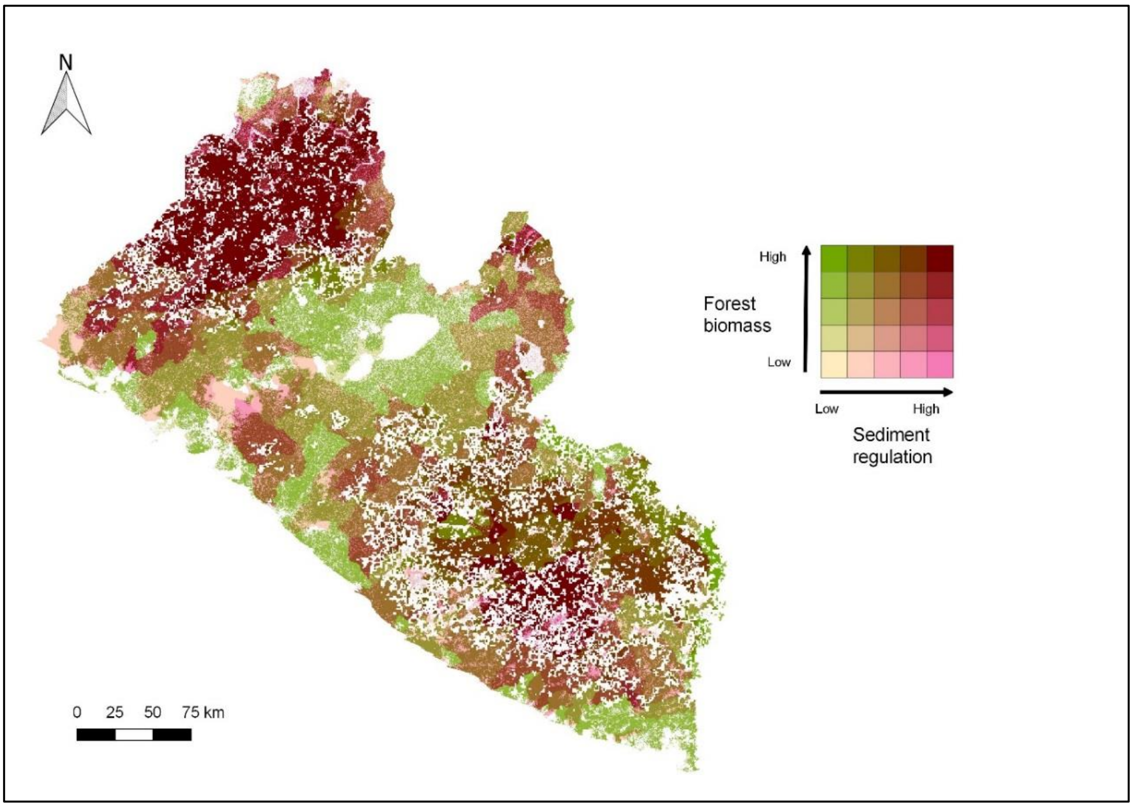


*Figure 15 Map showing the relationship between sediment regulation and carbon biomass. As shown in the legend (right) areas in dark pink are high in carbon and high in sediment regulation.*

## Feedback on the session

At the end of the working session in Tubmanburg, a training impact survey was submitted to the participants. This survey aimed to assess after 2-3 months following a UN-REDD capacity-building event how the knowledge gained in the training was used by participants. A second survey focused on the current working session was submitted to the participant the last day of the training in Monrovia.

The key results of the two surveys are discussed below by thematic areas.

**Training impact survey**

***Effectiveness of the training in capacity building to meet UNFCCC REDD+ requirements and in increasing GIS knowledge for REDD+ planning***

The UNFCCC REDD+ requirements included in the survey were: understanding REDD+ and the UNFCCC, National REDD+ strategies or action plans, Policies and Measures (PAMs) for REDD+ implementation and REDD+ safeguards.

Approximately 90% of the respondents found the event effective in building capacity to understand REDD+ and UNFCCC, as well as the National REDD+ strategies or Action Plans; whereas 80% found it effective in building capacity on PAMs and REDD+ safeguards.

More than 50% of the participants found the training very effective in increasing GIS knowledge for REDD+ planning and 36% found it moderately effective.

*Contribution for REDD+ objectives and use of the knowledge gained during the training*

More than 80% of the respondents reported that the event made a positive contribution to the REDD+ objectives or activities in the past 6 months.

Almost 70% of the respondents have significantly used the knowledge gained during the training in their work and more than 90% have shared this knowledge with colleagues. Several examples of positive environmental and institutional outcomes on REDD+ in the country thanks to the use of the knowledge gained during the working session were provided by the respondents. In particular one respondent wrote "Through this training I was able to better explain to local communities the importance of REDD+ and its benefits to the nation" and another "The knowledge gained during the training helped us validate our national datasets, so as to see hotspots that need immediate intervention".

All the answers to the last, optional, question of the survey, "If the knowledge shared during the event has not contributed to you work or to any outcome for your organization or the larger REDD+ environment in the country, what were the main limiting factors?", reported that realizing the benefits and outcomes of the event requires more time.

**Second working session satisfaction survey**

***Effectiveness of the training***

All the respondents found the event effective in increasing their knowledge for the advancement of REDD+ in the country, with 39% categorizing the training as moderately effective and 61% very effective. The overall level of satisfaction of the training show a higher percentage (82%) of the respondents reporting to be very satisfied with the event.

***Areas of knowledge improvement***

**Knowledge improvement of REDD+**

The respondents reported that their knowledge was highly improved in two areas: drivers of deforestation and forest degradation (70%) and national REDD+ strategies or action plans (78%). Only 54% of the respondents found that their knowledge on REDD+ and UNFCCC was highly improved. See Figure 16 for the whole overview of knowledge improvement areas.

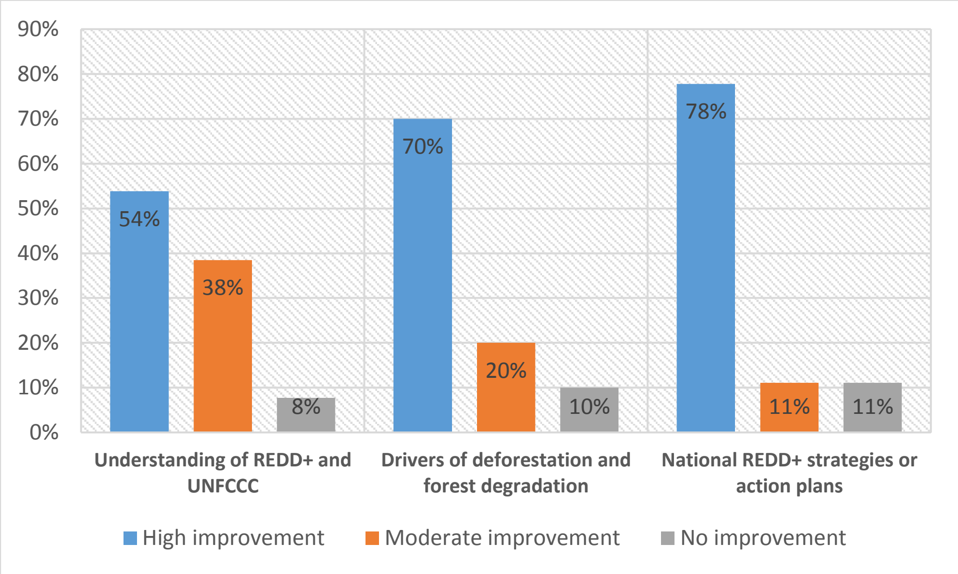


*Figure 16 Answers to the question: "How did your knowledge of the following REDD+ areas improve as a result of the event?"*

**Knowledge improvement on spatial data, GIS and spatial analyses for REDD+ planning**

Approximately 58% of the respondents found the event very effective in increasing their knowledge on spatial data, GIS and spatial analyses for REDD+ planning, and 33% found it moderately effective.

The respondents reported an improvement of their knowledge in all the GIS topics covered during the training, but the ones that were highly improved, as shown in Table 4, are "Types of data that can be used to map benefits beyond carbon" (77%) and how field data can be collected using GPSs and analyses using QGIS to validate land cover datasets (85%).

*Table 4 Detailed results for the question on "Knowledge improvement of GIS".*

| ***GIS topics*** | ***High improvement*** | ***Moderate improvement*** | ***No improvement*** | ***N/A*** |
|---|---|---|---|---|
| *How maps and spatial data can contribute to REDD+ planning* | 69% | 31% | 0% | 0% |
| *Types of data that can be used to map benefits beyond carbon* | 77% | 23% | 0% | 0% |
| *How to map current and future drivers of deforestation and forest degradation* | 54% | 46% | 0% | 0% |
| *How field data can be collected using GPSs and analysed using QGIS to validate land cover datasets* | 85% | 15% | 0% | 0% |
| *How to develop a logical workflow to undertake spatial analyses for REDD+ planning* | 69% | 23% | 0% | 8% |
| *How to use vector data in spatial analyses* | 62% | 38% | 0% | 0% |
| *How to use raster data in spatial analyses* | 69% | 23% | 0% | 8% |

All the respondents agreed that:

- Their knowledge on REDD+ preparedness and implementation increased,
- They will use what they learned during the event and that it will be useful to share that knowledge with colleagues,
- They would like to will participate again in similar knowledge exchange events and they would recommend them to colleagues or partners in the country.

***Effectiveness of the methodologies used during the working session***

All the respondents found particularly effective two methodologies utilized during the working session, "Learning from leading technical experts" (100%) and "Field visits" (100%). See Table 5 for the detailed results.

*Table 5 Detailed results for the question "Select and rate the effectiveness of the methodologies used during the event"*

| | ***In-effective*** | ***Neutral*** | ***Effective*** | ***N/A*** |
|---|---|---|---|---|
| *Learning from leading technical experts* | 0% | 0% | 100% | 0% |
| *Learning from the experience of other countries/participants* | 0% | 58% | 33% | 8% |
| *Networking with other countries/participants* | 0% | 67% | 33% | 0% |
| *Sharing and reflecting on your country's experience* | 0% | 42% | 50% | 8% |
| *Working on case studies* | 0% | 18% | 73% | 9% |
| *Group work and roleplay* | 0% | 17% | 83% | 0% |
| *Field visits* | 0% | 0% | 100% | 0% |
| *Guided discussions / knowledge cafe* | 8% | 25% | 67% | 0% |

- 83% of the respondents found that the combination of methodologies was effective and 67% assessed as excellent the balance of time between presentations, discussions and group exercises.
- 39%, 33% and 22% of the respondents suggested giving more priority to, respectively, group exercises, lecture/presentations and discussions in similar events.

***Final comments and feedback***

The main final comments provided by the respondents in both the training impact and satisfaction survey, is that there is a need for further GIS training sessions lasting more than one week. Continued GIS support to the national GIS technicians was therefore recommended.

## Annex 1 Agenda for second working session

**Tubmanburg, 23 – 26 April 2018**

| Time | Topic and activity |
|---|---|
| ***23rd April*** | |
| *14:00 – 14:15* | Welcoming remarks |
| *14:15 – 14:30* | Introduction and objectives of the training |
| *14:30 – 15:00* | Spatial data: scales, limitations and how to validate data using different tools in QGIS |
| *15:00 – 17:30* | How to prepare field surveys using QGIS. Using QGIS, *the participants will prepare survey data points data, to be used in the following days during the field exercises, and upload in the GPSs.* |
| ***24th April*** | |
| *08:30 – 17:00* | Field exercise. *In the field, the teams will collect the information (forest type, canopy cover, elevation, disturbance, signs of wildlife) in the field datasheets.* |
| ***25th April*** | |
| *08:30 – 13:30* | Field exercise. *In the field, the teams will collect the information (forest type, canopy cover, elevation, disturbance, signs of wildlife) in the field datasheets.* |
| *14:00 – 14:30* | At FTI Review and Group discussion about the data collected |
| *14:30 – 14:50* | Instructions on how to classify land cover using QGIS and field data and on the methods used to validate a dataset using field data. |
| *14:50 – 17:30* | The participants will work in teams to prepare a land cover map of the study area and to validate the Geoville forest cover map using the canopy cover data collected in the field. |
| ***26th April*** | |
| *08:30 – 13:30* | The participants will work in teams to prepare a land cover map of the study area and to validate the Geoville forest cover map using the canopy cover data collected in the field. |

**Monrovia, 30 April-04 May 2018**

| Time | Topic and activity |
|---|---|
| **30th April** | |
| *09:00 - 09:10* | Welcoming remarks |
| *09:10 – 09:30* | Recap of the first working session |
| *09:30 - 09:45* | Introduction and objectives of the training |
| *09:45 – 10:30* | Presentation on Liberia REDD+ strategy and policies and measures (PAMs) by Mr. Saah A. David, Jr. |
| *10:30 – 10:50* | Coffee/tea break |
| *10:50 – 12:30* | The participants will present the homework from last session and will report any issue encountered |
| *12:30 – 13:00* | Presentation by Joel Gamys from WRI on the Forest Atlas project and on the other GIS work carried out in Liberia |
| *13:00 - 14:00* | Lunch |
| *14:00 – 14:20* | Presentation on spatial workflows |
| *14:20 - 15:30* | The participants will be divided in teams and each team will identify a REDD+ intervention (PAM), the GIS data and the technical steps necessary (spatial workflow) to identify potential priority areas for this intervention using QGIS |
| *15:30 – 15:50* | Coffee/tea break |
| *15:50 – 17:00* | Continue the exercise |
| ***1st May*** | |
| *09:00 – 10:30* | Each team will present the REDD+ interventions to the rest of the participants |
| *10:30 – 10:50* | Tea/coffee break |
| *10:50 – 11:15* | Presentation on Great Apes Survival Partnership – REDD+ Mapping Project, followed by 10 min Q&A |
| *11:00 – 11:20* | Presentation and demonstration on the use of QGIS Graphical Modeller to create, edit and manage spatial workflows |
| *11:20 – 13:00* | Each team will use the QGIS graphical modeller (using the tutorial "Building spatial workflows to help identify potential areas for undertaking a REDD+ intervention using QGIS Graphical Modeller" as a guide) for identifying priority areas for the REDD+ action previously identified. |
| *13:00 - 14:00* | Lunch |
| *14:00 – 15:30* | Continue exercise using QGis Graphical Modeller |
| *15:30 – 15:50* | Tea/coffee break |
| *15:50 – 17:00* | Continue exercise using QGis Graphical Modeller |
| ***2nd May*** | |
| *09:00 – 10:30* | Continue exercise using QGis Graphical Modeller |
| *10:30 -10:50* | Tea/coffee break |
| *10:50 – 13:00* | Continue exercise using QGis Graphical Modeller |

| | |
|---|---|
| *13:00 – 14:00* | Lunch |
| *14:00 – 15:30* | Continue exercise using QGis Graphical Modeller |
| *15:30 – 15:50* | Tea/coffee break |
| *15: 50 – 17:00* | Continue exercise using QGis Graphical Modeller |
| ***3rd May*** | |
| *09:00 – 10:30* | Continue exercise using QGis Graphical Modeller |
| *10:30 – 10:50* | Tea/coffee break |
| *10:50 – 13:00* | Continue exercise using QGis Graphical Modeller |
| *13:00 – 14:00* | Lunch |
| *14:00 – 14:30* | Presentation and group discussion on how to present spatial information in an effective way for policy makers |
| *14:30 – 15:30* | Each team will start preparing the layout of the maps showing priority areas for their REDD+ action |
| *15:30 – 15:50* | Tea/coffee break |
| *15:50 – 17:00* | Continue working on the maps layout |
| ***4th May*** | |
| *09:00 – 10:00* | The teams will continue working on the maps layout and relative presentation |
| *10:00 - 10:50* | Each team will present the final output, explaining the logical workflow followed to the Liberia “GIS working group” |
| *10:50 – 11:00* | Tea/coffee break |
| *11:00 – 11:30* | Continue the presentation of the teams to the Liberia “GIS working group” |
| *11:30 – 13:00* | Final presentation on the GIS work carried out in Liberia: coordination and next steps. The presentation will be followed by an open discussion with Q&A |
| *13:00 – 14:00* | Lunch |
| *14:00 – 15:00* | Closing remarks |

# Annex 2 Participants list

| | Name | Contact details | Gender | Organization |
|---|---|---|---|---|
| 1 | Isaac Nyaneyon Kannah | inkteah@gmail.com | M | RIU/REDD+ |
| 2 | James Kpadehyea | jkpadehyeah@gmail.com | M | RIU/REDD+ |
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| 5 | Florence Nyumah | taiwahnyumah@yahoo.com | F | LISGIS/GIS |
| 6 | Jannie Fahnbulleh | Janfahnbulleh2010@gmail.com | M | LISGIS/GIS |
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| 9 | Uriah Garsinii | | M | LLA |
| 10 | J. Omage Paye | jomagepaye@gmail.com | M | FDA/GIS |
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| 12 | Teta Bonar | Bteta100@gmail.com | F | FTI |
| 13 | Yekeh D. Howard | yekehhoward2016@gmail.com | M | EPA/GIS |
| 14 | Lucas Knight | Lucasknight09@gmail.com | M | EPA/GIS |
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| 16 | Solomon C. Carlon | scarlon@conservation.org | M | CI |
| 17 | Daniel D. Wleh Jr | danieldwlehjr@gmail.com | M | WRI |

## Annex 3 Field datasheet

Date: Location: GPS point:

Team: Weather:

| ID GPS | UTM | | Elevation | Forest type | Canopy cover | | | | Wildlife sign | Human disturbance | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | Y | | | 1 | 2 | 3 | 4 | | | |
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