# Forest Landscape Restoration Opportunities Assessment

Mano River Union


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The present report has been developed in the framework of the cooperation between Mano River Union and IUCN for the Mano River Ecosystem Conservation and International Water Resources Management (IWRM) Project. This is a working draft document intended exclusively for the MRU Secretariat revision for the purposes of the consultancy contract between MRU and IUCN-DC. As such, and in accordance with the contract signed between MRU and IUCN for this work, this report should not be shared.

# Forest Landscape Restoration Opportunities Assessment

## Mano River Union

**Guinea, Liberia, Sierra Leone and Cote d'Ivoire**

**GEF – MRU – IUCN**

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# Acronyms

| | |
|---|---|
| AfDB | African Development Bank |
| ANADER | Agence Nationale d'Appui au Développement Rural |
| BMZ | German Federal Ministry for Economic Cooperation and Development |
| BRIDGE | Building River Dialogue and Governance |
| BRLi | Consultant Company BRLi |
| CEO | Chef Executive Officer |
| CEPF | Critical Ecosystem Partnership Fund |
| CI | Ivory Coast |
| CSO | Civil Society Organization |
| CSSL | Conservation Society of Sierra Leone |
| DFID | UK governmental Department for International Development |
| ECOWAS | Economic Community of West African States |
| ESIA | Environmental and Social Impact Assessment |
| ESMP | Environmental and Social Management Plan |
| ESMS | Environmental and Social Management System |
| EU | European Union |
| FACE | Farmers Associated to Conserve the Environment |
| FDA | Forest Department Agency |
| FLEGT | Forest Law Enforcement, Governance and Trade mechanism |
| FPCF | Forest Carbon Partnership Facility |
| FPIC | Free prior informed consent |
| FLR | Forest Landscape Restoration |
| GEF | Global Environment Facility |
| GGO | IUCN's Global Gender Office |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| GN | Guinea |
| HYCOS | Hydrological Cycle Observation System |
| IFC | International Finance Corporation |
| INDC | Intended Nationally Determined Contributions |
| ISLA | Initiative for Sustainable Landscapes |
| ISP | Institutional Strengthening Plans |
| IUCN | International Union for Conservation of Nature |
| IWMP | Integrated Water Management Program |
| IWRM | International Water Resources Management |
| KfW | German government-owned development bank |
| LB | Liberia |
| MARFOP | Mano River Forest Ecosystem Management Program |
| MINEF | Ministry of Water and Forest (CI) |
| MRU | Mano River Union |
| NAPA | National Adaptation Programme of Action |
| NBA | Niger Basin Authority |

| | |
|---|---|
| NFP | National Forest Policy |
| NGO | Non-Governmental Organization |
| NPAA | National Protected Areas Authority |
| NPCU | National Project Coordination Unit |
| OIPR | Ivorian Office of Parks and Reserves |
| OI-REN | Ivorian Observatory for Natural Resources Sustainable Development |
| OMVS | Office de Mise en Valeur du Fleuve Sénégal |
| PAAS | Project Appraisal and Approval System |
| PACO | West and Central Africa Program |
| PCMS | Project Complaints Management System |
| PGS | Project Guidelines and Standards |
| PIF | Project Identification Form |
| PNECI | National Water Partnership in Ivory Coast |
| PPG | Project Preparation Grant |
| PRE | Ecosystems Restoration Project |
| PTF | Funding and Technical Partners |
| RA | Rainforest Alliance |
| RBA | Rights-based approach |
| REDD+ | Reducing Emissions from Deforestation and Forest Degradation |
| RICCE | Rural Integrated Center for Community Empowerment |
| RPMU | Regional Project Management Unit |
| SAP | Strategic Action Plan |
| SL | Sierra Leone |
| SLBCP | Sierra Leone Biodiversity Conservation Project |
| SODECI | Water Supply Company of Ivory Coast |
| SODEFOR | Forest Development Company (CI) |
| STEWARD | Sustainable and Thriving Environments for West African Regional Development |
| TDA | Transboundary Diagnosis Analysis |
| ToR | Terms of references |
| UNEP | United Nations Environment Program |
| USAID | United States Agency for International Development |
| WA-BiCC | West Africa Biodiversity and Climate Change |
| WB | World Bank |
| WCF | Wildlife Conservation Fund |
| WRCU | Water Resources Coordination Unit |

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# Foreword

The GEF-funded “Mano River Ecosystem Conservation and International Water Resources Management (IWRM) Project” targets the Upper Guinea forest covering Côte d’Ivoire, Guinea, Liberia, and Sierra Leone. All four countries are interested in integrated water and forest resources management approaches that are sensitive to the livelihood needs of their population.

The Mano River Union (MRU) project aims “to strengthen transboundary natural resource management for sustainable ecological benefits and improved livelihoods for adjacent forest communities”, through supporting local communities in developing alternative sources of income to facilitate sustainable management and related benefits of natural resources at local, national, regional and global levels (ecosystem services, biodiversity, carbon sinks).

The project has two components: Component 1 – Integrated Forest Management; Component 2 – Sustainable Management of Transboundary Waters. For Component 1, the MRU Project selected the Restoration Opportunities Assessment Methodology (ROAM) to identify and prioritise landscape restoration opportunities for sustainable forest ecosystem management and landscape restoration. The outcomes of ROAMs at national level were intended to provide the basis for the development or enhancement of national strategies on landscape restoration, and provide inputs to land use plans and livelihood strategies at local scales.

This MRU-level transboundary ROAM report gathers and builds on the individual Activity Reports submitted by national consultants for ROAM processes carried out in each country. The core activities of ROAM under this project depend on the consultative stakeholder-driven approach, and the collection and analysis of local data by national consultants hired by the National Committee in each of the four MRU countries. To restore forest ecosystem services, conserve biodiversity and increase the resilience of the local livelihoods, ROAM aims to identify, analyse and locate specific areas of FLR opportunities based on a spatial multi-criteria analysis. The process is based on multi-stakeholder participatory approach driven by the local context and priorities of the landscapes under analysis.

Although the project covers the four countries of the Union, the MRU-level ROAM focuses on a coherent transboundary approach for the restoration of degraded landscapes and sustainable forest management. The process has identified and made recommendations concerning forest landscape restoration (FLR) opportunities at four transboundary sites. FLR seeks to provide social, economic and environmental benefits through the promotion and sustainable use of forests and tree crop resources, strengthening the role of forests in poverty alleviation and livelihoods, while ensuring that the ecosystem values on which it is based are maintained.

The action plan provides a basis for planning and administration and a draft rationale and framework for investment in FLR by governments, partners and other

stakeholders. Objectives of national government forest department strategies are implicitly included in the action plan through a shared framework of expected results.

# Executive summary

The following is based on findings and recommendations of national reports on the assessment of forest landscape restoration opportunities prepared by national consultants and of the four countries of the Mano River Union during the period 2018-19. These are hereby summarized and synthesized with updated land use information and multi criteria spatial information at the trans-boundary level.

The principal overall threat to the forests is identified as conversion of land to agriculture, with logging and charcoal production playing a more significant role in and around Gola (Liberia). Drivers related to climate change in the two northern most sites again are agriculture related, including the seasonal use of fire to clear land for subsistence farming and the loss of native forest and plant species.

The total area of FLR opportunity identified at all sites is calculated as follows:

| Site | FLR Opportunity Area (Ha) |
|---|---|
| Gola | 55,400 |
| ▪ Gola Liberia | 6,205 |
| ▪ Gola Sierra Leone | 49,194 |
| Diecke / Nimba complex (all) | 93,000 |
| Wonogizi – Ziama (all) | 76,682 |
| Sapo - Grebo | |
| Total | 225,082 |

The proposed principal FLR actions are different models of agroforestry, various levels of intercropping of cash crops with native tree species to assisted natural regeneration (ANR) or ensuring natural forest is ‘set aside’ where local levels of forest protection and safeguards need to be effective enough to prevent land clearance.

A mixed agroforestry model that builds on existing community knowledge of the local forest resources will also include cultivation of cash commodities and propagation of fast-growing multipurpose native tree species to produce both fruit and timber. Success in expanding the mixed agroforestry model will require an adequate and effective level of external support to farmers that includes inputs (provision of seed, seedlings, knowledge) and market advice.

FLR through assisted natural regeneration (ANR) will involve establishment / propagation of selected existing species in degraded land through enrichment

planting. ANR should be done in such a way as to join together and restore patches of degraded forest into larger spatial units. Both agroforestry models will benefit in practice by implementation through a collaborative multi-stakeholder engagement between local government, local communities and transnational partners.

Potential risks include inadequate support to local stakeholders / farmers in crop establishment, outbreaks and incidence of crop pests (e.g. cacao leaf rust) uncontrolled or unregulated expansion of cash cropping and expansion into the natural forest. Poor understanding of market factors or policy formulation, where cropping may be negatively impacted by governance mechanisms, policies and laws may contribute to negative outcomes. Local regulations and agreements may require a consultation platform for all stakeholders.


*Figure 1 Location of the four transboundary forest sites in relation to forest and major river basins*

# 1 | Background

Three of the four countries in Mano River Union have committed to restore collectively eight million hectares of degraded and deforested lands in the framework of the Bonn Challenge.[1]

The report examines evidence from consultations with stakeholders and makes recommendations to support FLR as a shared strategy for **Wonigizi –Ziama, Diecke-Nimba, Gola, Sapo-Grebo-Tai,** four forested landscapes spanning national boundaries of the Mano River Union countries.

This MRU-level transboundary ROAM report gathers and builds on the individual Activity Reports submitted by national consultants for ROAM processes carried out in each country. The core activities of ROAM under this project depend on the consultative stakeholder-driven approach, and the collection and analysis of local data by national consultants hired by the National Committee in each of the four MRU countries. However, issues on the application of the methodologies and incompatibilities in the information prevented some local level data, so the present MRU-level transboundary ROAM report was developed with available information. The intended standardisation of the methodology and data used across all four landscape allow for the comparison between the different transboundary forest landscapes, as well as a prioritisation based on the same criteria.

Multi criteria spatial analysis methods are used to identify and prioritise potential FLR opportunities at the trans-boundary forest sites

The report further builds on and references findings detailed in the individual national reports prepared during 2018-19 by national consultants (i.e. the 'national' ROAM activity reports) submitted to IUCN and the MRU Secretariat following fieldwork and site visits.

The present report integrates and compiles facts and information from the national ROAM activity reports that were obtained by consultation and participation in the field. Multi criteria spatial analysis is used to more precisely quantify and locate the extent of restoration opportunities and thus enable the next stage, financial planning and budgeting requirements of priority FLR interventions, to take place.

Fig 1 shows the 4 trans-boundary forest sites in relation to forest and the principal river basins of the Mano River Union. With the exception of Grebo/Tai (in the Cavally basin) the sites are also multi-basin, (i.e. spanning multiple river basins) with Wonegizi-Ziama and Diecke / Nimba located in the upper headwaters of catchments.

The project involves two components, sustainable management of forests and management of international waters shared by the countries of the Union. In the

[1] The three countries are Cote d'Ivoire, which committed to restore 5 million hectares; Liberia to restore 1 million hectares; and, Guinea to restore 2 million hectares. For more information: https://infoflr.org/countries

management of forest ecosystems, the development of agroforestry aims to restore the functionality of degraded forest ecosystems, promote forest-friendly agriculture, to generate various products and services from the land and forests restored, and protect habitats and wildlife corridors. These activities will be based on different forms of tree systems to solve the various problems linked to the degradation of ecosystems. To provide lasting and natural solutions to the phenomenon of forest landscape degradation, the project intends to ensure the participation of local communities and other local actors. This participation ranges from the identification of the factors of deterioration to the appropriate FLR interventions allowing the reversal of the trend, identifying the precise places where these interventions must be carried out.

## 1.1 FLR Objectives

The MRU-level transboundary ROAM defines two principle FLR objectives: to conserve biodiversity and restore ecosystem services; and improve livelihoods of local communities in the MRU transboundary landscapes. The outcomes from the ROAM process will help to develop or enhance national strategies on landscape restoration and provide inputs to land use plan and livelihoods strategies at local scale in the MRU-level transboundary landscapes.

The approximately 250,000 hectares of FLR opportunity identified in this study, represents 3.2% of the collective total of 8 million hectares of degraded land that the three Mano River signatory countries (except Sierra Leone) have committed to start restoring by 2020 under the Bonn Challenge agreement. Although this is only a small percentage of the total restoration commitment, the FLR opportunity especially in relation to safeguarding high conservation value and biodiversity rich transboundary forest landscapes whilst improving local livelihoods makes it particularly significant.

The principle of the Bonn Challenge is adoption of the FLR approach for degraded land, which will restore ecological integrity and at the same time improving human well-being by re-establishing multifunctional landscapes.

## 1.2 Drivers of Deforestation and Land Degradation

The individual national reports provide a rich and varied source of detailed information, explanation and local analysis on the local drivers of forest loss, land use change and degradation. With the possible exception of Gola (Liberia) national reports all identify land clearance for smallholder farming as this single most important primary driver of deforestation and land degradation. In Wonegizi the threat is reported to be intensifying as the extensive manner farmers produce subsistence crops, and shorter fallow cycle of shifting cultivation results in increasingly large areas of forest loss.

The information has been obtained either directly from on-site meetings with individuals from communities living in or near the protected areas or within the

notional 5 kilometre buffer distance to the PA boundary being proposed as a protection zone within which the FLR interventions will take place. To avoid repetition, only the main common conclusions from data in the national reports are reproduced here.

The following factors driving deforestation and degradation are cited in the national reports in descending order of importance:

- Expansion of smallholder agriculture and cultivation of ash crops – cocoa, rubber (Ziama)
- Small scale subsistence farming (Wonegizi – Ziama, West Nimba) shifting cultivation, swamp rice.
- Commercial farming with estate crops including palm oil (Diecke)
- Mining (Gola SL, Gola Liberia) of alluvial diamonds and gold
- Timber extraction and logging (Gola SL)
- Charcoal production
- Construction
- Road building

Although producing a large volume of important information gathered from local stakeholders, the national reports were somewhat less effective at linking the reported information to spatial data on degraded land in a way to ensure that potential FLR interventions can be quantified and prioritised on the basis of reliable evidence-based data. This is especially important when the sites are in close proximity and separated only by national borders.

The multi criteria spatial analysis (MCA) process of the Restoration Opportunities Assessment Methodology (ROAM) attempts to identify FLR opportunities in relation to a number of physical and if possible socioeconomic conditions. As consultants carried out this analysis exclusively within their own national area the spatial outputs are inevitably inconsistent at the trans-boundary level and cannot easily, if at all, be brought together as a whole for the entire continuous landscape. In an attempt to resolve this, land use mapping with recent satellite imagery has been used to identify the extent and location of loss and degradation, and recognize where FLR has the best opportunity of produce results and the highest potential of addressing challenges to success.

## 1.3 Theory of Change

The expected changes will result from implementing the vision of communities within the 5 km buffer zones adjacent to the protected areas in which deforested and degraded sites will be rehabilitated with cash/tree crops that will yield both ecosystem and direct economic benefits for communities, improving livelihoods. Also prioritized is protection of rivers and streams as sources of fresh water by maintaining tree cover on river banks to limit erosion, soil loss and preservation of water quality.

The expected outcome of FLR, a vision typically shared by local and state government agencies, is that of returning the land to a natural level of ecological balance, including the rehabilitation of abandoned mines and other land that has been degraded. The conditions for this to take place require a cohesive community vision and a responsive, functional enabling environment facilitated by the various national agencies.

FLR interventions at the MRU-level are envisioned as an interrelated package of community led activities that include:

i) Local development of multipurpose agroforestry and silvicultural practices, including cash cropping of cocoa, rubber, and palm oil, and local timber species (i.e. Inga) within natural forest and in relative proximity to settlements and roads.

ii) Efforts to link and unite the remaining islands of degraded and intact (relict) natural forest into larger blocks, carrying out enrichment planting and reseeding tracts of degraded forest with a mix of native tree species.

The expectation is that local markets exist for cash crops and agroforestry products that will drive and sustain the reforestation process in the long term.

Unique challenges exist implementing FLR in trans-boundary landscapes, where harmonization and coordination of activities is beneficial to neighbouring communities who may have different customs and local official regulations. An explicit FLR strategy document may be required, developed as a set of specific land-use agreements, to provide overall guidelines concerning what local laws, policies, and regulations are involved in the FLR process.

### 1.4 FLR in the MRU Countries

Assessment of forest change over time data 2000-2018 (Hansen study) and the detailed LULC mapping made in this study indicate by far the biggest challenge to the Union in maintaining and restoring degraded forest land arises from the progressive and sustained rate of conversion of forest to agriculture.

The solution to the FLR challenge in mitigating loss of forest cover, habitat and biodiversity lies in supporting creation of local livelihoods based on a feasible and economically effective agroforestry system that produces a diverse range of goods and brings multiple benefits to the communities.

Pledges made to the Bonn Challenge by the MRU countries indicate strong political will to address these challenges and demonstrate commitment to the voluntary and international agreements that support FLR.

# 2 | Multi-criteria Spatial Analysis of FLR

The MCA process is concerned with integrating geospatial data to identify opportunities and develop appropriate strategies for FLR. The relative value of MCA as a planning tool is highly reliant on data accuracy and an adequately high level of

detail is essential to produce results that are a true representation of reality and can be put into practice locally. The land inventory, prepared as a land use / land cover map (LULC) is usually the single most important thematic input to this process and it is expected to be an accurate account of the physical landscape, in particular the level of current human impact or use. Changes in LULC can occur very rapidly and for three of the four sites, after a review of the LULC used in the MCA produced in the national reports it was deemed necessary to prepare new land cover maps using high resolution satellite data to produce a more current and realistic representation of the current land use situation. However, most other spatial data typically used in a ROAM were not available at this detailed level, requiring use global datasets on soils, slope, erosivity, and erodibility as the only available solution.

Lack of detailed spatial data on local socioeconomic conditions was a further limitation, making the MCA results driven mainly by the geophysical factors.

### Data sets available for multi criteria spatial analysis in the ROAM process

An essential first step in formulating a logical and targeted plan for reforestation, the MCA relies on availability of accurate spatial data at a scale appropriate to the area being evaluated. The combined total area of just 20,000 km2 for all 4 of the transboundary forest sites meant use of low resolution gridded global data sets for MCA at smaller sites such as these, risks producing over generalized results that lack sufficient necessary detail needed to produce meaningful FLR results that are locally relevant. The multi criteria spatial analysis is an essential part of the ROAM process and the procedure by which land degradation is evaluated and restoration opportunities can be identified and justified. Finally, the MCA is expected to produce reliable estimates of land areas for restoration interventions. Some of the data sets are used as a proxy for degraded land in for the MRU-level transboundary ROAM process: specifically, soil erodibility, rainfall erosivity, and soil cation exchange capacity (as an indicator of poor fertility, and therefore degradation). After combining all the thematic data and MCA analysis, the next stage involves evaluation and preparation of realistic investment costs for approval and eventually implementation.

The FLR opportunities are identified only within the 5-kilometre buffer area adjoining the boundary of the protected area. According to the current boundaries measured against the LULC mapping, nearly all the 4 protected area sites include sizeable areas of cultivated land within the protected area boundaries, from a high of 9,647 hectares (10% of the whole PA) in Ziama to 371 hectares (0.5%) for Gola PA in Liberia. It is assumed that within the PA, reforestation opportunities (e.g. change from smallholder agriculture to agroforestry, silviculture, etc.) are much less contingent upon participatory processes and consultation than in land beyond the PA in the buffer zone and are therefore far easier to implement.

*Table 1 Cultivated and other land use types occurring within each of the protected areas (February 2020).*

| Protected Area | Cultivated Land | Old fallow Land | Swamp Rice | Village | Rubber | Oil Palm | Totals (Ha) (%) |
|---|---|---|---|---|---|---|---|
| Ziama PA | 5,842.60 | 2,949.50 | 522.9 | 137.9 | 221.5 | | 9,674.4 |
| % of Ziama PA | 6.5 | 3.3 | 0.6 | 0.2 | 0.2 | | 10.8 |
| Wonogizi PA | 2,299.90 | | | 6.4 | | | 2,306.3 |
| % of Wonogizi PA | 6.1 | | | 0 | | | 6.1 |
| Gola NP Sierra Leone | 188.3 | 171.7 | 11.8 | | | | 371.8 |
| % Gola SL | 0.3 | 0.2 | 0.0 | | | | 0.5 |
| Gola PA Liberia | 464.9 | 726.6 | | | | | 1,191.5 |
| % Gola L | 0.5 | 0.7 | | | | | 1.2 |
| Diecke PA | 4,382.70 | 547.3 | | 3.9 | | 71 | 5,004.9 |
| % of Diecke PA | 7.4 | 0.9 | | 0 | | 0.1 | 8.4 |
| M. Nimba PA (Guin) | 103.1 | 384.9 | | | | | 488.0 |
| % M. Nimba PA (Guin) | 0.7 | 2.6 | | | | | 3.3 |
| W Nimba PA (Lib) | 1,780.60 | 942.5 | | | | | 2,723.1 |
| % of W Nimba PA (Lib) | 17 | 9 | | | | | 26.0 |
| E Nimba PA (Lib) | 289.4 | 26.6 | | | | | 316.0 |
| % of E Nimba PA (Lib) | 2.2 | 0.2 | | | | | 2.4 |
| M. Nimba PA (CD) | 33.8 | 0.1 | | | | | 33.9 |
| % of M. Nimba PA (CD) | 0.7 | 0 | | | | | 0.7 |

indicates how some of the nominally protected areas in fact contain significant areas of cultivated land, ranging from 0.5 % of the entire area (Gola Sierra Leone) 10 % (Ziama) to as much as 26% (West Nimba, Liberia).

As land with protected legal status enshrined in law, it is assumed that planning forest restoration within the Protected Areas themselves will take place under the direct control of the relevant authority, whether by natural regeneration or reseeding, and not as part of any externally supported project activity.

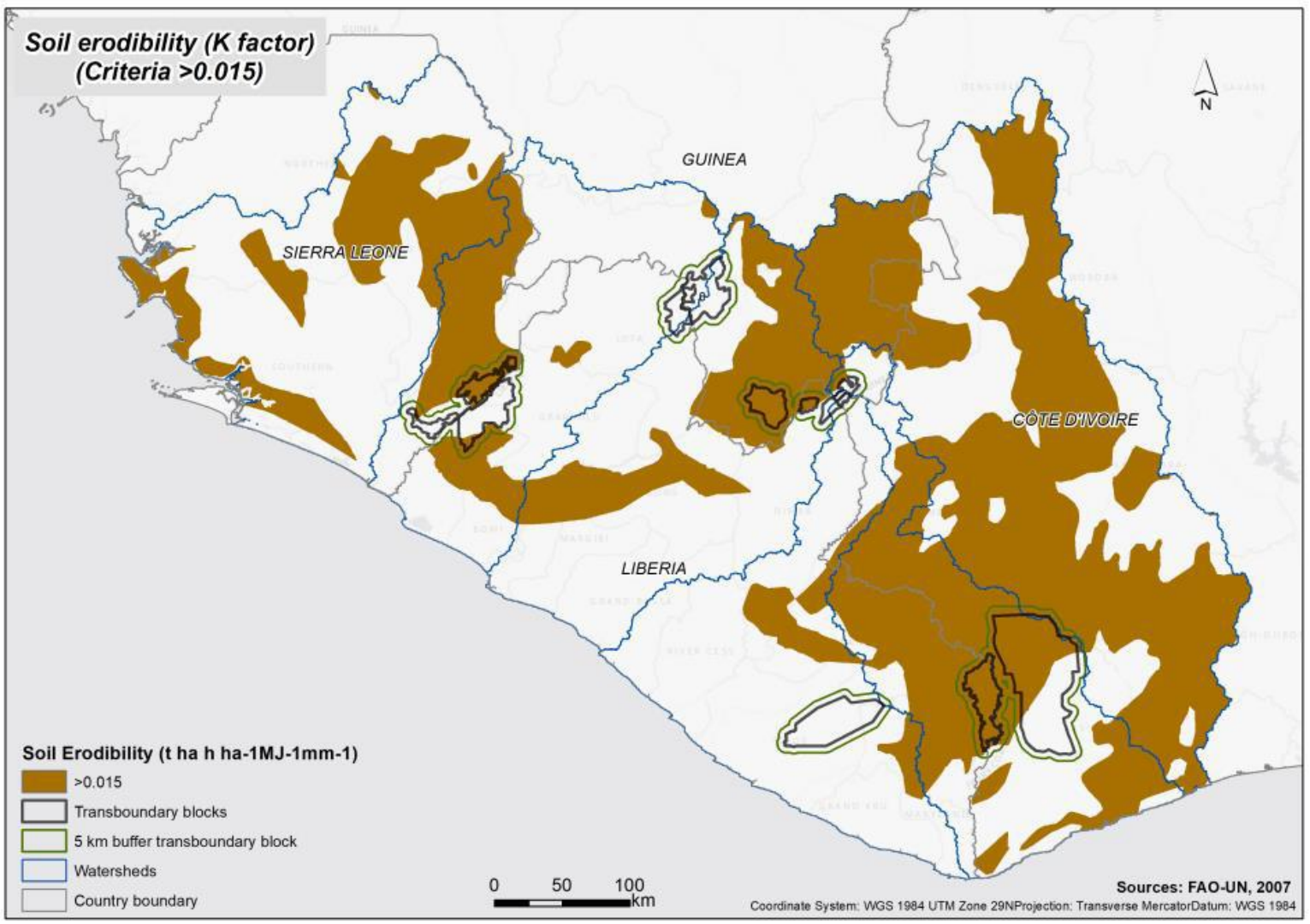



*Figure 2 Four transboundary sites and soil erodibility > 0.015 tonnes/ha (K factor)*

Some global datasets from the previous IUCN study (loss of canopy cover, burnt area, biodiversity intactness index) were not used in the spatial multi criteria analysis, either as they were replaced entirely (e.g. by the up to date LULC map) or because there was no significant local variation in the data at all within the 4 target areas, such as in the example of Gola (Figure 3), entirely within the area of high rainfall erosivity, or Wonegizi-Ziama, outside areas of high soil erodibility (Figure 2).

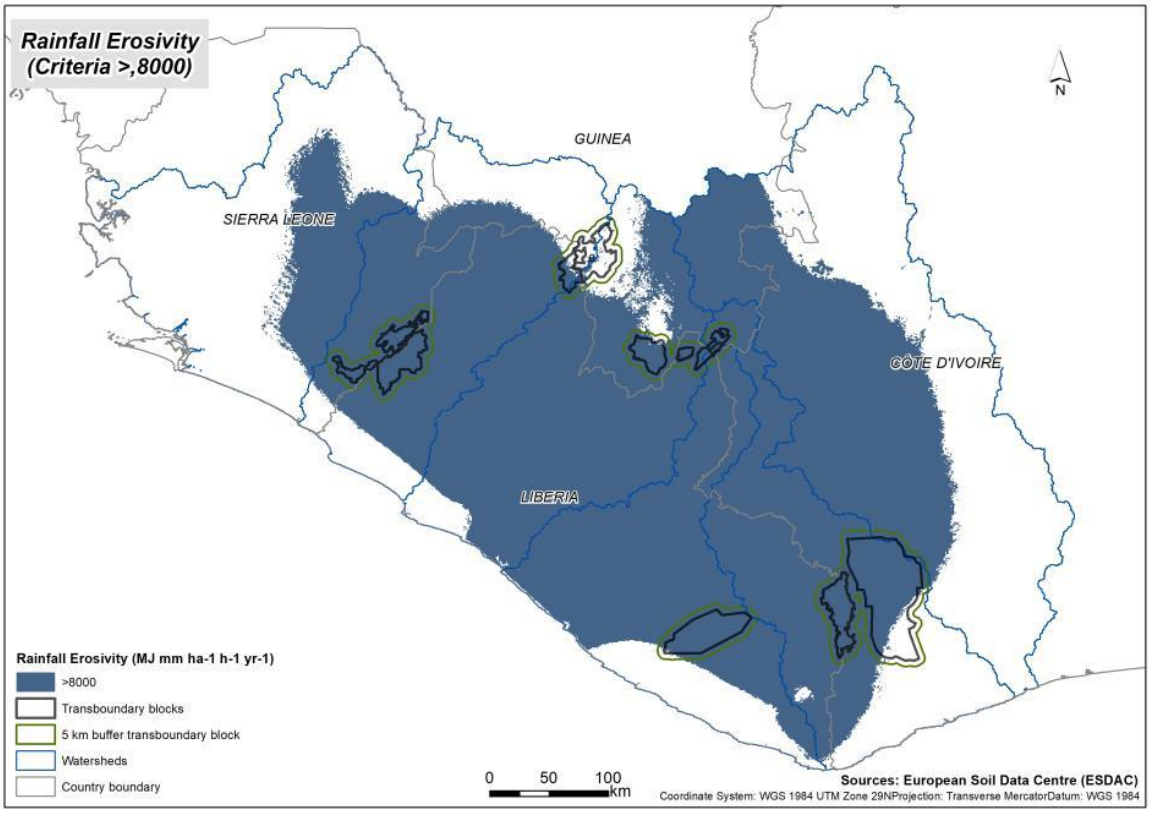



*Figure 3. Four transboundary sites and high rainfall erosivity (R >8,000)*

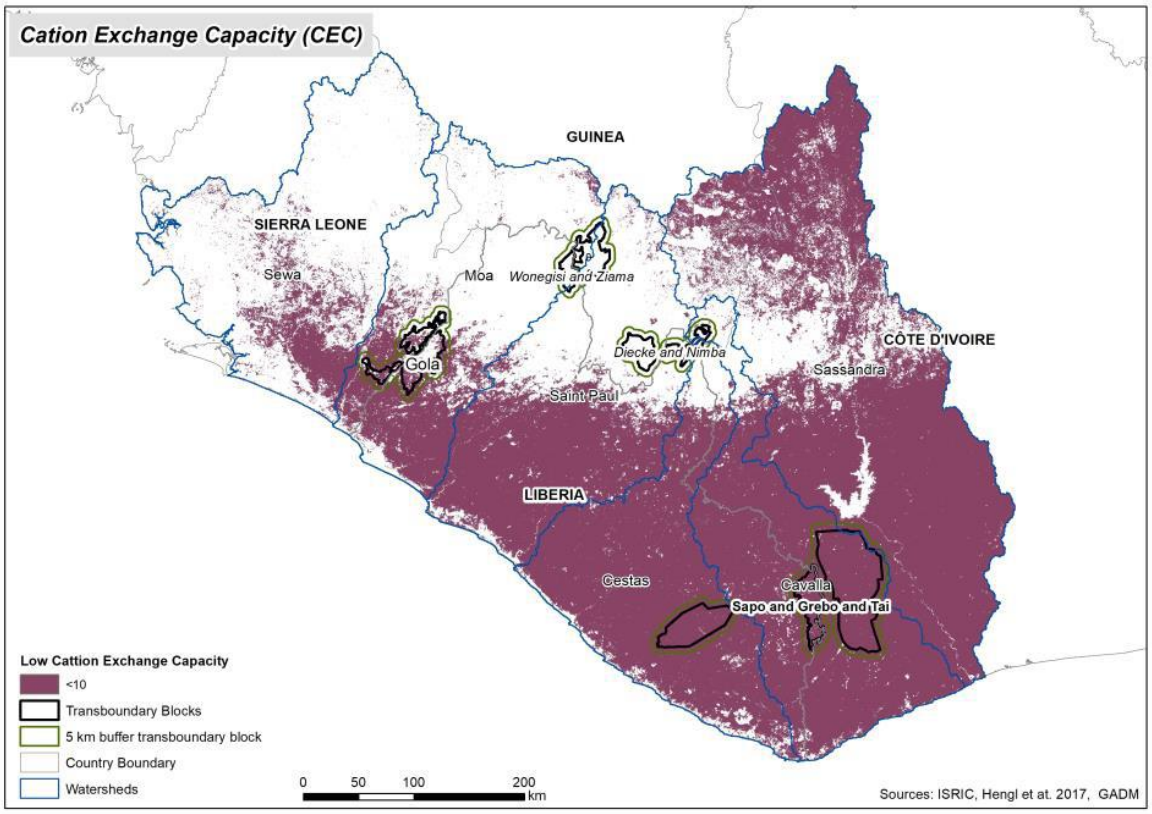


*Figure 4 Low Cation Exchange capacity – a proxy for land degradation. < 10*

## Updated February 2020 Land Use / Land Cover Maps

A fundamental requirement of the ROAM process is an up-to-date and accurate LULC map of the FLR assessment area, to be used with other spatial data in the MCA, as a basis for formulating the factual and logical basis for FLR proposals. For all the 4 MRU sites, with varying degrees, the data LULC available to and used by the national MRU studies is inadequate in effectively identifying FLR opportunities because when compared to a current satellite image it quite significantly misrepresents the actual land cover.

Land use maps have been prepared for three of the four sites based on cloud free ESA Sentinel 2 10m resolution data imaged in February 2020. The 10m image resolution is just high enough to resolve medium to large individual tree crowns, a substantial improvement in the use of data at lower resolution (i.e. Landsat) in addition to providing a necessary level of accuracy.

LULC data used in some of the national reports (Sierra Leone, Gola) are of much lower accuracy than others and with the exception of data used for Liberia sites (source: FDA REDD preparedness, satellite data from 2011) little at all can be known of the origin of these data, or their fitness for purpose in supporting FLR planning at a detailed level.

Image segmentation of cloud free Sentinel 10m imagery, cross-checked against Google Earth (as a proxy for field checking) was used to produce the LULC maps of the Wonegizi-Ziama, Gola and Diecke-Nimba-Mont Nimba sites used in this report.

Visual allocation of land use types to polygons using Google Earth as ground truth was used to rapidly prepare land use maps for three of the four MRU sites with 13 classes. Table 2.

*Table 2 Categories used for Wonigizi-Ziama, Gola and Diecke-Nimba LULC Maps*

| | LULC type | Description |
|---|---|---|
| 1 | Closed Forest | Undamaged mainly closed natural forest |
| 2 | Degraded Forest | Land with large fraction of remaining residual trees |
| 3 | Cultivated Land | Agricultural land, active shifting cultivation |
| 4 | Fallow Land | Dormant agricultural land, no evidence of cultivation |
| 5 | Rock | Permanent bare land |
| 6 | Rubber | Rubber Plantations |
| 7 | Village | Settlements |
| 8 | Grassland | Natural grassland and savannah |

| | | |
|---|---|---|
| 9 | Oil Palm | Oil Palm Plantation |
| 11 | Water | Rivers, lakes |
| 12 | Tree Crops | Undetermined tree crops |
| 14 | Mining Debris | Bare soil, grassland and fallout from mining operations |
| 16 | Swamp Rice | Valley bottom rice |

### Land Use Classes

Harmonisation of LULC data over both sides of the international border allows for standardisation of FLR opportunities and synergies in interventions and the FLR responses to these. Classes 2, (degraded forest) 3, (cultivated land) 4 (fallow land) and 14 (Mining debris - see

) are the main LULC categories in which FLR is likely to take place.

Degraded forest is evident and visible from a large amount of tree cover that can potentially form the basis for landscape restoration by natural regeneration alone or combined with enrichment planting. Note that in this case land is directly identified as 'degraded' from the presence of trees and plants (from former complete forest cover), rather than the implied or inferred degradation in ROAM which uses physical parameters (i.e. slope, soil cation content, erodibility or rainfall erosivity) as a proxy.

While there is a level of subjectivity involved in identifying and defining degraded forest on satellite imagery, the important feature is the visible presence of trees crowns and the 10m resolution of Sentinel imagery enables this.

Cultivated land is evident as bare soil or land with a smooth texture, indicating either presence of a planted bare field, or growing crop on the ground.

Fallow land is visible as land with some trees and bushes present, distinct from cultivated land by a rougher texture.

## 2.1 Wonegizi- Ziama

Overview of Site

The Wonegizi-Ziama site is located on the agroecological margin between the high rainfall forested landscape to the south and the drier savannah type grassland to the north. While there is ambiguity concerning the boundary of the PA on the Ziama side, both of the current PA boundaries should be subject to critical review as they are inconsistent with actual land use on the ground, with large forest areas beyond and large areas of agricultural land within the assumed boundary.

The national reports record a long history of partnership between Liberia and Guinea collaborating on transboundary land use issues in and around the Wonegizi-Ziama landscape

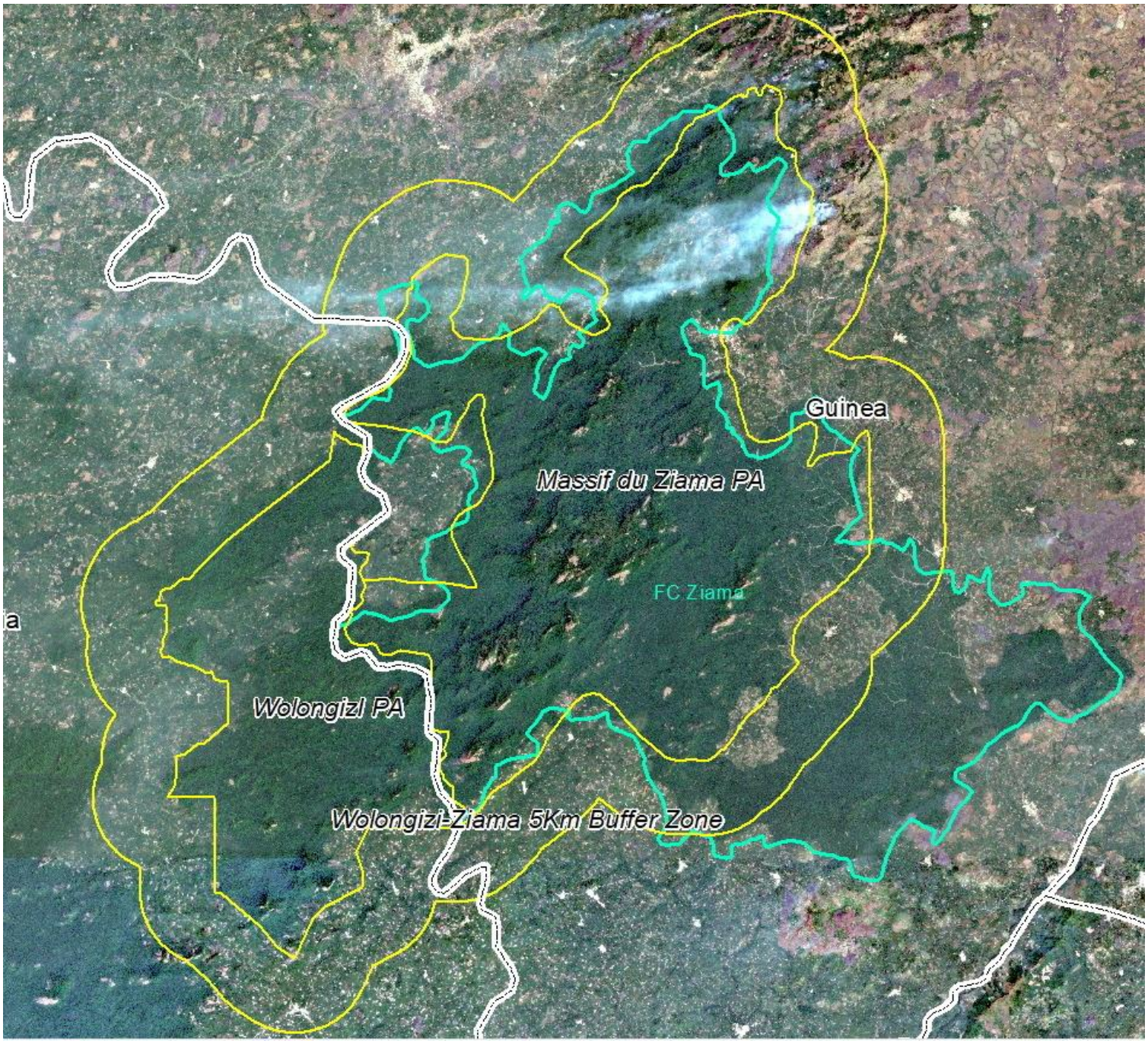



*Figure 5 Wonegizi–Ziama Landscape, PA and 5km buffer showing the WDPA boundary used (yellow) for this study and the possible alternative boundary (green) used by Guinea, which (unlike the WDPA) appears to include all forest in the landscape, and two enclaves of Boo and Baimany (Figure 6)*

*Image: Sentinel 2, 20 February 2020 used to produce LULC data.*

## Boundary Issues

There is uncertainty on the Guinean side concerning the actual legal boundary as the national consultant report uses a boundary that is significantly different to that in the WDPA and in the original GEF project document, identifying core, intermediate (tampon) and buffer zones (Figure 6). This MRU-level transboundary ROAM report adheres to the boundary reported in the project document as being legally authoritative.

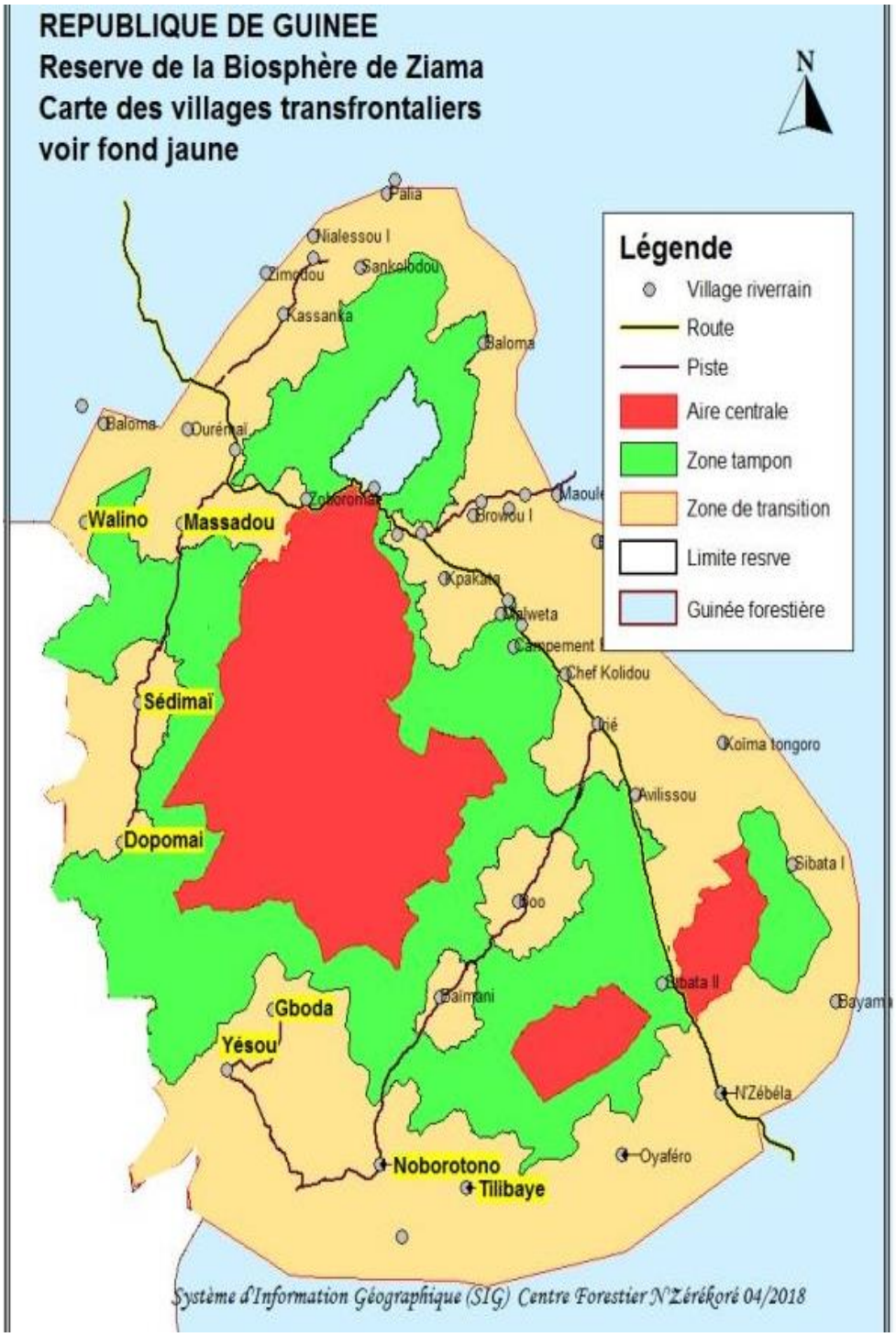



*Figure 6 Rapport De Mise En Place Des Co Mites Consultatifs Locaux Des Paysages De Ziama-Diecke- Monts Nimba. (Rapport de mission CCL p15)*

## Wonegizi (Liberia) National Report – FLR Opportunities

The Wonegizi national report describes the commitment of local stakeholders to bring at least 3000 ha of degraded/deforested land under restoration over a period of five years and identifies three principal restoration intervention strategies for the 5k buffer area outside the Wonegizi PPA as follows:

1) Assisted natural regeneration with indigenous species, on degraded land, secondary forests, old and young fallow land. Planting of medicinal and timber species on stream banks, and steep slopes. Two components – reforestation of degraded natural forests and stream bank protection.

2) Development of Oil Palm and Cocoa, Coffee and or Rubber tree crops with at least 10% indigenous trees on degraded old and young fallow lands occurring between towns, villages and other settlements. Investments and labour requirements require tree crops need to be within an accessible distance to village and road access to transport crops to markets.

3) Assisted Natural Regeneration through enforcement of Laws and By-Laws. Fewer less intensive (if any) actions involves restoration of degraded areas at long distances from villages.

*Table 3 Summary of FLR options (extract from Wonegizi national report)*

| | FLR opportunities Wonegizi | Restoration Options/Interventions | Locations |
|---|---|---|---|
| 1 | Degraded old and young fallow lands occurring between towns, villages and other settlements within 5 km of the Wonegizi PPA; | Assisted Natural Regeneration, Afforestation/Reforestation with indigenous fruit, medicinal and timber species | locations (further from villages and nearer to PPA); that, these should comprise indigenous species with timber, fruit and medicinal value; that priority should be given to slopes, river/stream banks and/or areas likely to impact services downstream. |
| 2 | Degraded old and young secondary forests occurring between the Wonegizi PPA; and close to the border between Liberia and Guinea; | Agroforestry systems development preferably based on hybrid Oil Palm and Cocoa; Coffee and or Rubber development, interspersed with 10% indigenous trees. | Land with easy access from villages and by road |
| 3 | Degraded and degrading water heads, stream/river banks and other fragile | Protection by state law or By-Law enforcement, Assisted Natural | fragile areas such as water heads, degrading or degraded stream and river |

| | | | |
|---|---|---|---|
| | areas in both zones of agricultural mosaics nearer to communities) and in widescale (nearer forests) restoration areas. | Regeneration and selective cultivation of indigenous fast colonizing species. | banks; both in mosaic restoration and wide scale areas |

## Ziama (Guinea) FLR opportunities

The Ziama (Guinea) national report identifies 5 village areas (Sedimai, Kpoda, Massadou, Yezou, Noborotono) each of which are divided into zones with the same restoration interventions as Wonegizi of natural regeneration, agroforestry and silviculture. The interventions are determined according to prevailing local physical factors, with land on steep slopes with high levels of rainfall targeted for reforestation and silviculture, and agroforestry on shallower slopes with lower rainfall intensity.

The total land area of the 5 villages, nearly 20,000 hectares, is actually closer to 15,000 Ha as the village boundaries in the report includes both 3,500 hectares of land lying beyond (outside) the nominal 5km buffer distance and 2,515 hectares of land which is inside the PA boundary itself. As mentioned above, location and area of land for FLR is potentially ambiguous as there appear to be different boundaries defined for the protected area

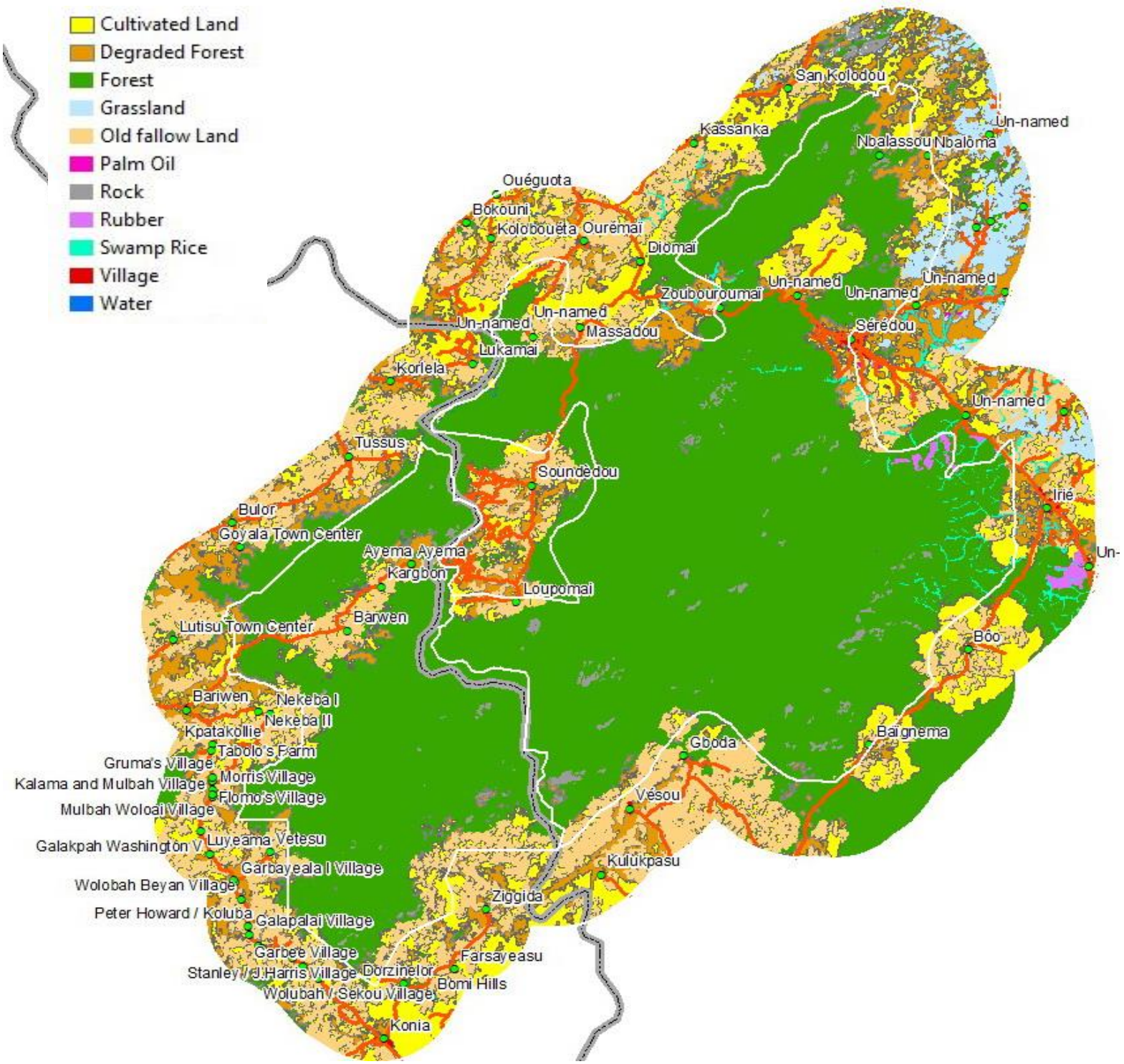



*Figure 7 Wonogizi-Ziama Land Use / Land Cover from Sentinel Imagery date 20.02.2020*

### 2.1.1 Wonegizi-Ziama - Current land use

Figure 7 shows the 02.2020 LULC map resulting from image segmentation of the cloud free Sentinel 10m image (Figure 1) The result was cross-checked against Google Earth to produce a current land use land cover of the Wonegizi-Ziama Landscape that can be used to effectively measure degraded land. The same method was used to produce the result for Gola and Diecke-Nimba-Mont Nimba. Visual allocation of land use types to polygons using Google Earth as ground truth was used to prepare land use maps for three of the four MRU sites with 13 classes.

The 'degraded forest' (class 2) is defined land that has until recently been forested and still contains a significant proportion of residual tree cover that could form a viable basis for forestry, whether as enrichment planning with indigenous fast-growing tree species or as multi-purpose tree crops inter-planted with indigenous trees or mixed agroforestry.

The 'fallow land' (class 4) seeks to identify land not currently used for continuous agriculture for food production. Some form of mixed agriculture / tree cropping system could be proposed for these areas without replacing or competing with land used currently for food crops.

*Table 4 Current Land Use (Feb 2020) within the entire Wonegizi-Ziama Landscape (Hectares) See Figure 1*

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| LULC | All | % of total | Ziama PA | % of Ziama PA | Wonogizi PA | % of Wonogizi PA |
| Forest | 126,804.8 | 51.8 | 74,973.9 | 82.9 | 30,916.9 | 81.4 |
| Cultivated Land | 41,418.6 | 16.9 | 5,842.6 | 6.5 | 2,299.9 | 6.1 |
| Old fallow Land | 40,194.2 | 16.4 | 2,949.5 | 3.3 | | |
| Degraded Forest | 26,669.7 | 10.9 | 4,166.1 | 4.6 | 1,336.0 | 3.5 |
| Grassland | 5,019.5 | 2.0 | 425.4 | 0.5 | 3,178.9 | 8.4 |
| Rock | 1,721.5 | 0.7 | 1,223.3 | 1.4 | 241.9 | 0.6 |
| Swamp Rice | 1,608.6 | 0.7 | 522.9 | 0.6 | | |
| Village | 801.6 | 0.3 | 137.9 | 0.2 | 6.4 | 0.0 |
| Rubber | 635.1 | 0.3 | 221.5 | 0.2 | | |
| Water | 32.8 | 0.0 | 14.4 | 0.0 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Palm Oil | 31.3 | 0.0 | | 0.0 | | |
| Totals | 244,937.7 | 100.0 | 90,477.5 | 100.0 | 37,980.0 | 100.0 |

Table 4 and Table 5 report total land use within the entire transboundary landscape and the two individual national protected areas. It indicates nearly 9,000 hectares of agriculture (cultivated and fallow land) exist within Ziama PA and 2,300 within the Wonegizi PA.

## Land Use within each of the two 5Km Wonegizi and Ziama buffer zones

*Table 5 Current (2020) Land Use (Hectares) within the two 5k buffer areas of Wonegizi–Ziama Transboundary Landscape.*

| | 7 | 8 | 9 | 10 |
|---|---|---|---|---|
| LULC | Wonogizi 5k Buffer | % of Wonogizi 5k Buffer | Ziama 5k buffer | % of Ziama 5k Buffer |
| Forest | 4,435.2 | 11.1 | 16,478.8 | 21.5 |
| Cultivated Land | 12,051.6 | 30.2 | 21,224.5 | 27.7 |
| Old fallow Land | 15,635.9 | 39.2 | 18,429.9 | 24.1 |
| Degraded Forest | 7,586.3 | 19.0 | 13,581.3 | 17.7 |
| Grassland | | 0.0 | 4,594.1 | 6.0 |
| Rock | 17.2 | 0.0 | 239.1 | 0.3 |
| Swamp Rice | | | 1,085.7 | 1.4 |
| Village | 166.5 | 0.4 | 490.8 | 0.6 |
| Rubber | | | 413.6 | 0.5 |
| Water | 14.8 | | 3.6 | 0.0 |
| Palm Oil | | 0.0 | 31.3 | 0.0 |
| Totals | 39,907.5 | 100.0 | 76,572.7 | 100.0 |

Table 5 shows land use within the 5 km buffer zone, the area within which FLR opportunities are to be identified. The data indicates nearly 21,000 hectares of closed forest and more than 21,000 hectares of degraded forest within the combined buffer zones.

## Land use changes and drivers of deforestation

The Wonegizi national report indicates that the principal threats to the protected areas and the dominant drivers of deforestation and land degradation arise from shifting cultivation, charcoal production and small-scale logging. There are also lesser threats from small-scale mining and dry season fires.

## Drivers of Deforestation between 2001 and 2018.

## Background and recent land use change history 2001-2018

It is possible to look more closely at this by examining rate of land use change from forest to non-forest on the Hansen data < reference> between 2001 and 2018. the data show higher rates of change in Wonegizi, than in Ziama, with low rates of change up to 2012, then a markedly increasing rate.

## Forest loss within the 5km buffer zone

*Table 6 Rates of change from forest to non-forest 2001-2018 in the Wolongizi and Ziama 5Km buffer areas (Source: Hansen)*

| Wonegizi 5km buffer area | | | Ziama 5km buffer area | | |
|---|---|---|---|---|---|
| Year | Area (Ha) Forest Loss | % annual loss | Year | Area (Ha) Forest Loss | % annual loss |
| 2001 | 343.2 | 0.86 | 2001 | 171.2 | 0.22 |
| 2002 | 112.7 | 0.28 | 2002 | 328.0 | 0.43 |
| 2003 | 14.8 | 0.04 | 2003 | 68.5 | 0.09 |
| 2004 | 70.2 | 0.18 | 2004 | 137.2 | 0.18 |
| 2005 | 114.7 | 0.29 | 2005 | 67.8 | 0.09 |
| 2006 | 198.7 | 0.50 | 2006 | 81.2 | 0.11 |
| 2007 | 733.4 | 1.84 | 2007 | 551.8 | 0.72 |
| 2008 | 491.6 | 1.23 | 2008 | 171.7 | 0.22 |
| 2009 | 788.4 | 1.98 | 2009 | 216.4 | 0.28 |

| | | | | | |
|---|---|---|---|---|---|
| 2010 | 265.5 | 0.67 | 2010 | 78.7 | 0.10 |
| 2011 | 382.2 | 0.96 | 2011 | 271.3 | 0.35 |
| 2012 | 493.4 | 1.24 | 2012 | 210.8 | 0.28 |
| 2013 | 1,396.5 | 3.50 | 2013 | 1,393.2 | 1.82 |
| 2014 | 1,651.6 | 4.14 | 2014 | 1,629.9 | 2.13 |
| 2015 | 1,962.3 | 4.92 | 2015 | 1,976.3 | 2.58 |
| 2016 | 1,654.3 | 4.15 | 2016 | 2,199.2 | 2.87 |
| 2017 | 1,866.7 | 4.68 | 2017 | 2,525.7 | 3.30 |
| 2018 | 1,820.8 | 4.56 | 2018 | 2,227.4 | 2.91 |

| | | |
|---|---|---|
| Total area (ha) | 39,904.4 | 76,573.0 |
| Total deforested (ha) | 14,361.04 | 14,306.4 |
| Percent deforested | 36.0 | 18.7 |
| Area unchanged (ha) | 25,543.3 | 62,266.6 |
| Percent unchanged | 64.0 | 81.3 |

Table 6 shows that although the area of change in forest to non-forest has been almost identical in both buffer zones (14,361 hectares in Wolongizi, 14,306 hectares in Ziama) the percentage of deforestation has been much higher in Wolongizi, with 36% of land deforested, compared to 18.7% in Ziama. This is evident in Figure 3, with a much higher density and earlier (yellow and green) evidence of deforestation in the south west than in the north east.

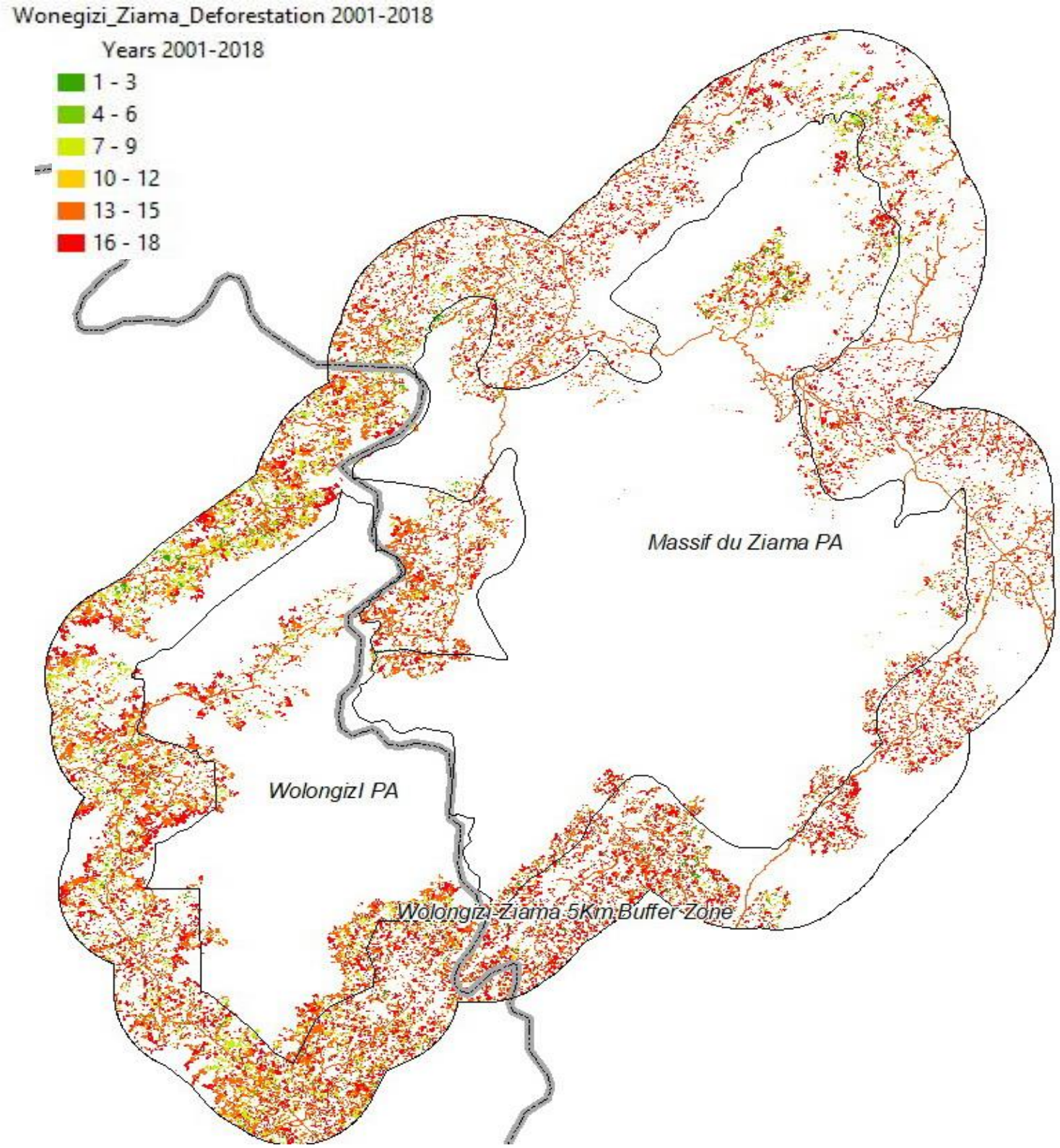

Wonegizi_Ziama_Deforestation 2001-2018
Years 2001-2018
1 - 3
4 - 6
7 - 9
10 - 12
13 - 15
16 - 18
Massif du Ziama PA
Wolongizi PA
Wolongizi-Ziama 5Km Buffer Zone

*Figure 8 Rate and size of change from forest to non-forest largest in Wonegizi-Ziama. Data shows deforestation in south west remains as high (red and yellow areas) over the past 10 years as in the past 10-20 years (green areas). (Source: Hansen)*

## 2.1 Functional degradation

While FLR is possible on cleared land (cultivated or fallow) through seeding and re-planting, restoration of degraded forest is usually the quickest, most practical and effective reforestation opportunity as may still contain residual tree and plant species from which natural regeneration can progress. Degraded forest is defined as uncultivated or partially cultivated land where some viable tree cover is still present, providing the seeding stock as the source for reforestation by natural regeneration or in some cases combined with enrichment planting. The February 2020 mapping estimates a total of 26,669 hectares degraded forest exist over the entire landscape: 1,336 hectares of degraded forest within Wolongizi PA, 4,166 within Ziama PA and 20,000 hectares within the buffer zones of both.

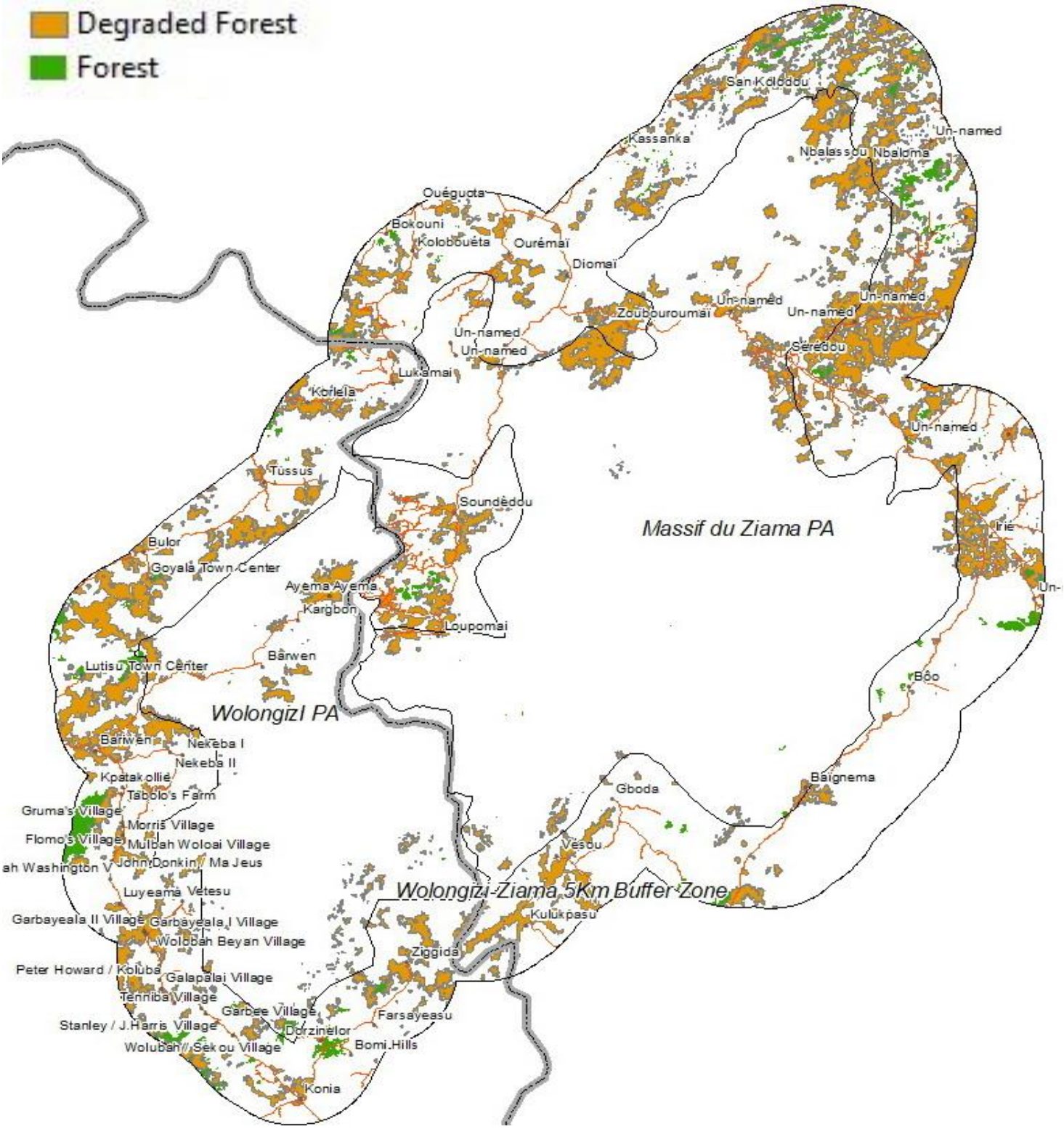



*Figure 9 Degraded Land and outlying blocks of closed forest within the 5km buffer area*

Restoration of degraded forest should be prioritized where these are adjacent or close to outlying islands of intact natural forest and provide the longer-term opportunity to promote development of larger contiguous blocks of forest (Fig 4) that can be developed to function as effective corridors of biodiversity in the landscape. Since defining or identifying land as 'partially forested' as distinct from 'fallow'

involves a degree of subjectivity and may not always be possible even when standing on site in the field, reforestation on fallow and some cultivated land must also be considered, according to a number of relevant criteria.

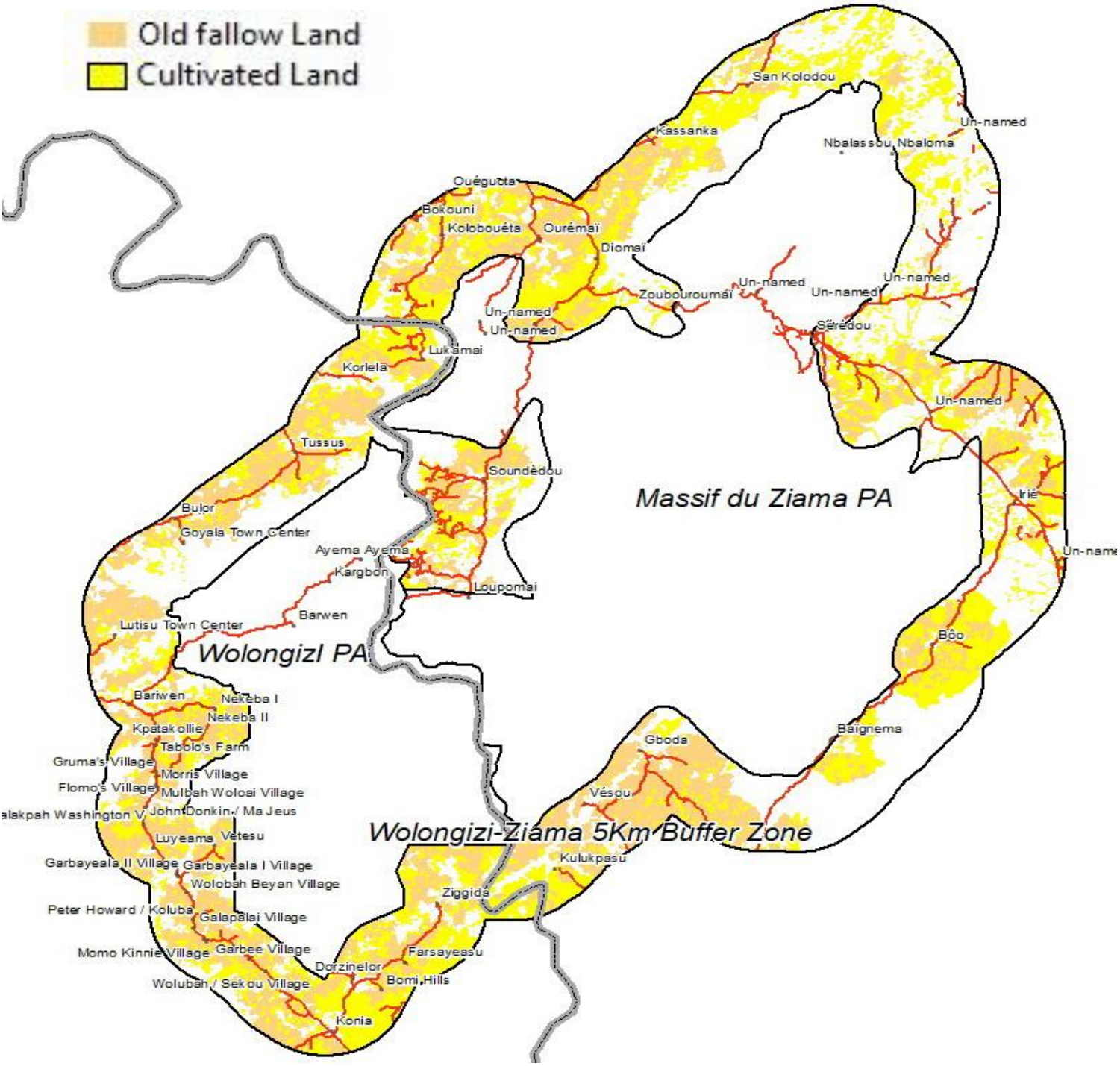



*Figure 10 Cultivated and fallow land within the 5km buffer area*

The remaining opportunities for FLR exist on land that is either currently cultivated, or is lying fallow.

The Liberia report specifies distance and proximity to potential FLR sites from villages and road access as a highly important factor, although these distances are not stated exactly.

### MCA Analysis of Wonegizi Ziama

Spatial definition of degradation and use of multi-criteria spatial analysis to identify FLR opportunities within the 5km buffer zone. The following MCA analysis seeks to identify appropriate land on which to implement the three FLR strategies proposed in the Wolongizi national report.

1. Restoration of old and young fallow land close to villages within the buffer zone, with multi-purpose tree crops, timber and fruit bearing trees. In closer proximity to villages, with mixed intercropping with food crops this would be the priority area for FLR.
2. Restoration of degraded (secondary) forests through agroforestry and silviculture, with cash crops and indigenous trees.
3. Restoration by assisted natural regeneration (ANR) – active planting and assisting the establishment of indigenous species and through strict observance and adherence to national laws on forest protection.

Both Liberian and Guinean national reports (for Wolongizi and Ziama) make FLR recommendations in which mean annual rainfall, slope and current land use emerge as the principal defining criteria for restoration. The Liberian report in particular emphasizes forest function in supporting transboundary river flow and the protective role of forests in both the upper headwaters of rivers and streams and along the drainage network in protecting river banks from erosion.

Table 7 shows the most significant factors related to land degradation within the WZ landscape for which spatial data is available. The list includes proximity of land to villages, streams and roads, cited in the Liberia MRU Report as a principal element in the designing of a FLR strategy.

*Table 7 Physical factors related to land degradation within the WZ landscape.*

| # | Criteria | Condition |
|---|---|---|
| 1 | Slope | > than 5 degrees |
| 2 | R value | > 8000 |
| 3 | Land Use | Cultivation, fallow, degraded land |
| 4 | Distance to village | Land Use within 1km, 2.5km, 5km, 10km |
| 5 | Distance to River bank | Within 100m of stream |
| 6 | Distance to Road | Within 100m of a road |

* 5 and 6 not related to degradation – to include post MCA

Cultivated, fallow land or degraded forest within 100m of road – tree crops

Cultivated, fallow land or DF within 100m of stream River banks– Protection. ANR

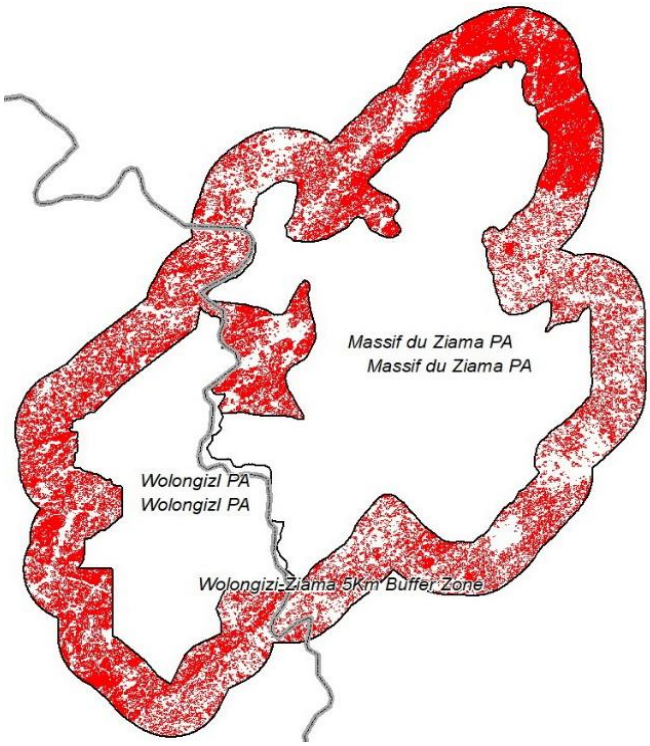
Steep slopes > 5 deg - afforestation Protection. ANR

Cultivated fallow land or DF within 1km of villages – food crops or tree crops

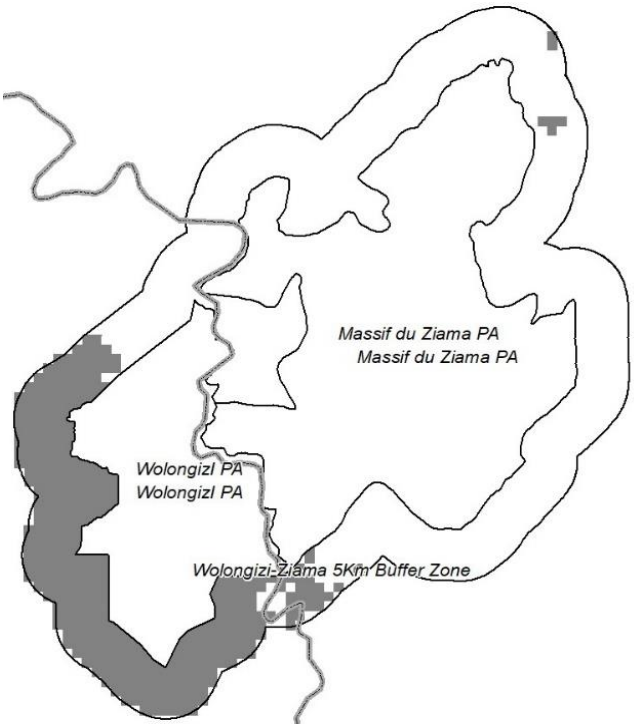
Cultivated, fallow land or DF within 2.5km of villages – tree crops

Cultivated, fallow land or degraded forest within 2.5-5km of villages – ANR

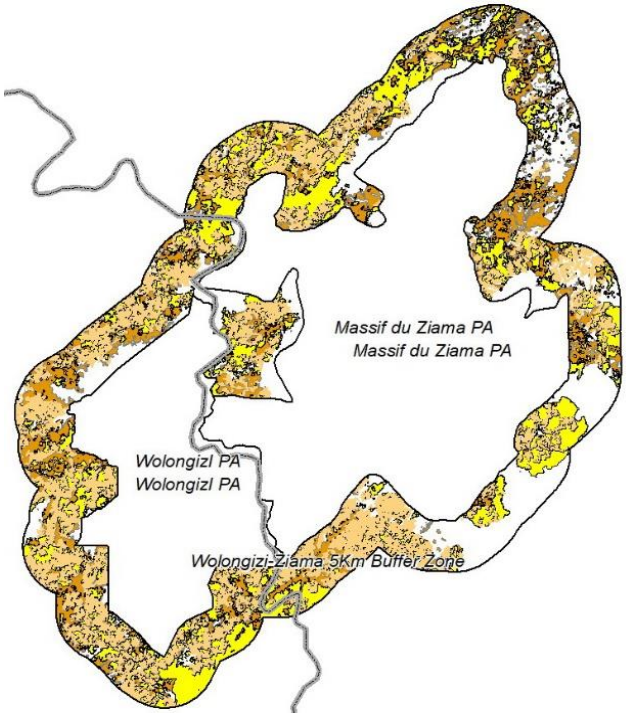
FLR opportunities on fallow and cultivated land will be more dependent on investments and labour in seeding, replanting and the opportunity cost of giving up land otherwise usable to produce food crops.



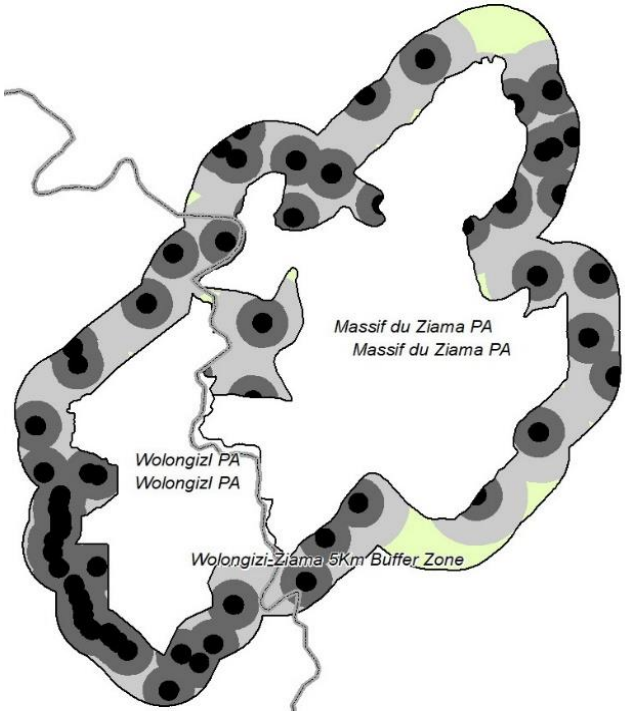

1. Land with greater slope than 5 degrees




2. Rainfall erosivity > 8,000




3.Degraded forest, fallow and cultivated land




Proximity: land within 1, 2.5, 5 and > 5 kilometres distance from a village

*Figure 11 Elements used in multi criteria spatial assessment of Wonegizi–Ziama buffer zone*

## 2.1.4 FLR Opportunities in Wonegizi-Ziama identified using MCA.

*Table 8 Multi-criteria analysis for Wonegizi-Ziama: Input data combinations, FLR opportunities and area*

| Multi-criteria inputs | | | | | |
|---|---|---|---|---|---|
| Land Use | Eros.[1] | Slope[2] | Dist to Village | FLR Opportunity | Area of intervention (Hectares) |
| Fallow Land<br>Cultivated Land<br>Degraded Forest | Hi/lo | Hi/lo | < 1km, < 2.5km < 5km < 10km | | |
| | | | | | |
| Degraded Forest | Hi | Any | < 5km | 1.**Priority** restoration ANR | 9,825.5 |
| Degraded Forest | Lo | Hi | < 5km | | |
| Degraded Forest | Lo | Lo | Any | 2 **Priority** restoration (protection) of degraded forest on steep slopes | 10,892.0 |
| Fallow Land<br>Cultivated Land | Hi | Hi | < 2.5 km | **3. Priority** - Tree crops, Agroforestry | 18,830.3 |
| Fallow Land<br>Cultivated Land | Hi | Lo | < 2.5 km | | |
| Fallow Land<br>Cultivated Land | Lo | Any | < 2.5 km | 4. Tree crops, Agroforestry | 22,300.5 |
| Fallow Land<br>Cultivated Land | Hi | Any | < 5 km | **5. Priority** (protection) restoration ANR | 7,822.4 |
| Fallow Land | Lo | Hi | < 5km | 6. Natural restoration | 2,908.4 |
| Cultivated Land | Lo | Any | > 5km | 7. Natural restoration | 4,103.8 |

[1] Rainfall Erosivity [2] Slope: steep = > 5 degrees

*Table 9 Wonegizi-Ziama FLR opportunities and areas.*

| # | FLR_Action | Hectares |
|---|---|---|
| 4 | Tree Crops and Agroforestry | 22,300.5 |
| 3 | Priority Tree Crops and Agroforestry | 18,830.3 |
| 2 | Priority Protection ANR in degraded forest | 10,892.0 |
| 1 | Assisted Natural Regeneration of Degraded Forest | 9,825.5 |
| 5 | Regeneration FLR | 7,822.4 |
| 7 | Priority regeneration FLR | 4,103.8 |
| 6 | Natural Regeneration | 2,908.4 |
| | Total | 76,682.9 |

### 2.1.5 Forest Landscape Restoration interventions

- **FLR opportunity 1** proposes reforestation by assisted natural regeneration on 9,825 hectares of degraded forest in areas of high rainfall erosivity, on steep slopes within 5 kilometres of a village. The intervention targets soil erosion prevention and catchment protection objectives.
- **FLR opportunity 2,** Prioritizes assisted natural regeneration of degraded forest on low slopes and erosivity at any distance from villages.
- **FLR opportunity 3,** Prioritizes FLR on 10,830 ha of cultivated or fallow land on steep stopes where erosivity is high, within 2.5km distance of a village.
- **FLR opportunity 4**, is the largest is in which tree crops are planted on 22,300 hectares of currently cultivated or fallow land within 2.5Km distance of a village. This is the lowest FLR priority because the only factor is only the distance to village
- **FLR opportunity 5** reforestation by ANR of fallow or Cultivated land on steep slopes less than 5km from a village. Priority in limiting soil erosion.
- **FLR opportunities 6 and 7** reforestation by regrowth of fallow or cultivated land > 5Km from a village.

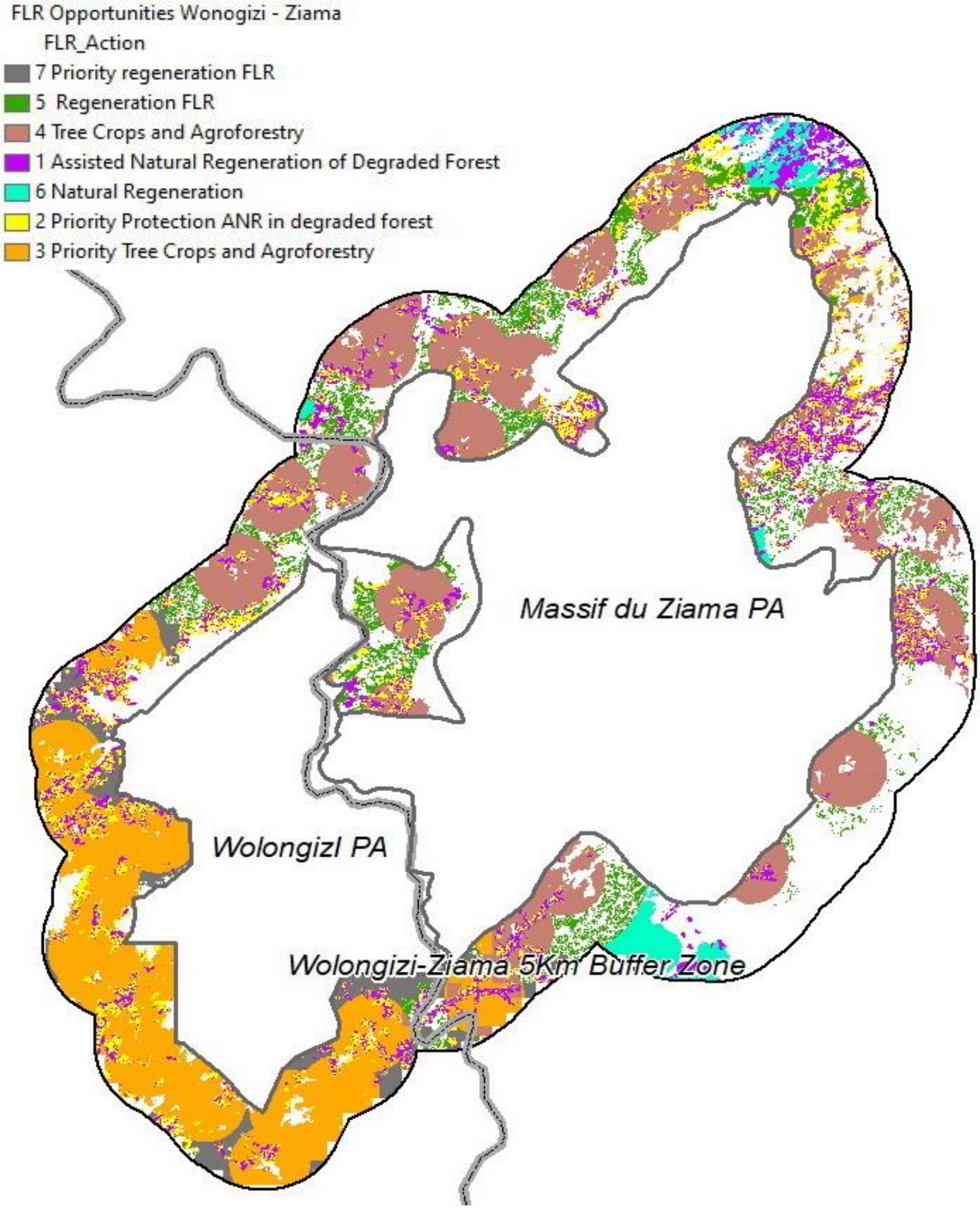

FLR Opportunities Wonogizi - Ziama
FLR_Action
7 Priority regeneration FLR
5 Regeneration FLR
4 Tree Crops and Agroforestry
1 Assisted Natural Regeneration of Degraded Forest
6 Natural Regeneration
2 Priority Protection ANR in degraded forest
3 Priority Tree Crops and Agroforestry
Massif du Ziama PA
Wolongizl PA
Wolongizi-Ziama 5Km Buffer Zone

*Figure 12 FLR opportunities consistent with national reports for Wonegizi-Ziama*



Table 9: Wonogizi-Ziama FLR opportunities and areas in

## 2.2 Gola

### Overview of Site

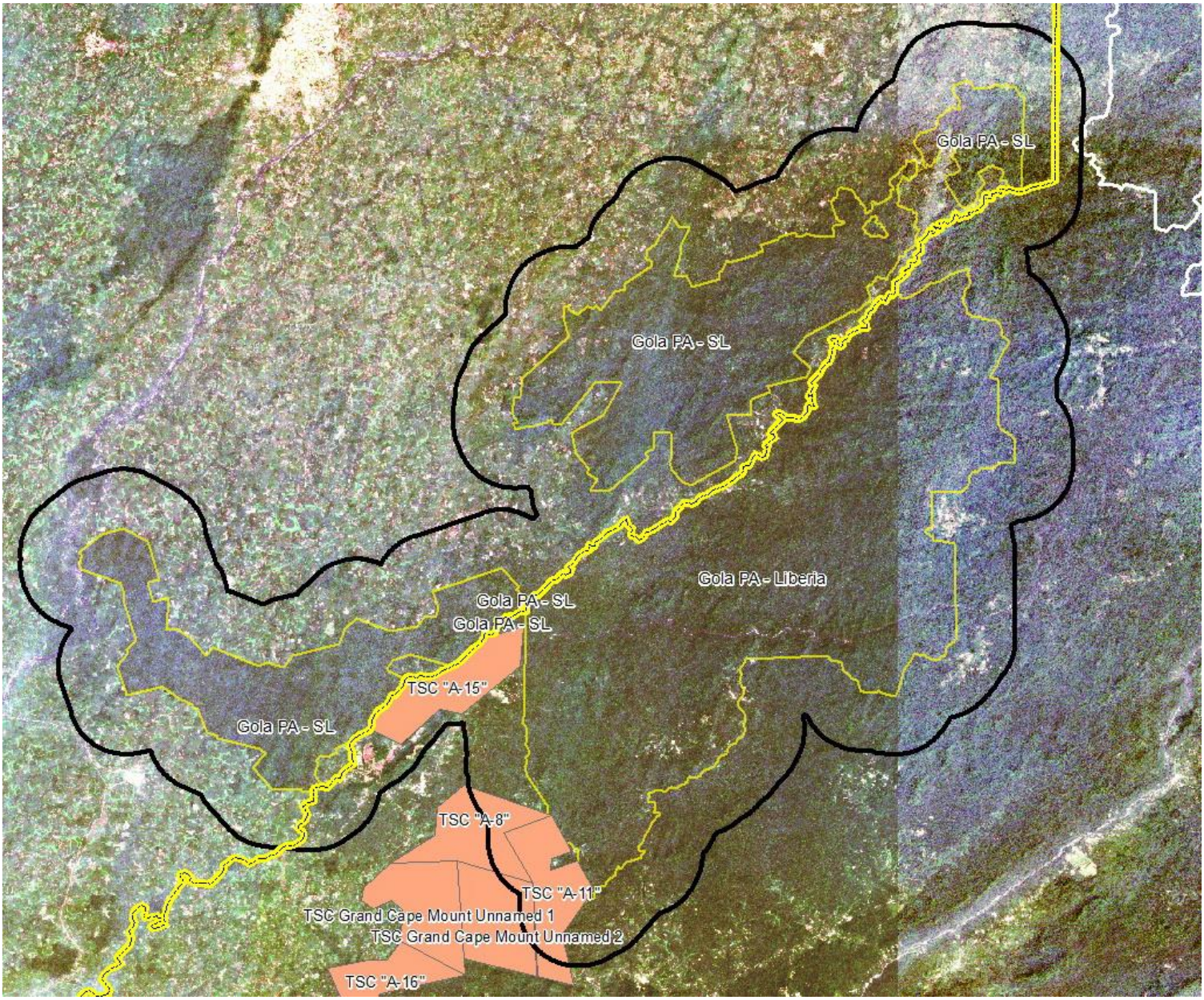



*Figure 13 Gola Trans-boundary area. Sentinel 2 image February 20, 2020 used to generate LULC information, showing Timber Service Companies (TSCs).*

Land use changes in Gola are primarily driven by agriculture in the Sierra Leone part of the landscape. Figure 13 indicates timber enterprises located within the 5 kilometre buffer zone adjacent to Gola PA (Liberia) and adjacent to Gola NP on the Liberian side of the border. This is also the area disturbed by mining activities suggesting the two activities are closely connected.

Figure 14 and Table 10 shows the land cover map and statistics calculated for each of the two protected areas and the two 5 kilometre buffer zones. The total estimate of

degraded forest 3,641.7 is in marked contrast to the estimate of 170,181 hectares quoted in the Liberia national report (3.1 Gola ROAM - Report_Final_April 22, 2020 p38).

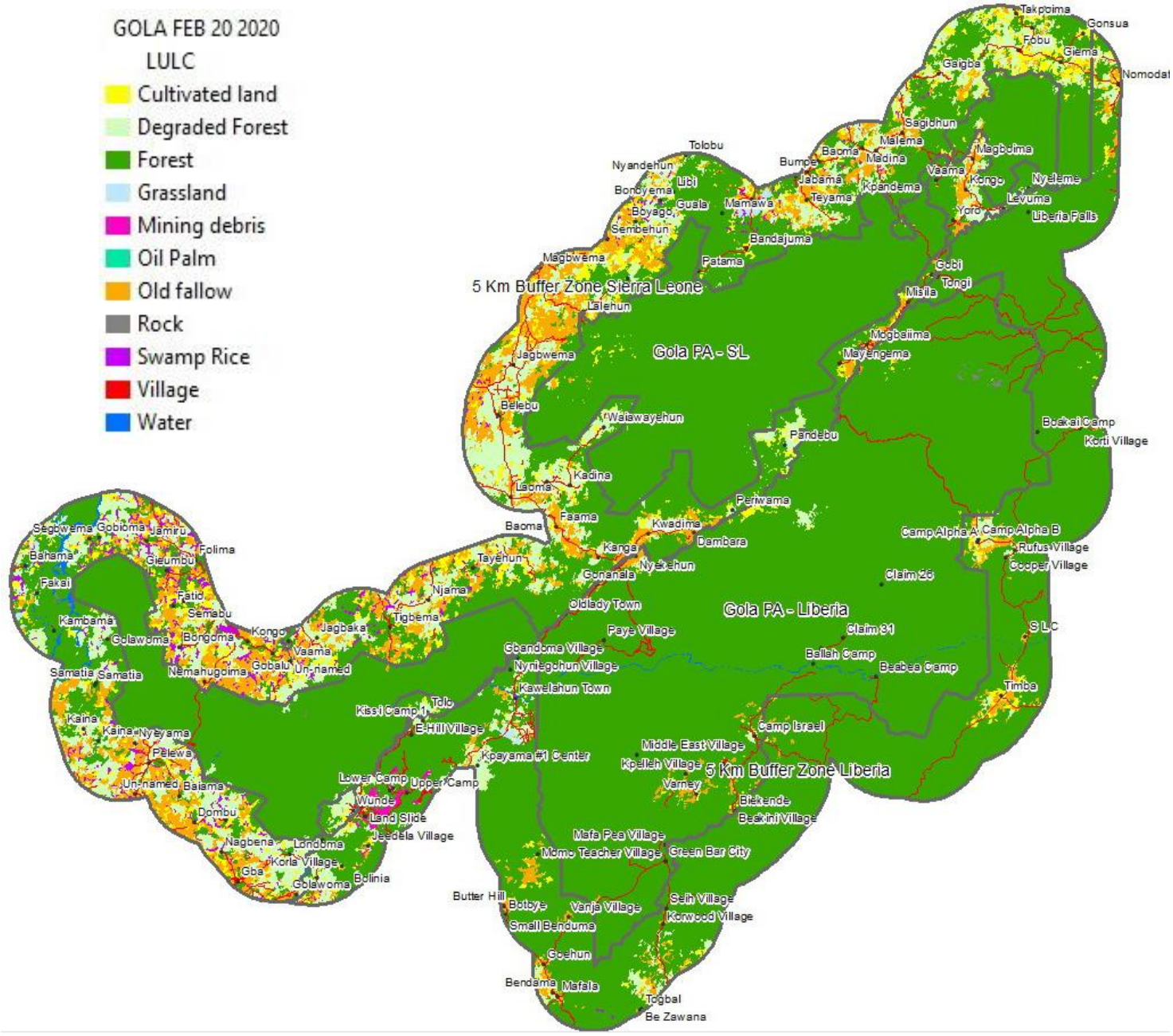



*Figure 14 Gola NP (SL) Gola PA and 5K buffer zones Land Use Land Cover map*

*Table 10 Land cover map and statistics for Gola NP (SL) Gola PA (Lib) and both countries part of the 5 kilometre buffer zone. From Sentinel imagery dated 02 February 2020.*

| LULC Gola | Gola NP Sierra Leone | 5K Buffer Sierra Leone | Gola PA Liberia | 5K Buffer Liberia |
|---|---|---|---|---|
| Forest | 70,300.4 | 46,515.8 | 95,813.9 | 71,546.7 |
| Degraded Forest | 378.8 | 26,128.6 | 391.2 | 3,250.7 |
| Old fallow | 171.7 | 21,120.0 | 726.6 | 2,494.8 |
| Cultivated land | 188.3 | 12,086.0 | 464.9 | 1,655.7 |
| Mining debris | | | | 540.1 |
| Water | 12.5 | 944.6 | 342.0 | 354.7 |
| Grassland | | 415.0 | | 87.1 |
| Village | | 113.1 | 12.8 | 52.2 |
| Swamp Rice | 11.8 | 3,084.2 | | 31.3 |
| Oil Palm | | | | 6.4 |
| Rock | 6.0 | 54.9 | 97.0 | 0.6 |
| Totals | 71,069.5 | 110,462.2 | 97,848.4 | 80,020.3 |

## 2.2.1 Gola Land Use Land Cover

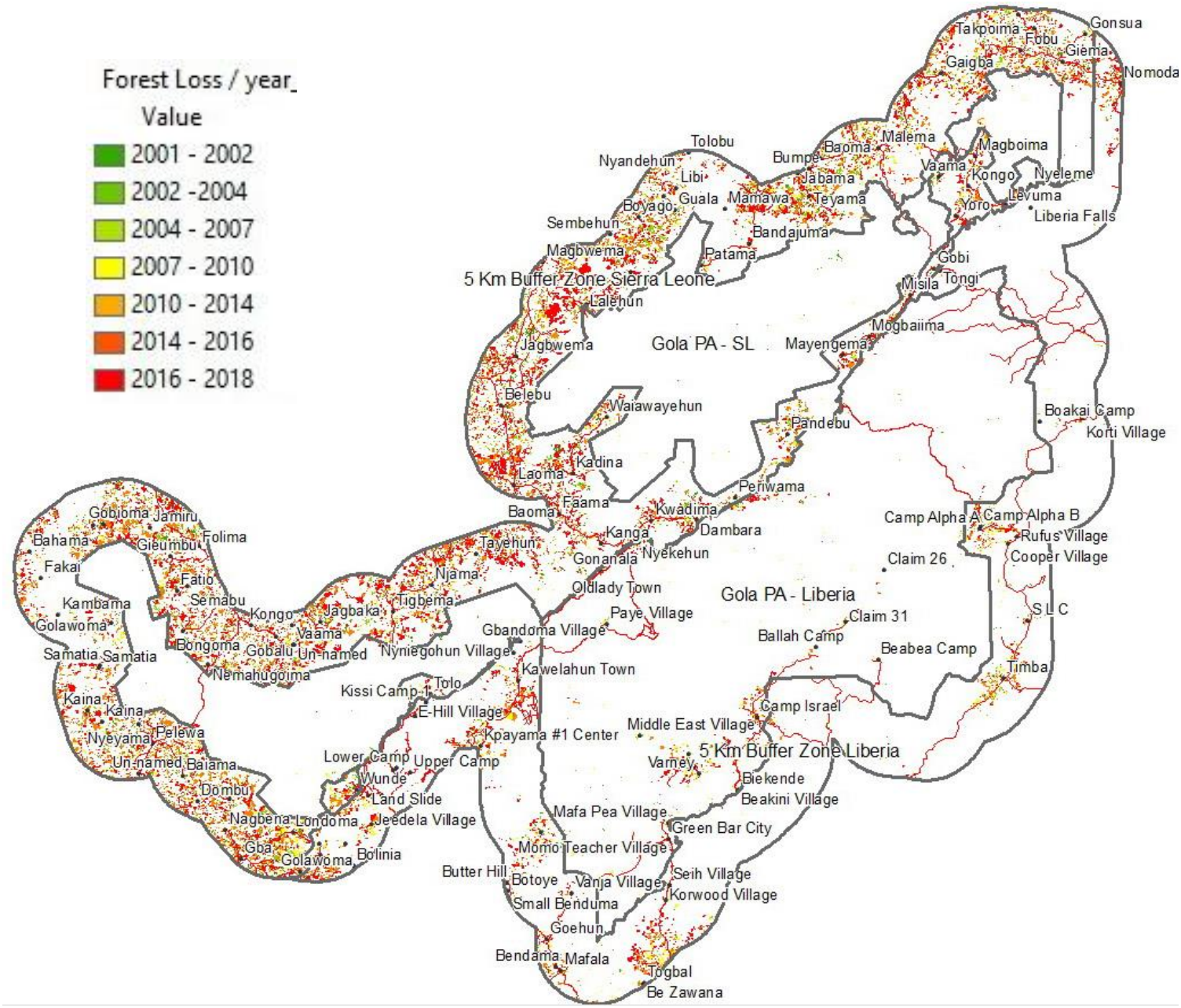



*Figure 15 Changes from forest to non-forest in Gola NP / PA and respective buffer zones 2001-2018 (Source: Hansen)*

## 2.2.2 Functional degradation

Land use changes and drivers of deforestation in Gola

Data from the Hansen study of deforestation 2001-2018 shows an acceleration in deforestation rates in the Gola buffer from 2013. Table 11shows 21 percent of the

Sierra Leone buffer area and 4.1 percent of the Liberian buffer was deforested during this time. Forest change in the Gola buffer zone

*Table 11 Year and size of charge from forest to non-forest in Sierra Leone and Liberia buffer zones (Source: Hansen)*

| Sierra Leone buffer zone | | Liberia buffer zone | |
|---|---|---|---|
| Year | Hectares | Year | Hectares |
| 2001 | 263.0 | 2001 | 27.0 |
| 2002 | 178.0 | 2002 | 19.0 |
| 2003 | 294.0 | 2003 | 9.0 |
| 2004 | 37.0 | 2004 | 9.0 |
| 2005 | 113.0 | 2005 | 9.0 |
| 2006 | 697.0 | 2006 | 67.0 |
| 2007 | 500.0 | 2007 | 71.0 |
| 2008 | 455.0 | 2008 | 48.0 |
| 2009 | 845.0 | 2009 | 291.0 |
| 2010 | 230.0 | 2010 | 27.0 |
| 2011 | 198.0 | 2011 | 27.0 |
| 2012 | 651.0 | 2012 | 146.0 |
| 2013 | 2,728.0 | 2013 | 245.0 |
| 2014 | 1,610.0 | 2014 | 231.0 |
| 2015 | 3,274.0 | 2015 | 600.0 |
| 2016 | 2,878.0 | 2016 | 386.0 |
| 2017 | 3,995.0 | 2017 | 491.0 |
| 2018 | 3,442.0 | 2018 | 573.0 |
| Total deforested] | 22,388.0 | Total deforested] | 3,276.0 |
| Unchanged | 84,343 | Unchanged | 76,213 |
| Total | 106,731.0 | Total | 79,489.0 |
| percent deforested | 21.0 | percent deforested | 4.1 |

With rates of change far higher on the Sierra Leone side of the border than Liberia a comparison was made between the year in which deforestation was recorded, and the current land use as recorded by the Feb 2020 mapping carried out for the present MRU-level transboundary ROAM report. The comparison shows that although these changes are mainly accounted for by land that is currently recorded as cultivated or old fallow, large areas of land recorded as 'deforested' 2001-18 is still currently mapped as forest (3,938,9 Ha) or degraded forest (8,615.2 Ha). Some of these numbers may be accounted for by technical differences in the mapping (accuracy, resolution etc. – note the unlikely 'deforestation' to rock).

The amount of change from forest to cultivation and fallow land (50%) is nearly the same as change to degraded forest (32.4%) – or apparently not changed, to forest (14.8%), signifying the impact of shifting cultivation and progressive regrowth of forest and secondary forest.

*Table 12 Year of forest loss 2001-2018 (Hansen) compared to currently recorded land use, Gola National Park 5Km Buffer Zone, Sierra Leone. Main areas of change and percent of land area indicated in red*

| Forest change to: | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cultivated land | 95.60 | 50.5 | 93.4 | 14.8 | 36.7 | 161.9 | 108.4 | 107.4 | 190.2 | 63.5 | 46.3 |
| Degraded Forest | 203.80 | 97.3 | 192.5 | 28.8 | 66.9 | 370.1 | 240.0 | 220.7 | 460.9 | 129 | 150.8 |
| Forest | 92.80 | 63.7 | 89.3 | 28.4 | 29.4 | 169.8 | 91.3 | 81.5 | 207.5 | 67.6 | 53.3 |
| Grassland | 2.30 | 1.1 | 0 | | 0.7 | 2.3 | 3.2 | 2.4 | 13.3 | 8.4 | 0.9 |
| Old fallow | 161.20 | 94.9 | 144.4 | 33.6 | 51.8 | 312.6 | 228.0 | 203.6 | 348.2 | 144.9 | 95.1 |
| Rock | | 0 | | | | | 0.2 | | 0.2 | 0.2 | |
| Swamp Rice | 16.40 | 13.7 | 9.5 | 2.5 | 2.4 | 22.2 | 8.5 | 12.0 | 25.1 | 4.1 | 6.4 |
| Village | 3.10 | 4.2 | 0.4 | 0.3 | 0.2 | 3.5 | 0.9 | 0.6 | 1.8 | 2.3 | |
| Water | 0.60 | 0.3 | 0.3 | 0.0 | | 1 | 0.3 | 0.3 | 1.1 | 0.1 | 0.6 |

| Forest change to: | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Totals | % |
|---|---|---|---|---|---|---|---|---|---|
| Cultivated land | 118.7 | 435.9 | 276.5 | 470.4 | 599 | 737 | 1,171.4 | 4,778.0 | 18.0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Degraded Forest | 244.4 | 994.6 | 707.2 | 1355 | 1,080 | 1,234.7 | 838.7 | 8,615.2 | 32.4 |
| Forest | 120.0 | 524.5 | 275 | 459.4 | 484 | 636.1 | 465.5 | 3,938.9 | 14.8 |
| Grassland | 2.0 | 21.2 | 11.1 | 37.5 | 29 | 56.8 | 59.9 | 251.9 | 0.9 |
| Old fallow | 223.6 | 924.3 | 639 | 1071 | 1,121 | 1,389 | 1,088.3 | 8,274.7 | 31.1 |
| Rock | | 100.6 | 0.1 | 0.4 | 0.1 | 0.1 | 0.7 | 102.6 | 0.4 |
| Swamp Rice | 20.9 | | 64 | 66.1 | 69 | 116 | 122.4 | 580.7 | 2.2 |
| Village | 0.1 | 0.6 | 2.5 | 0.4 | 2 | 0.6 | 1.1 | 24.8 | 0.1 |
| Water | 0.4 | 0 | 0.2 | 0.2 | 0.7 | 1.2 | 0.9 | 8.2 | 0.0 |
| Totals | | | | | | | | 22,388.0 | |

| | |
|---|---|
| Liberia 5K Buffer | 76,213 hectares unchanged (3,276 forest > non forest) |
| Sierra Leone 5K Buffer | 84,343 hectares unchanged (22,388 forest > non forest) |

Within the Gola NP in Sierra Leone 163 ha changed from forest to non-forest, in Gola PA Liberia, 1,012 ha changed from forest to non-forest.

*Table 13 Land use changes within 5km buffer zone of Gola National Park (Sierra Leone) and Gola PA (Liberia).*

| Sierra Leone | | % | Liberia | % |
|---|---|---|---|---|
| Cultivated land | 4,778.0 | 18.0 | 581.7 | 15.0 |
| Degraded Forest | 8,615.2 | 32.4 | 904.7 | 23.4 |
| Forest | 3,938.9 | 14.8 | 1,401.7 | 36.2 |
| Grassland | 251.9 | 0.9 | 56.6 | 1.5 |
| Mining debris | | 0.0 | 28.0 | 0.7 |
| Oil Palm | | 0.0 | 0.2 | 0.0 |
| Old fallow | 8,274.7 | 31.1 | 877.4 | 22.7 |
| Rock | 2.0 | 0.0 | 0.1 | 0.0 |
| Swamp Rice | 681.3 | 2.6 | 5.2 | 0.1 |
| Village | 24.8 | 0.1 | 5.2 | 0.1 |
| Water | 8.2 | 0.0 | 9.0 | 0.2 |
| | 22,388.00 | | 3,276.80 | |

Main land use changes have been to cultivated and fallow land. Large areas identified as deforested are currently mapped as degraded or as forest land, indicative of full or partial forest re-growth under shifting cultivation. FLR options and interventions in Gola (p29 Gola Liberia Report).

*Table 14 Restoration options and interventions in Gola (p29 Gola Liberia Report)*

| | Degradation Hotspot | Restoration Options/Interventions | Objective (s) |
|---|---|---|---|
| Inside the GFNP | | | |
| 1 | Abandoned mine | Assisted Natural Regeneration | Reinstating ecological function |
| 2 | Active mine | Law enforcement or ESI Evaluation | |
| 3 | Degraded gallery forests | Law enforcement & Assisted Natural regeneration | |
| Outside the GFNP, within 5 km periphery | | | |
| 4 | Abandoned farms, old and young fallows | Hybrid Oil Palm and Cocoa Plantation development | Supporting Livelihood |
| 5 | Unmanaged home gardens | Rehabilitation | Supporting Livelihood |
| 6 | Abandoned mine | Assisted Natural Regeneration with Bamboo or other species | Detoxification & Reinstating ecological function |
| 7 | Active mine | Law Enforcement & ESI Evaluation | |
| | Degraded gallery forests | Assisted Natural regeneration | Reinstating ecological function |

The national report prioritizes restoration of abandoned and active mining within the Gola PA area as an FLR opportunity. 540 ha of degraded land linked to mining are mapped and included as an FLR opportunity in the following MCA process.

### 2.2.3 Multi-criteria assessment inputs Gola NP and Gola PA

The multi criteria spatial assessment of Gola uses 4 indicators: LULC, slope, high K values (Soil erodibility), and low soil cation exchange value, used in ROAM as a proxy for land degradation.

All four factors can be combined to identify locations that have coincident criteria, prioritising those which have more criteria and identifying what type of FLR action would ideally then take place to restore these degraded areas.

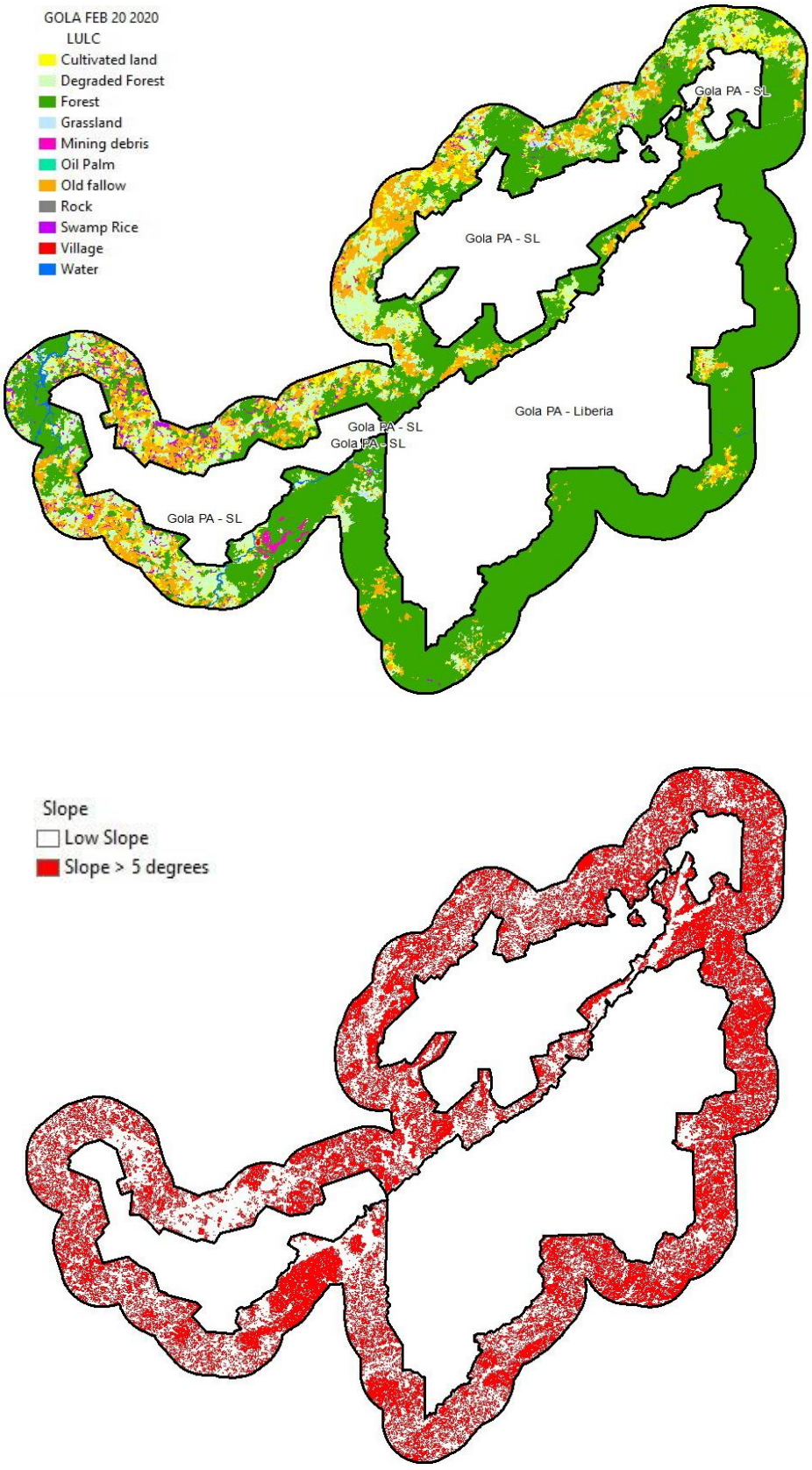



*Figure 16 Data elements used in MCA of Gola buffer zone: LULC and slope greater than 5 degrees*

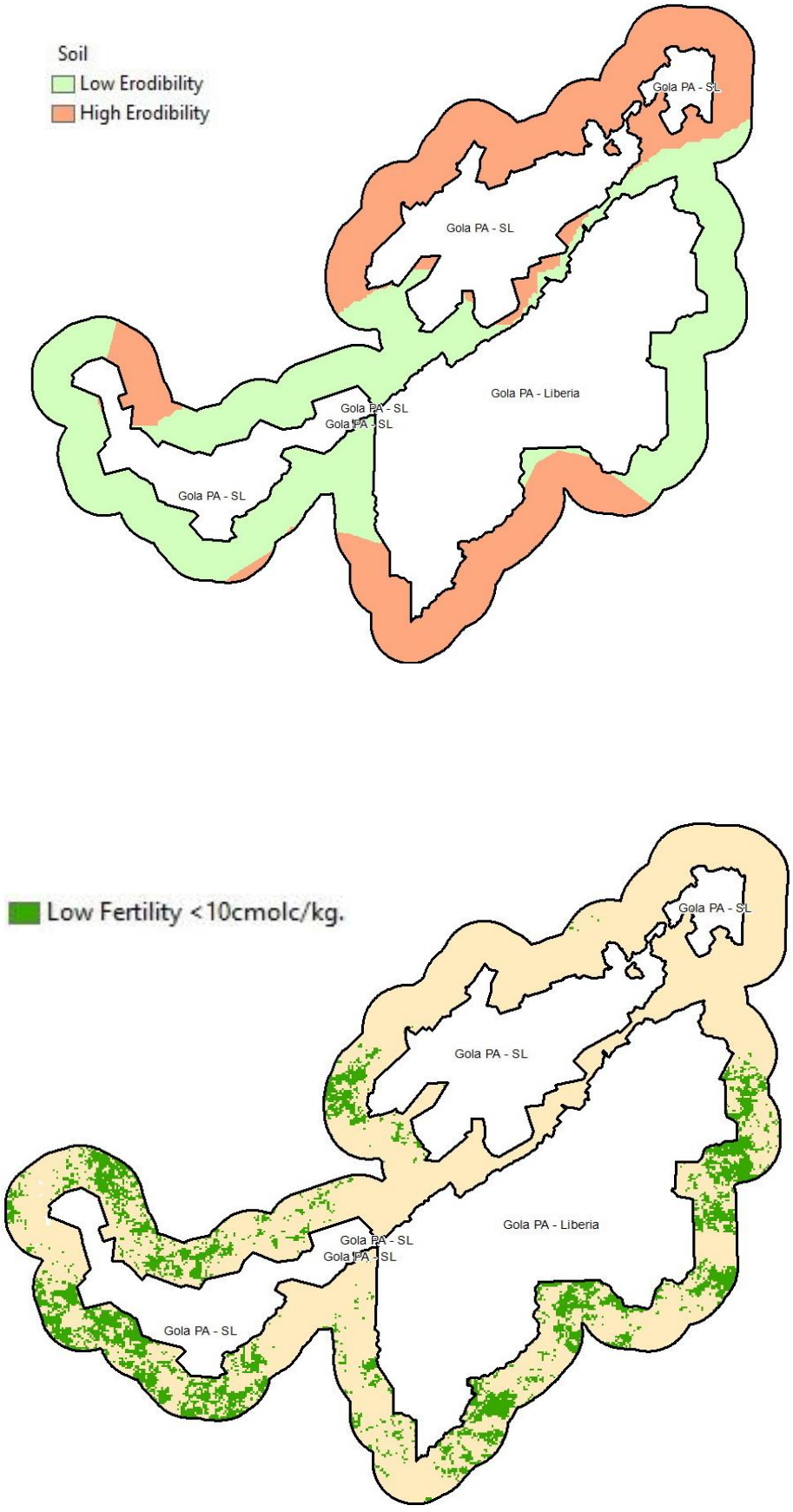
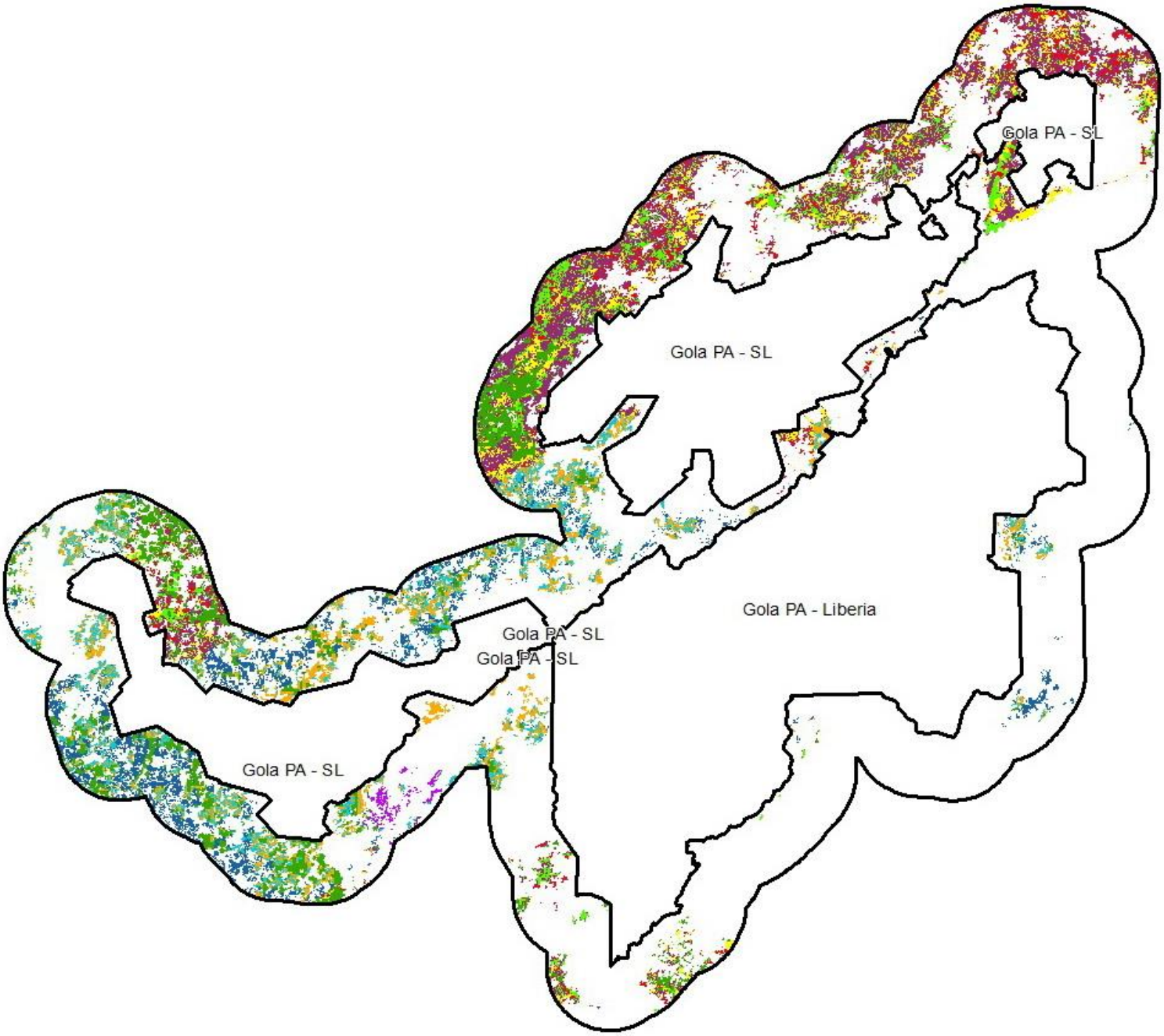



*Figure 17 Data elements used in MCA of Gola buffer zone: Areas of high soil erodibility and low soil fertility*




## 2.2.4 FLR opportunities areas in Gola

*Figure 18  55,000 hectares of FLR opportunities in the 5K buffer zone around Gola NP (Sierra Leone) and Gola PA (Liberia) 49,194 ha in Sierra Leone, 6,205 ha in Liberia*

The MCA identifies 55,000 hectares of potential FLR opportunities according to the amount coincidence (overlap) between the land uses (degraded forest, cultivated land, fallow land) and key indicators for degradation: slope, soil erodibility and soil cation exchange capacity (a fertility indicator).  This large area can be further

subdivided and prioritized as a means of focusing on diverting specific resources on local FLR opportunities such as reforestation of mining sites. slope protection, erosion control and rehabilitation of degraded forest.

| FLR Priority | Description of Land | Area |
|---|---|---|
| Priority 1. | Reforestation of degraded forest, fallow land, cultivated land on highly erodible soils on steep slopes with low fertility. | 7,889 |
| Priority 1. | Reforestation of land degraded by mining activities on steep and low slopes (Hectares) | 377 |
| Lower Priority 1 | Cultivated, Degraded or Fallow land on highly erodible soils on lower slopes | 13,479 |
| Lower Priority 2 | Degraded Forest | 6,867 |
| Lower Priority 2 | Cultivated, Degraded or Fallow land on highly erodible soils on steep slopes | 14,279 |
| Priority 3 | Degraded forest on steep slopes | 5,512 |
| Priority 4 | Fallow land on steep slopes with low fertility | 6,995 |
| Total | | 55,398 |

*Table 15. Matrix of FLR opportunities in 5K buffer zone around Gola NP (Sierra Leone) and Gola PA (Liberia) prioritized according to land cover, slope, soil erodibility and soil fertility*

| LULC | Slope | Erodibility | Soil Fertility | FLR Opportunity / Intervention Logic | Hectares |
|---|---|---|---|---|---|
| Degraded Forest | 1 | 0 | 1 | 1 Priority - Reforest Degr.For.Steep Slopes.Low Fert | 1,495.0 |
| Degraded Forest | 0 | 0 | 1 | 1 Priority - Reforest Degr.For..Low Fert | 2,408.9 |
| Cultivated Land | 0 | 1 | 1 | 1.Priority - Reforest Cult..Erod. Low Fert | 346.5 |
| Cultivated Land | 1 | 1 | 1 | 1.Priority - Reforest Cult..Erod.Steep Slopes.Low Fert | 262.3 |
| Degraded Forest | 1 | 1 | 1 | 1.Priority - Reforest Degr.For.Steep Slopes.Low Fert | 700.1 |
| Degraded Forest | 0 | 1 | 1 | 1.Priority - Reforest Degr.For..Low Fert | 1,091.0 |
| Fallow Land | 1 | 1 | 1 | 1.Priority - Reforest Fallow..Steep Slopes.Low Fert | 659.3 |
| Fallow Land | 0 | 1 | 1 | 1.Priority - Reforest Fallow...Low Fert | 926.5 |
| | | | | Subtotal Priority 1 | 7,889.6 |
| Mining Debris | 0 | 0 | 1 | Priority 1 - Mining Debris low slopes | 61.2 |
| Mining Debris | 1 | 0 | 0 | Priority 1 Mining Debris on Steep slopes | 285.8 |
| Mining Debris | 1 | 0 | 1 | Priority 1 Mining Debris on Steep slopes | 30.0 |
| | | | | Subtotal Mining Reforestation | 377.0 |
| Cultivated Land | 0 | 1 | 0 | Lower Priority 1 Cult.Erodible Soil | 3,292.3 |
| Degraded Forest | 0 | 1 | 0 | Lower Priority 1 Deg.For.Erodible Soil | 5,286.4 |
| Fallow Land | 0 | 1 | 0 | Lower Priority 1 Fallow.Erodible Soil | 4,900.8 |
| | | | | Subtotal Lower Priority 1 | 13,479.5 |
| Degraded Forest | 0 | 0 | 0 | Low Priority 2 Deg.For.Only | 6,867.3 |
| Cultivated Land | 1 | 1 | 0 | Priority 2 | 3,380.5 |
| Degraded Forest | 1 | 1 | 0 | Priority 2 | 5,857.1 |
| Fallow Land | 1 | 1 | 0 | Priority 2 | 5,041.4 |
| | | | | Subtotal Lower Priority 2 | 14,279.0 |
| Degraded Forest | 1 | 0 | 0 | Priority 3 | 5,512.5 |

| | | | | | |
|---|---|---|---|---|---|
| Fallow Land | 1 | 0 | 0 | Priority 4 | 3,504.6 |
| Fallow Land | 1 | 0 | 1 | Priority 4 | 1,267.8 |
| Fallow Land | 0 | 0 | 1 | Priority 4 | 2,222.8 |
| | | | | Subtotal Lower Priority 4 | 6,995.2 |
| | | | | Total | 55,400.1 |

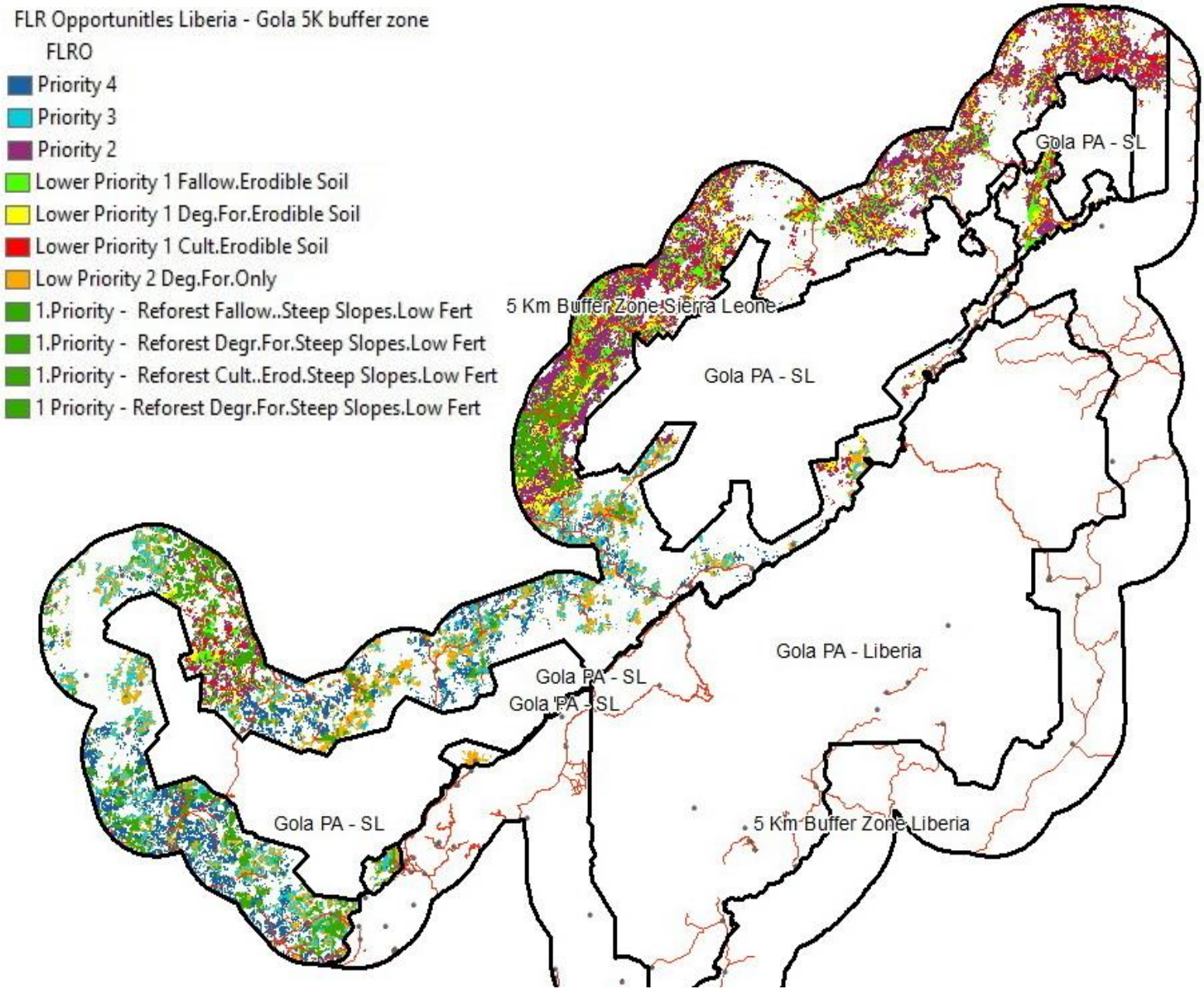



*Figure 19 FLR Opportunities – Sierra Leone Gola NP 5Km Buffer area*

*Table 16 Forest Land Restoration Opportunities – Sierra Leone Gola NP 5Km Buffer*

| Forest Land Restoration Opportunities SL Gola Buffer | Hectares |
|---|---|
| Priority 2 | 13,214.2 |
| Priority 4 | 6,393.9 |
| Low Priority 2 Deg.For.Only | 5,833.0 |
| Priority 3 | 4,915.3 |
| Lower Priority 1 Deg.For.Erodible Soil | 4,731.8 |
| Lower Priority 1 Fallow.Erodible Soil | 4,291.9 |
| 1 Priority - Reforest Degr.For.Steep Slopes.Low Fert | 3,493.0 |
| Lower Priority 1 Cult.Erodible Soil | 2,909.7 |
| 1.Priority - Reforest Degr.For.Steep Slopes.Low Fert | 1,579.4 |
| 1.Priority - Reforest Fallow..Steep Slopes.Low Fert | 1,328.1 |
| 1.Priority - Reforest Cult..Erod.Steep Slopes.Low Fert | 504.2 |
| Totals | 49,194.6 |

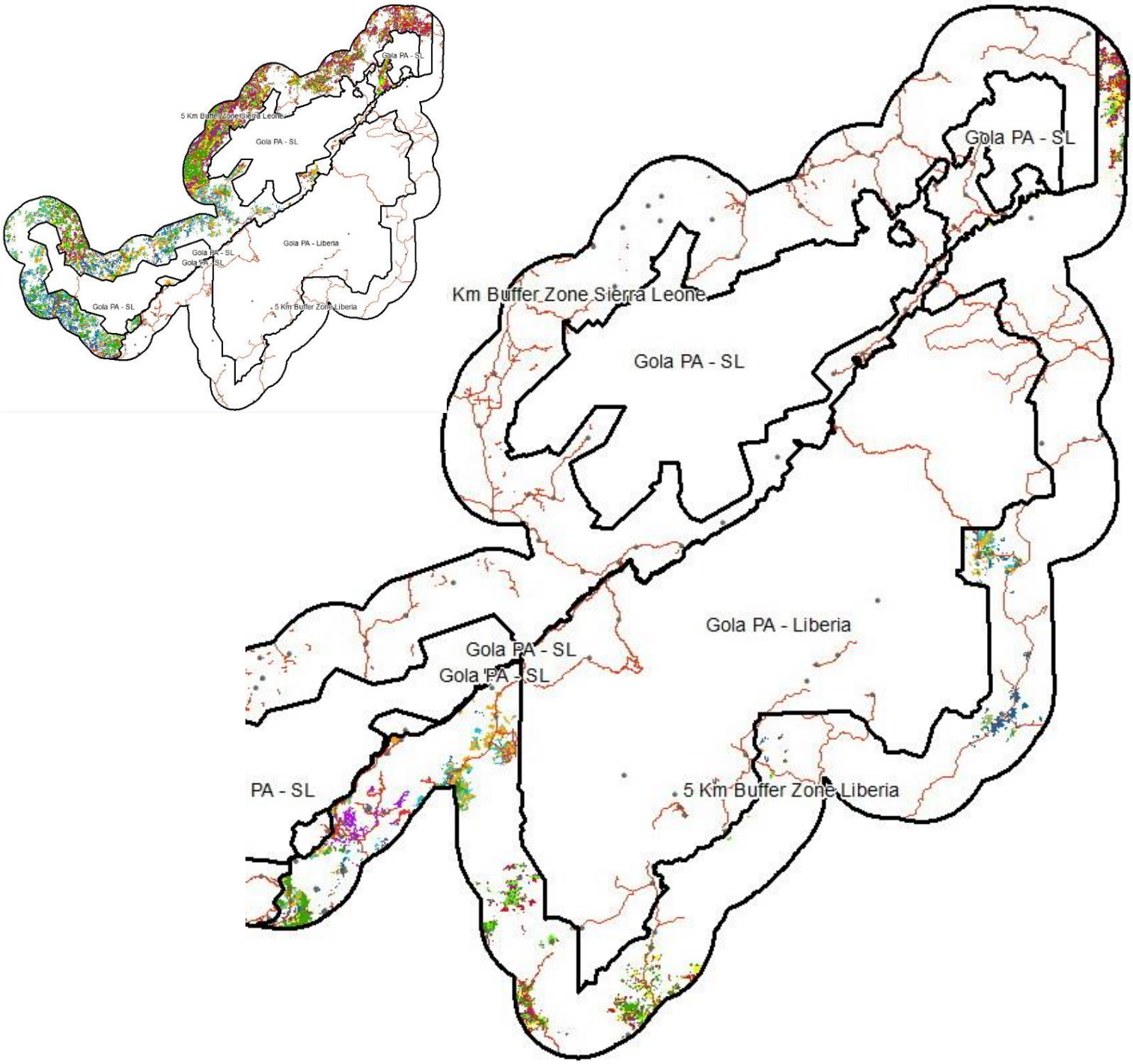



*Figure 20 FLR Opportunities – Sierra Leone Gola NP 5Km Buffer*

*Table 17 Forest Land Restoration Opportunities – Liberia Gola PA 5Km Buffer*

| Forest Land Restoration Opportunities | Hectares |
|---|---|
| Priority 2 | 1,064.9 |
| Low Priority 2 Deg.For.Only | 1,034.2 |
| Lower Priority 1 Fallow.Erodible Soil | 608.9 |
| Priority 4 | 601.2 |
| Priority 3 | 597.2 |
| Lower Priority 1 Deg.For.Erodible Soil | 554.6 |
| 1 Priority - Reforest Degr.For.Steep Slopes.Low Fert | 411.0 |
| Lower Priority 1 Cult.Erodible Soil | 382.6 |
| Priority 1 Mining Debris on Steep slopes | 315.8 |
| 1.Priority - Reforest Fallow..Steep Slopes.Low Fert | 257.7 |
| 1.Priority - Reforest Degr.For.Steep Slopes.Low Fert | 211.7 |
| 1.Priority - Reforest Cult..Erod.Steep Slopes.Low Fert | 104.5 |
| 1 Priority - Mining Debris low slopes | 61.2 |
| Total | 6,205.4 |

## 2.3 Diecke / Nimba / Mont Nimba

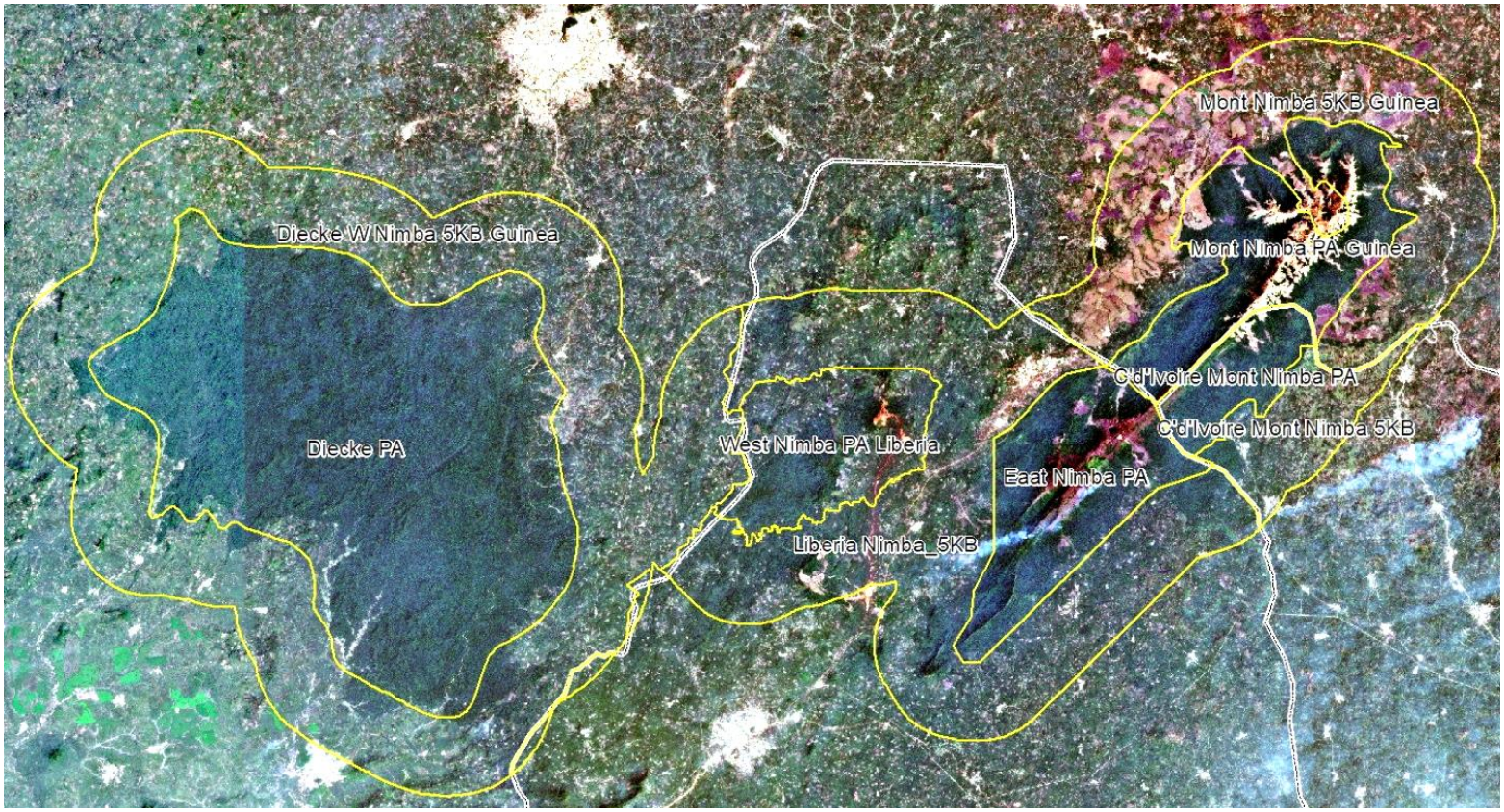



*Figure 21 Diecke / Nimba / Mont Nimba boundaries, Sentinel 2020 image used for LULC mapping*

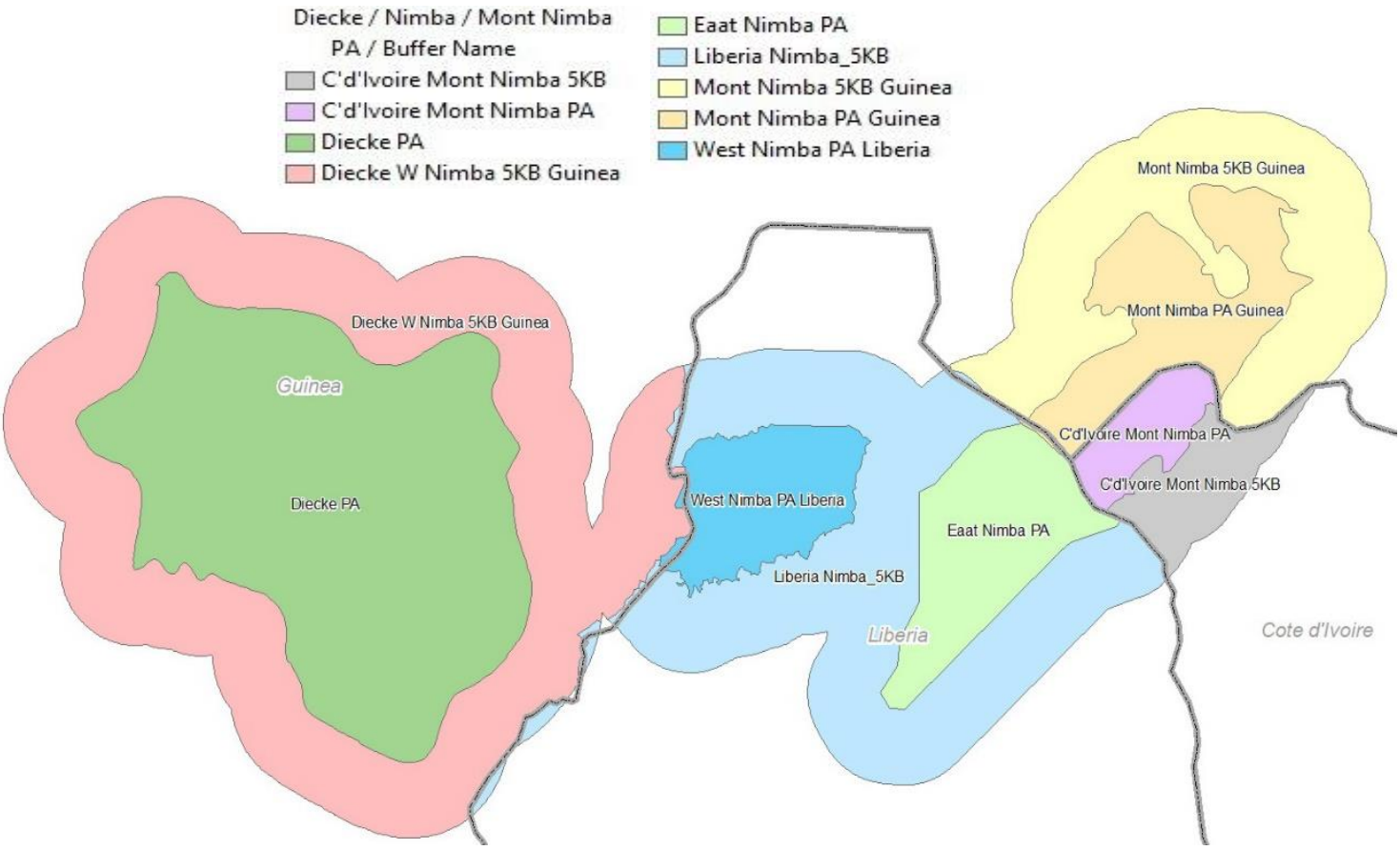



*Figure 22 Land administration boundaries Diecke / Nimba / Mont Nimba complex*

2.3.1 Overview of site

2.3.1 Land use situation, recent land use changes

2.3.2 FLR Opportunities

Findings of national reports

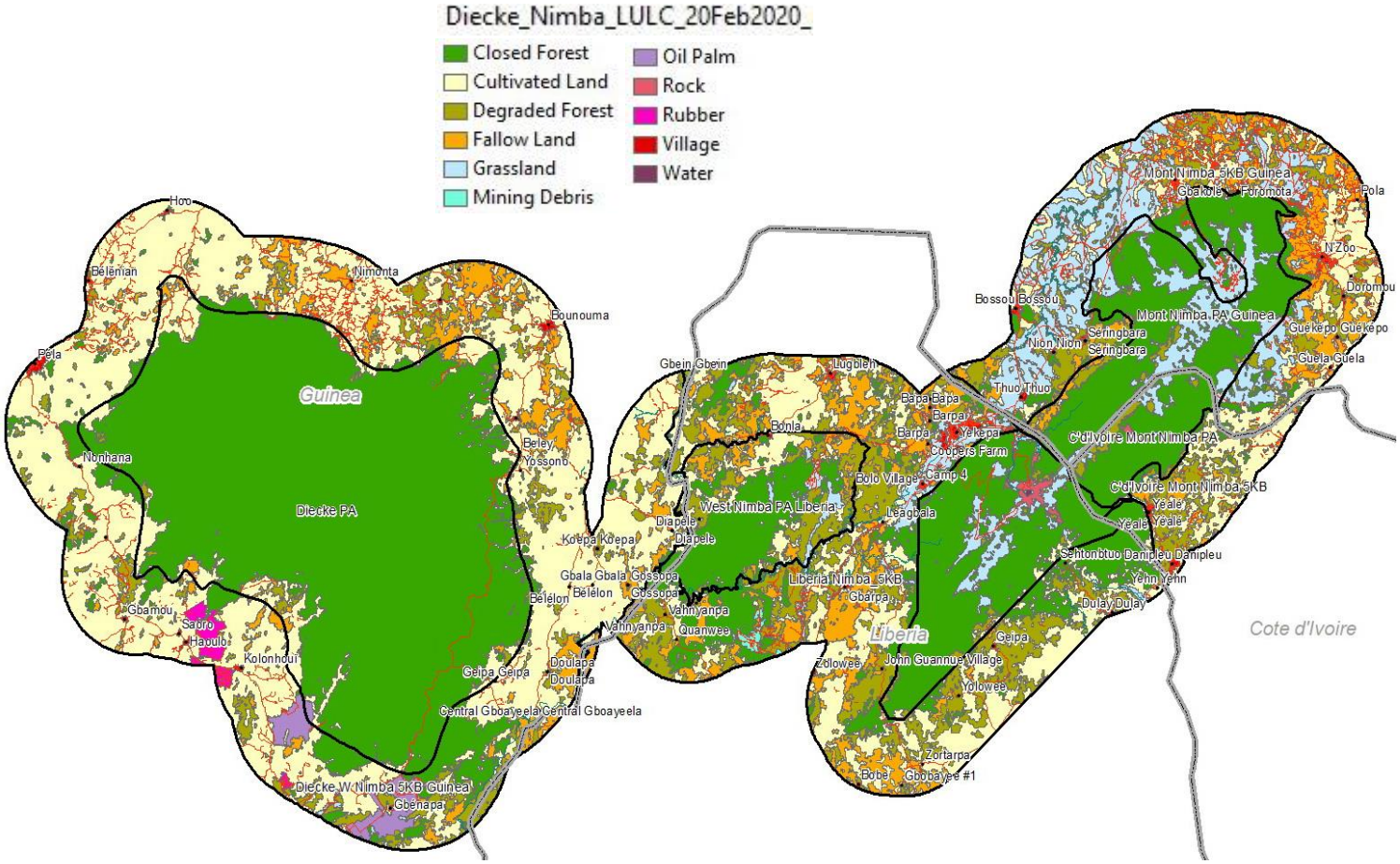



*Figure 23 LULC map 02.2020 Diecke / Nimba / Mont Nimba*

*Table 18 LULC statistics 02.2020 Diecke / Nimba / Mont Nimba*

| Land use | Hectares | Percent |
|---|---|---|
| Closed Forest | 98,408.7 | 39.7 |
| Cultivated Land | 78,023.3 | 31.5 |
| Degraded Forest | 28,759.2 | 11.6 |
| Fallow Land | 21,751.5 | 8.8 |
| Grassland | 16,817.5 | 6.8 |
| Mining Debris | 261.8 | 0.1 |
| Oil Palm | 1,606.9 | 0.6 |
| Rock | 377.5 | 0.2 |
| Rubber | 787.0 | 0.3 |
| Village | 1,099.4 | 0.4 |
| Water | 15.5 | 0.0 |
| Totals | 247,908.3 | 100.0 |

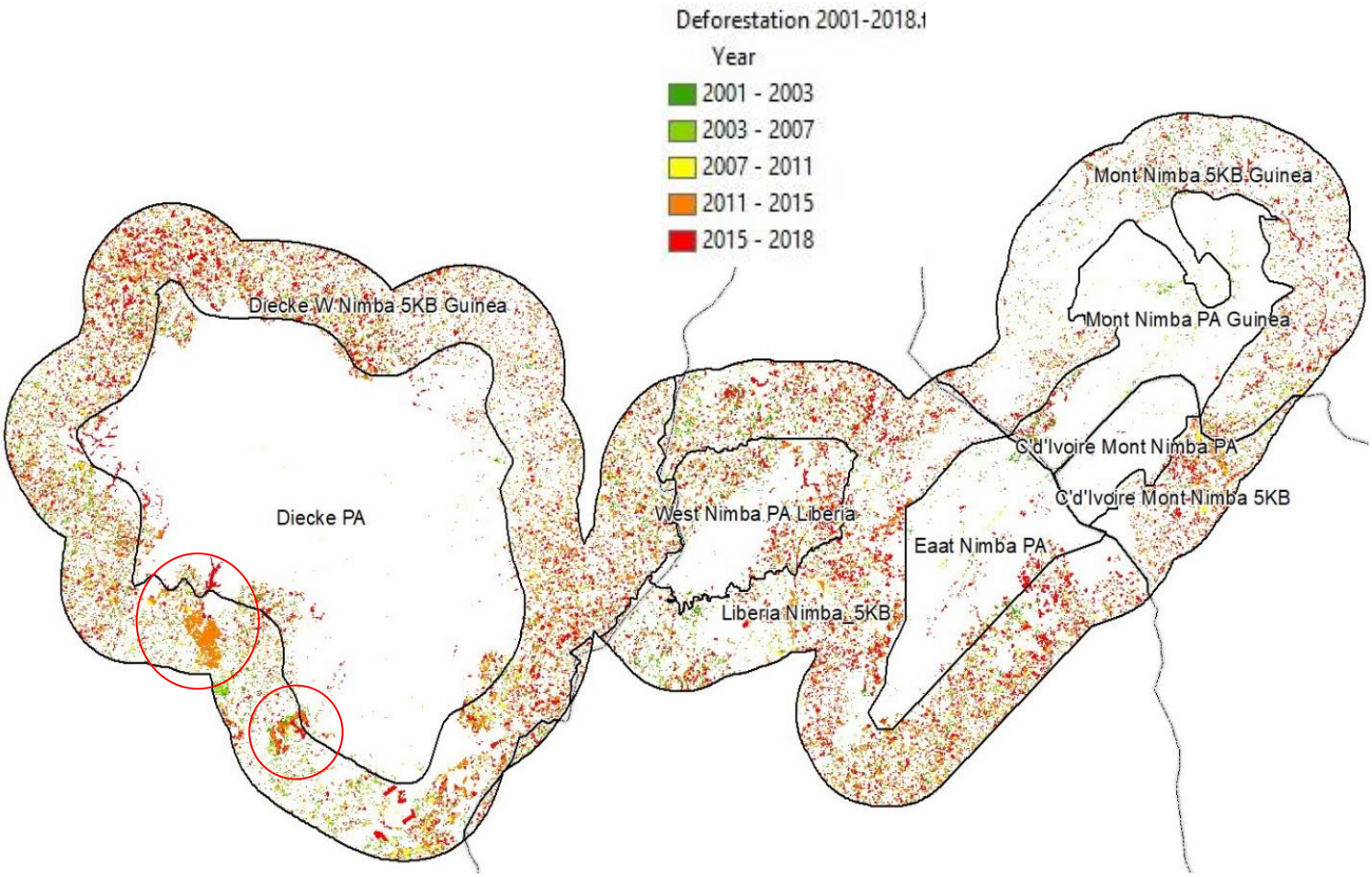



*Figure 24 LULC change Diecke / Nimba / Mont Nimba 2001-2018 (Source: Hansen)*

*Table 19 LULC change statistics Diecke / Nimba / Mont Nimba 2001-2018 (Hansen)*

| Year | Liberia Nimba 5KB | Diecke PA | Diecke_W Nimba_5KB Guinea | East Nimba PA | West Nimba PA | CD Mont Buffer | CD Mont N Nimba PA | Nimba_ PA Guinea | Nimba_ 5KB Guinea |
|---|---|---|---|---|---|---|---|---|---|
| 2001 | 50.0 | 2.0 | 53.0 | 13.0 | 2.0 | 2.0 | 0.0 | 3 | 19.0 |
| 2002 | 400.0 | 70.0 | 599.0 | 18.0 | 107.0 | 13.0 | 0 | 40 | 78.0 |
| 2003 | 87.0 | 10.0 | 129.0 | 10.0 | 7.0 | 2.0 | 0 | 26 | 26.0 |
| 2004 | 19.0 | 5.0 | 15.0 | 1.0 | 2.0 | 0.0 | 0 | 1 | 0.0 |
| 2005 | 22.0 | 0.0 | 88.0 | 0.0 | 3.0 | 4.0 | 0 | 4 | 11.0 |
| 2006 | 150.0 | 18.0 | 260.0 | 5.0 | 10.0 | 6.0 | 0 | 6 | 27.0 |
| 2007 | 210.0 | 21.0 | 226.0 | 5.0 | 24.0 | 19.0 | 0 | 6 | 105.0 |
| 2008 | 137.0 | 4.0 | 190.0 | 6.0 | 14.0 | 7.0 | 0 | 14 | 25.0 |
| 2009 | 124.0 | 12.0 | 108.0 | 2.0 | 9.0 | 4.0 | 0 | 0 | 18.0 |
| 2010 | 12.0 | 0.0 | 16.0 | 0.0 | 4.0 | 1.0 | 0 | 0 | 1.0 |
| 2011 | 64.0 | 10.0 | 152.0 | 0.0 | 12.0 | 68.0 | 0 | 2 | 24.0 |
| 2012 | 139.0 | 37.0 | 508.0 | 15.0 | 27.0 | 31.0 | 3 | 23 | 55.0 |
| 2013 | 625.0 | 87.0 | 1,665.0 | 15.0 | 92.0 | 78.0 | 3 | 14 | 55.0 |
| 2014 | 329.0 | 87.0 | 1,002.0 | 7.0 | 65.0 | 66.0 | 2 | 5 | 63.0 |
| 2015 | 1,150.0 | 203.0 | 1,678.0 | 21.0 | 244.0 | 112.0 | 1 | 17 | 212.0 |
| 2016 | 1,299.0 | 193.0 | 1,948.0 | 80.0 | 183.0 | 65.0 | 9 | 42 | 254.0 |
| 2017 | 1,483.0 | 363.0 | 2,316.0 | 41.0 | 336.0 | 153.0 | 2 | 39 | 574.0 |
| 2018 | 1,157.0 | 63.0 | 1,218.0 | 96.0 | 151.0 | 209.0 | 7 | 20 | 349.0 |
| Total Deforested | 7,457.0 | 1,185.0 | 12,171.0 | 335.0 | 1,292.0 | 840.0 | 27.0 | 262.0 | 1,896.0 |
| Percent deforested | 18.1 | 2.0 | 19.2 | 2.5 | 12.8 | 14.5 | 0.6 | 1.8 | 6.9 |
| Unchanged | 33,852.0 | 57,569.0 | 51,309.0 | 12,944.0 | 8,841.0 | 4,972.0 | 4,681.0 | 14,182.0 | 25,727.0 |
| Total Area | 41,309.0 | 58,754.0 | 63,480.0 | 13,279.0 | 10,133.0 | 5,812.0 | 4,708.0 | 14,444.0 | 27,623.0 |

*Table 20 LULC statistics of Diecke/Nimba complex in Guinea*

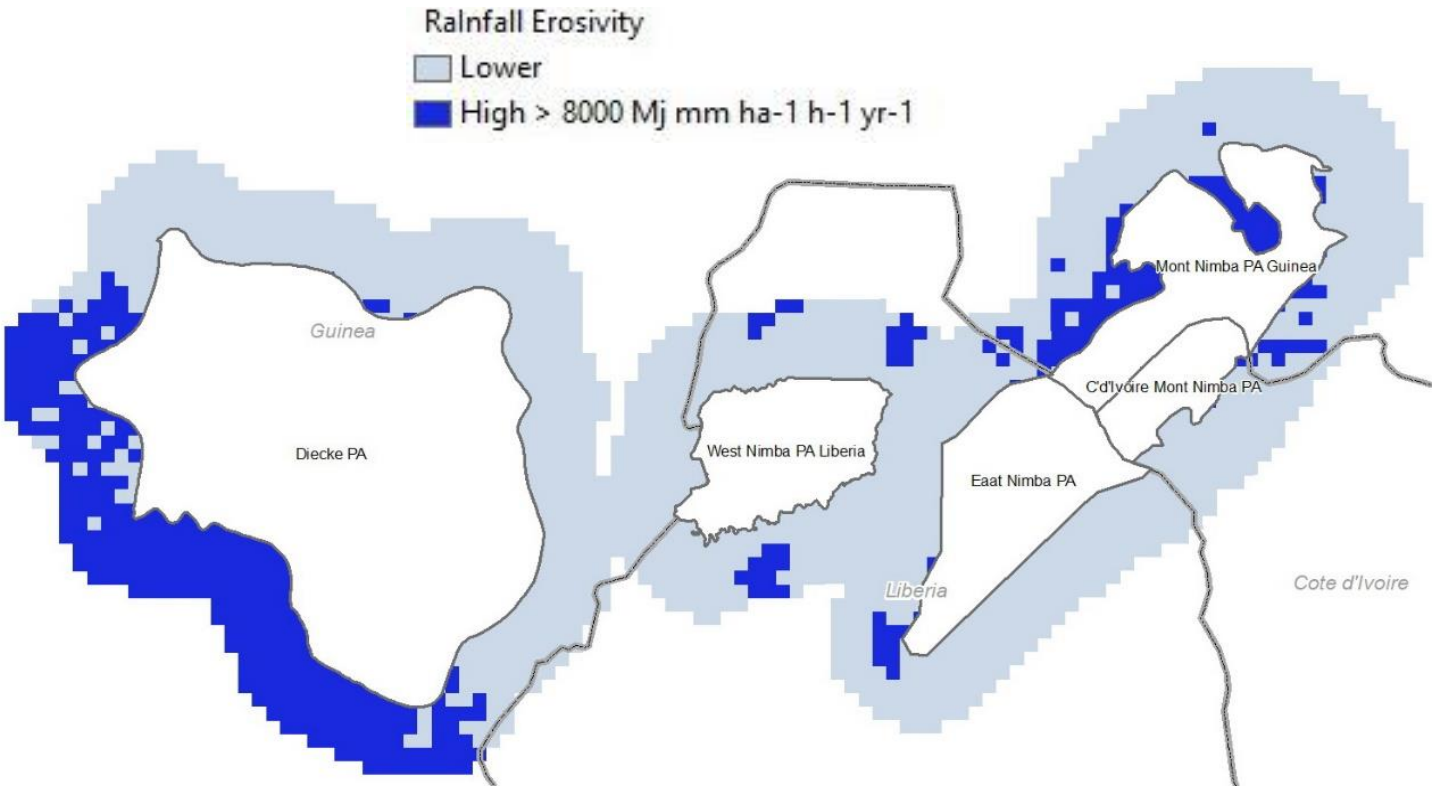
| LULC | Diecke PA | % | Diecke, W Nimba 5K Buffer (Guinea) | % | Mont Nimba 5K Buffer Guinea | % | Mont Nimba PA Guinea | % |
|---|---|---|---|---|---|---|---|---|
| Closed Forest | 53,584.3 | 90.5 | 5,687.3 | 8.5 | 2,003.5 | 7.0 | 10,089.1 | 68.9 |
| Cultivated Land | 4,382.7 | 7.4 | 46,571.2 | 70.0 | 7,834.5 | 27.3 | 103.1 | 0.7 |
| Degraded Forest | 594.9 | 1.0 | 6,085.0 | 9.1 | 4,338.3 | 15.1 | 793.6 | 5.4 |
| Fallow Land | 547.3 | 0.9 | 6,233.5 | 9.4 | 4,926.4 | 17.2 | 384.9 | 2.6 |
| Grassland | | | 99.0 | 0.1 | 9,299.8 | 32.4 | 3,270.0 | 22.3 |
| Oil Palm | 71.0 | 0.1 | 1,535.9 | 2.3 | | | | |
| Village | 3.9 | 0.0 | 357.6 | 0.5 | 284.8 | 1.0 | | |
| Rubber | | | 787.0 | 1.2 | | | | |
| Rock | | | | | | | | |
| Mining Debris | | | | | | | | |
| Water | | | | | | | | |
| Totals | 59,184.1 | | 66,569.5 | 100.0 | 28,687.3 | 100 | 14,640.7 | 100 |

*Table 21 LULC statistics of Diecke/Nimba complex in Liberia*

| LULC | W Nimba PA Liberia | % | E Nimba PA (Liberia) | % | Buffer 5Kb, E,W,Nimba, Liberia | % |
|---|---|---|---|---|---|---|
| Closed Forest | 4,892.6 | 46.8 | 10,535.4 | 78.4 | 7,623.2 | 17.4 |
| Cultivated Land | 1,780.6 | 17.0 | 289.4 | 2.2 | 14,202.0 | 32.4 |
| Degraded Forest | 2,340.4 | 22.4 | 569.0 | 4.2 | 11,815.8 | 27.0 |
| Fallow Land | 942.5 | 9.0 | 26.6 | 0.2 | 7,970.9 | 18.2 |
| Grassland | 480.1 | 4.6 | 1,666.0 | 12.4 | 1,562.6 | 3.6 |
| Oil Palm | | | | | | |
| Village | 13.4 | 0.1 | | | | |
| Rubber | | | | | | |
| Rock | | | 338.2 | 2.5 | | |
| Mining Debris | | | | | 261.8 | 0.6 |
| Water | | | 15.5 | 0.1 | 355.2 | 0.8 |
| Totals | 10,449.6 | | 13,440.1 | 100.0 | 43,791.5 | 100.0 |

*Table 22 LULC statistics of Diecke/Nimba complex in Cote d'Ivoire*

| LULC | CD Mont Nimba PA | % | CD Mont Nimba 5K Buffer | % |
|---|---|---|---|---|
| Closed Forest | 3,726.0 | 78.8 | 777.8 | 12.5 |
| Cultivated Land | 33.8 | 0.7 | 2,903.9 | 46.5 |
| Degraded Forest | 491.1 | 10.4 | 1,759.3 | 28.2 |
| Fallow Land | 0.1 | 0.0 | 719.1 | 11.5 |
| Grassland | 440.9 | 9.3 | | |
| Oil Palm | | | | |
| Village | | | 84.4 | 1.4 |
| Rubber | | | | |
| Rock | | | | |
| Mining Debris | | | | |
| Water | 39.3 | 0.8 | | |
| Totals | 4,731.2 | 100 | 6,244.5 | 100.0 |



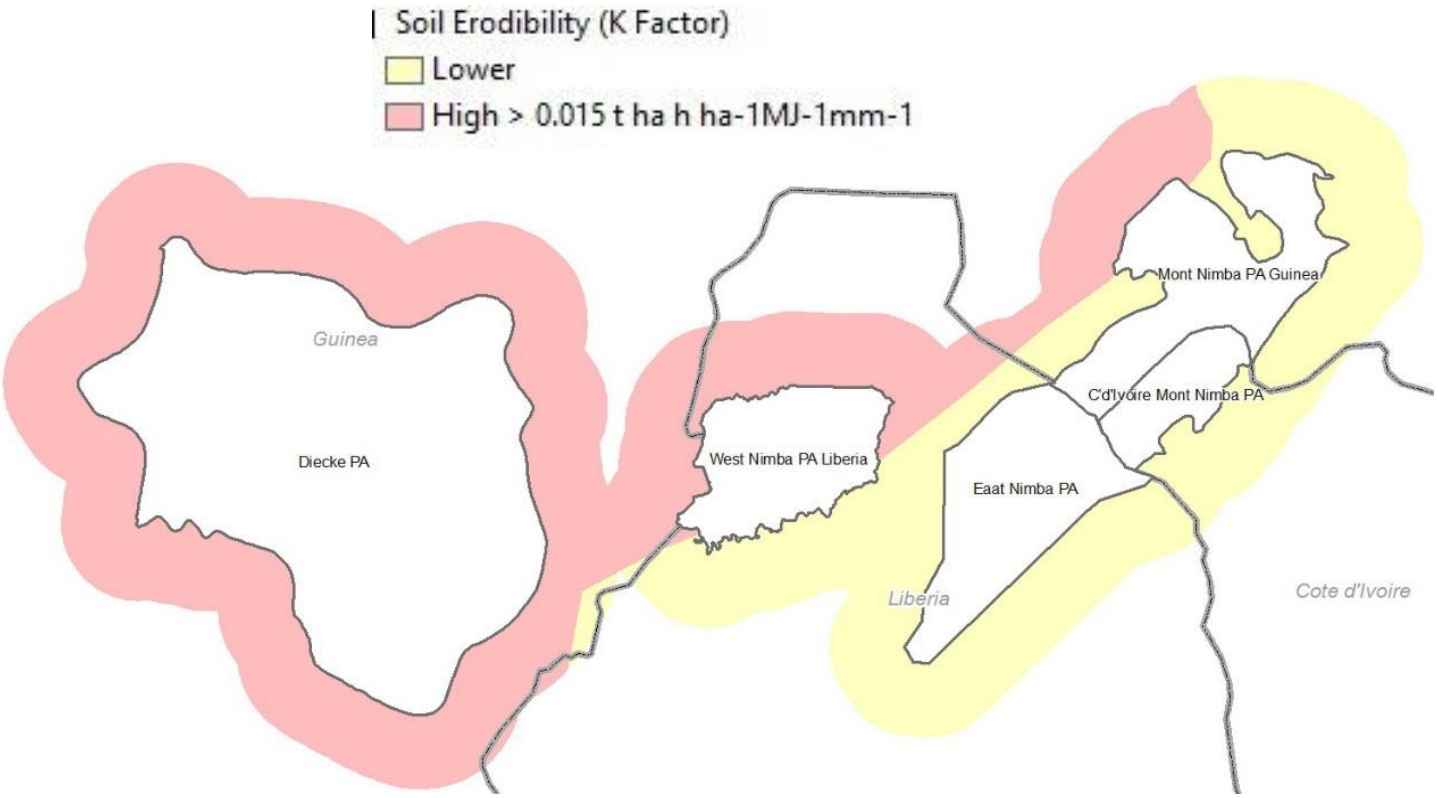




*Figure 25 MCA input elements Diecke / Nimba / Mont Nimba. Rainfall Erosivity, Soil Erodibility*

### 2.3.1 Multi-Criteria Spatial Analysis

Four input parameters are combined to calculate the FLR opportunities for the Diecke / Nimba complex: Rainfall erosivity, Soil Erodibility, Land Cover and slope.

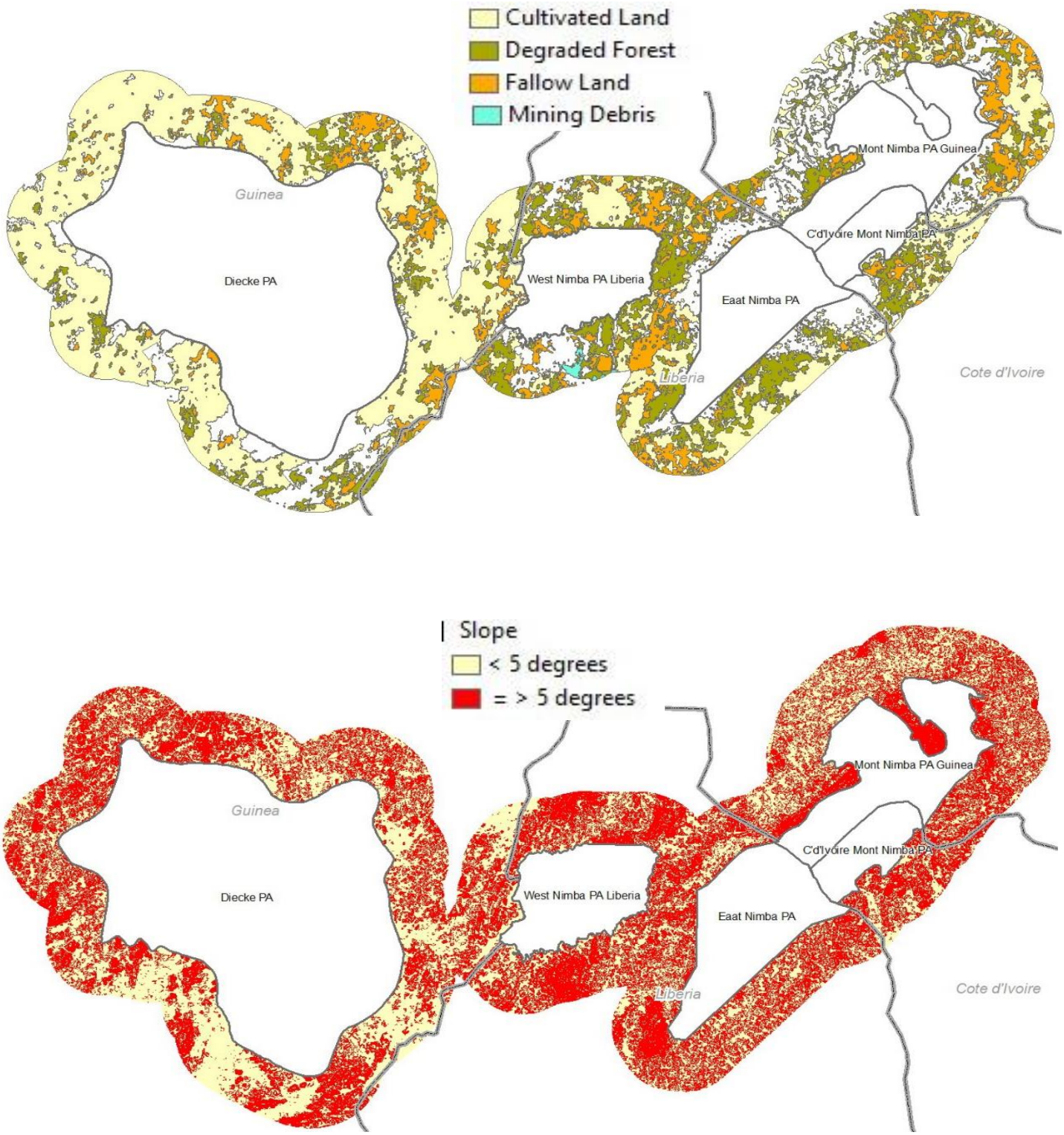



*Figure 26 MCA input elements Diecke / Nimba / Mont Nimba. LULC, Slope > 5 degrees.*

The same procedure is followed as for Gola and Wonegizi-Ziama in which the variables are spatially combined into a single dataset containing unique combinations that can be allocated to a FLR intervention plan according to an agreed priority. Table 21 shows the unique combinations, the suggested priorities and the areas of land involved. In this case the priorities suggested are draft proposals requiring consensus and agreement, but are based on physical conditions.

These are 1) restoration of degraded forest and fallow land on steep slopes in areas of high rainfall erosivity and soil erodibility and 2) restoration of all the remaining areas of degraded forest.

*Table 23 FLR Opportunities in Diecke / Nimba complex*

| LULC | H.Erod. | Erosivity | Slp > 5 | FLR_Opportunity / reason | HECTARES | PRIORITY |
|---|---|---|---|---|---|---|
| Deg.For | 0 | 0 | 0 | Restore all DF | 4,773.2 | 2 |
| Deg.For | 0 | 0 | 1 | Restore DF on steep slopes | 7,011.0 | 1 |
| Deg.For | 1 | 0 | 1 | Restore DF on steep slopes | 4,354.8 | 1 |
| Deg.For | 1 | 0 | 0 | Restore DF on erodible soils | 3,358.7 | 1 |
| Deg.For | 1 | 1 | 1 | Restore DF on steep slopes,HR,H Erod | 1,936.7 | 1 |
| Deg.For | 0 | 1 | 1 | Restore DF: High Erosivity, Steep slopes | 1,037.5 | 1 |
| Deg.For | 1 | 1 | 0 | Restore DF on HR,HErod | 738.1 | 1 |
| Deg.For | 0 | 1 | 0 | Restore DF in High Erosivity | 295.2 | 1 |
| mining debris | 0 | 1 | 1 | Afforestation of mining debris | 189.5 | 1 |
| mining debris | 0 | 0 | 1 | Afforestation of mining debris | 33.5 | 1 |
| mining debris | 0 | 1 | 0 | Afforestation of mining debris | 18.0 | 1 |
| fallow | 1 | 1 | 1 | Soil protection on fallow land | 762.7 | 1 |
| fallow | 0 | 1 | 1 | Soil protection on fallow land | 504.2 | 1 |
| cultivated | 1 | 0 | 0 | Soil protection on cultivated land | 18,566.7 | 0 |
| cultivated | 1 | 0 | 1 | Soil protection on cultivated land | 16,808.2 | 0 |
| cultivated | 0 | 0 | 1 | Soil protection on cultivated land | 9,488.1 | 0 |
| cultivated | 1 | 1 | 0 | Soil protection on cultivated land | 8,650.6 | 0 |
| fallow | 0 | 0 | 1 | Soil protection on fallow land | 5,614.2 | 0 |
| fallow | 1 | 0 | 1 | Soil protection on fallow land | 4,455.8 | 0 |
| fallow | 1 | 0 | 0 | Soil protection on fallow land | 3,444.3 | 0 |
| cultivated | 0 | 1 | 1 | Soil protection on cultivated land | 423.5 | 0 |
| fallow | 1 | 1 | 0 | Soil protection on fallow land | 364.1 | 0 |
| cultivated | 0 | 1 | 0 | Soil protection on cultivated land | 195.9 | 0 |
| fallow | 0 | 1 | 0 | Soil protection on fallow land | 117.6 | 0 |
| | | | | Totals | 93,142.1 | |

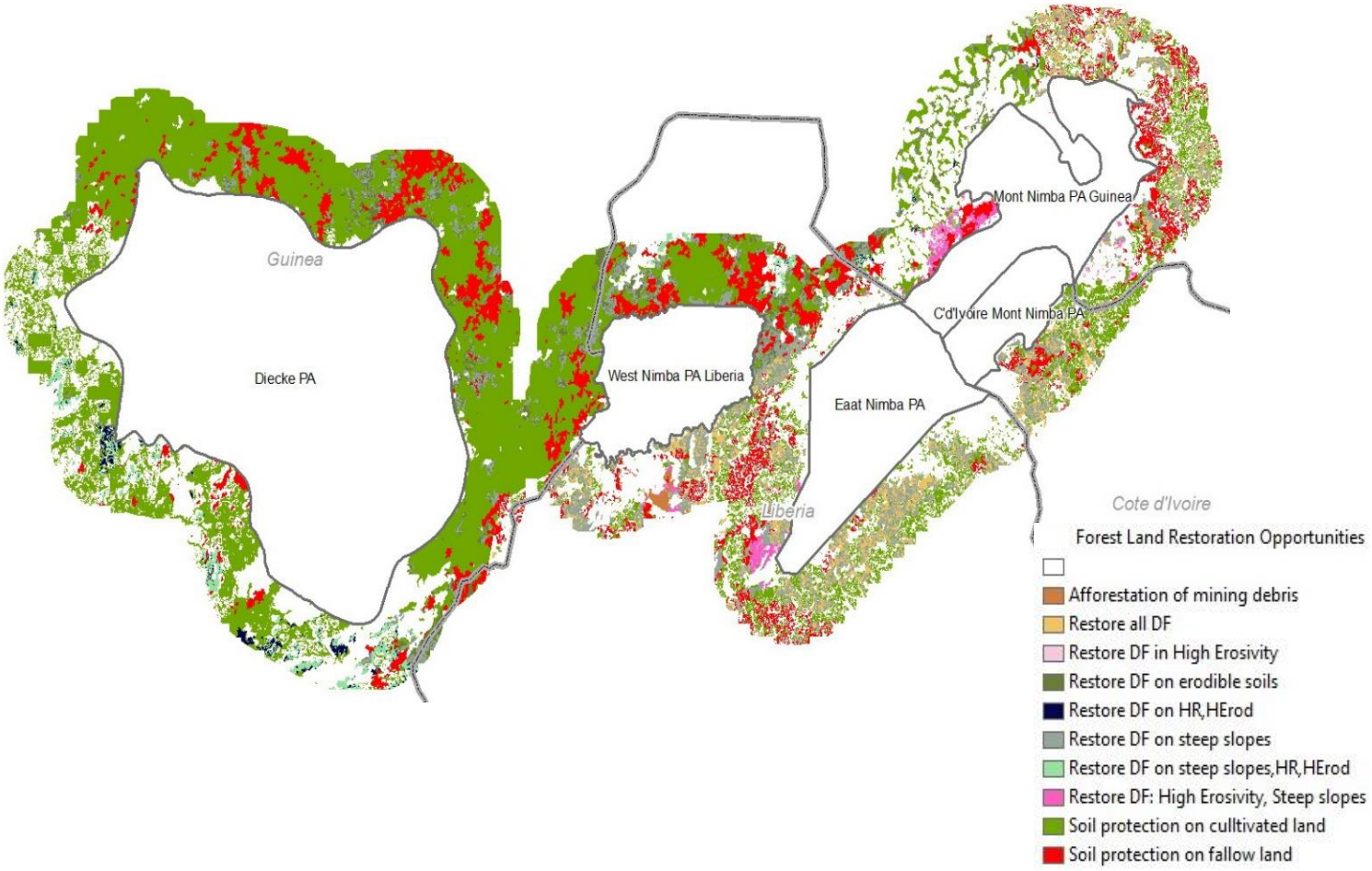



*Figure 27 FLR Opportunities map Diecke / Nimba complex*

## 2.4 Sapo-Grebo

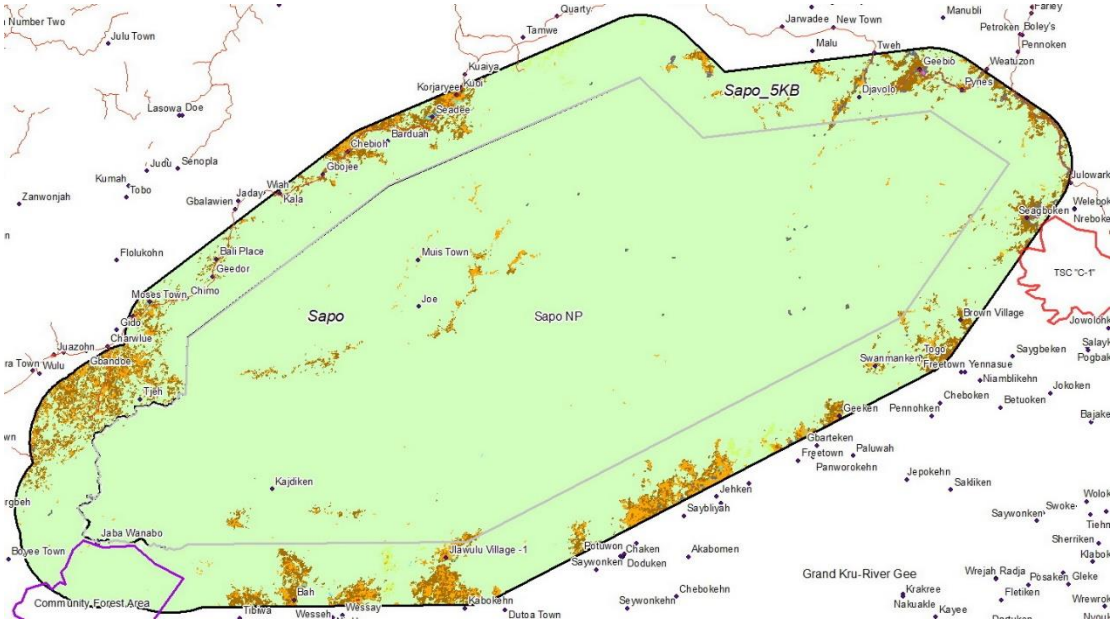
The Sapo - Grebo - Krahn - Tai area is a largely unbroken east-west tract of generally continuous forest that ecologically is a natural corridor for biodiversity, broken only by the national frontier between Liberia and Cote D'Ivoire.

### 2.4.1 Identification of forest degradation and MCA

Values in the spatial data used in MCA for the previous three sites, namely soil erodibility, rainfall erosivity, and soil cation exchange capacity (as an indicator of fertility) are all entirely homogeneous for the Sapo-Grebo-Tai (S-GK-T) complex, leaving only the land cover data as the basis on which to identify any potential FLR opportunities. This requires some additional confidence in the accuracy and reliability of the data for this purpose. The Liberia national report for S-GK-T correctly explains how the use of 'less than 30% forest cover' in the Metria data is an unsatisfactory and unreliable indicator for measuring actual degradation and is unusable at the site level from which to propose local FLR interventions. Forest cover 'less than 30%'

may indeed be degraded but may equally be naturally open or sparse, potentially due to variations in local geology soil type or other factors and may not be degraded in the sense of being restorable to any assumed previous state. To address this, a suggested 'workaround' use of the data is to identify land as 'degraded forest' if and only when it is physically adjacent to the 'shrub / fallow' or 'bare soil' categories, on the basis of a causal relationship between the two, thus eliminating the unlikely occurrence of isolated areas of 'degraded forest' and an unfeasible distance from settlements and roads.

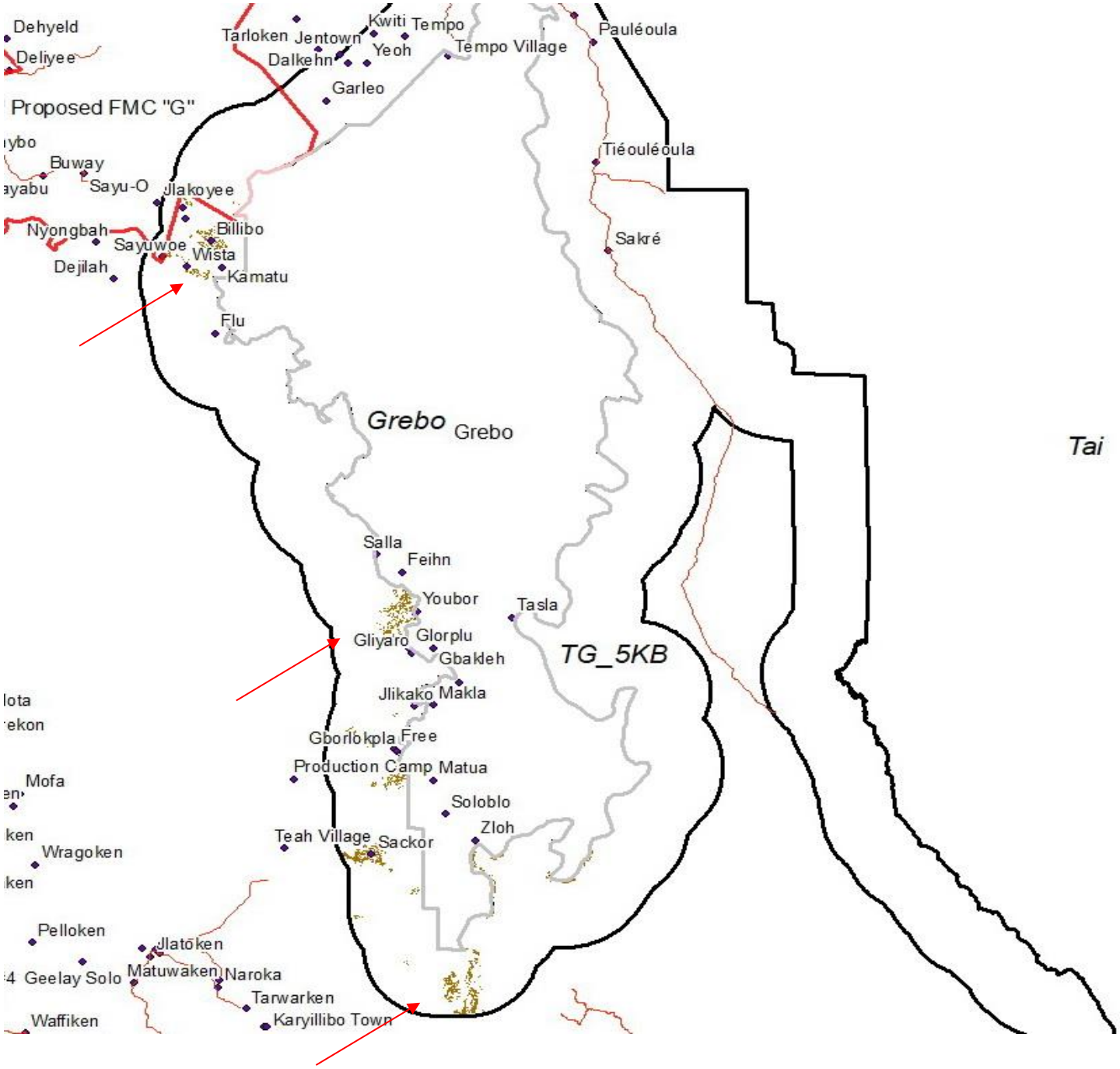
### 2.4.2 Sapo




The LULC map for Sapo revised on the above basis, is shown in Figure 28. With the lack of MCA spatial analysis for reasons mentioned above, it is estimated the 5km buffer zone may contain 10,538 hectares of degraded forest that could potentially be restored. Fix x2.

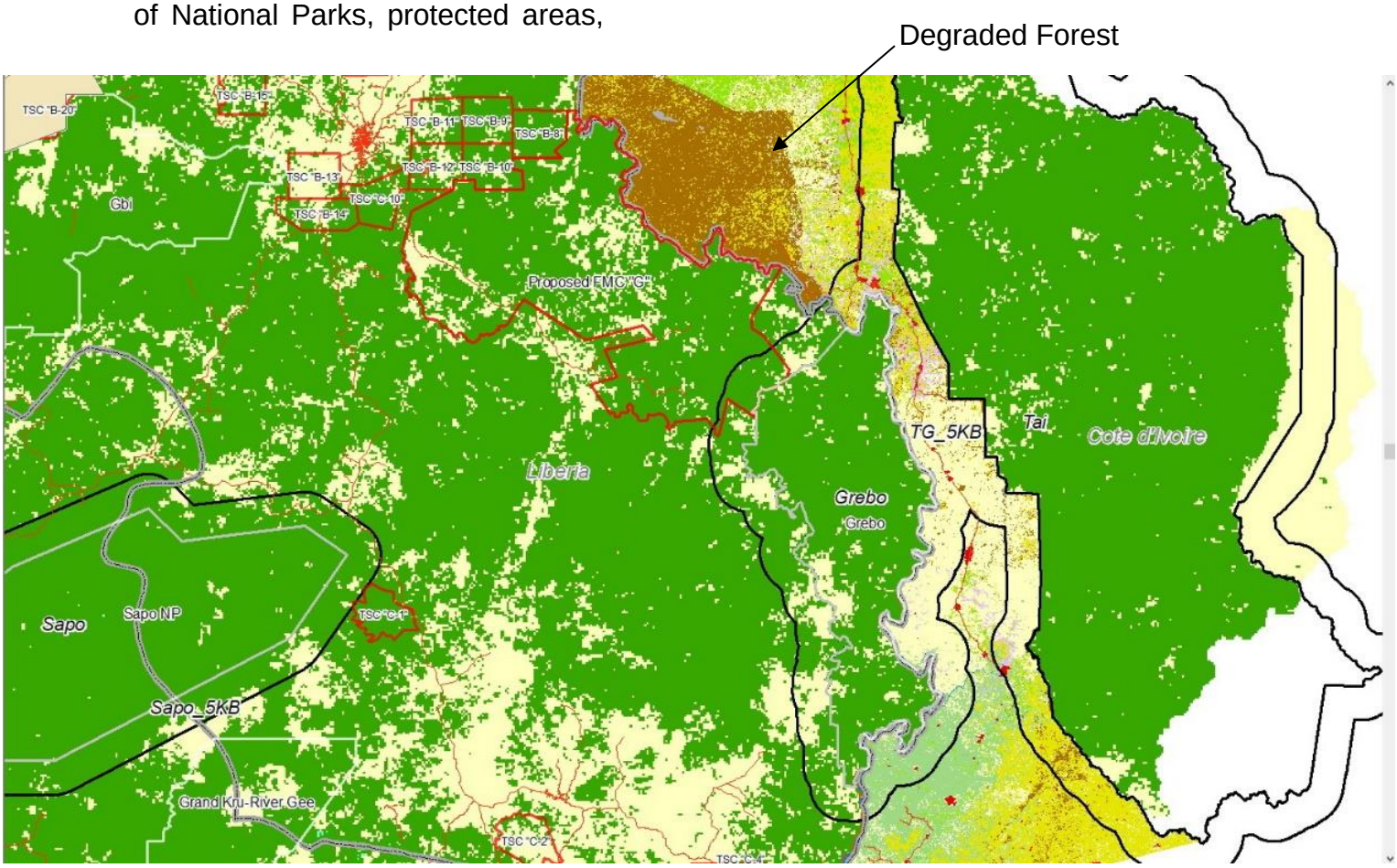
### 2.4.3 Grebo

The same workaround procedure to quantify potential degraded forest land in Grebo 5km buffer zone identifies 1,125 hectares of land.




Both the above estimates of forest degradation in Sapo and Grebo are unsatisfactory and probably inaccurate indicators of FLR opportunities as they are based on remote sensing image analysis designed to support REDD and calculate forest carbon, rather than degradation. This observation was made in the national report. While a more precise assessment using the same mapping procedure used for the other three sites would likely produce more accurate results, this would still miss the point that the scope for FLR in S-GK-T needs to be evaluated in the wider landscape level rather than within buffer zones, not least as Sapo is at least 50km distant from Grebo-Tai 5km buffer.

Figure 28 is an overview of Sapo Grebo-Krahn and Tai forests showing the position of National Parks, protected areas,




forest industries and timber sales companies (TSCs) in the landscape. In terms of landscape connectivity, where continuous tracts of forest form ecosystem corridors for the maintenance of plant and especially animal biodiversity Tai forest is entirely separated by the extensive agriculture and plantation crops (oil palm) on the Ivorian side.

*Figure 28 Forest Landscape between Sapo Grebo-Krahn and Tai (Globcover data)*

The large area of intact and degraded forest (brown area in Cote D'Ivoire immediately north – west of Grebo) is a high value and extensive (> 54,000 hectares) potential area for FLR lying opposite commercial forest concessions on the Liberian side (red polygons).

The multi criteria spatial analysis described earlier for Gola, Wonegizi–Ziama and the Diecke / Nimba / Mont Nimba complex uses detailed mapping to identify the area and location of FLR opportunities.

Currently available data for Sapo-Grebo-Tai does not allow for this, but given the importance of land use between forest blocks as functional wildlife and biodiversity corridors, a more detailed assessment is required that evaluates forest degradation in an area larger than simply the PA boundaries and associated PA buffer zones.

Such an assessment should form a more meaningful basis for planning FLR objectives at the wider landscape scale and with the intention to identify FLR

opportunities to restore or create functional forest connectivity between remaining large forest blocks. Typically, this would require a macro level of spatial planning that normally occurs in national development plans. FLR can define the highest priority areas to function as wildlife corridors, and thus deliver long-term strategic priorities for forest biodiversity conservation areas. This can be achieved through Key Biodiversity Area (KBA) and Red List of Ecosystem (RLE) layers where they exist, or with adequate surveying and inventorying of the FLR opportunities assessment area.

## 2.2 FLR opportunities areas (in the four transboundary landscapes)

Activities 1.4 and 1.6 – IUCN will develop flyers on the main technical FLR interventions for target groups

Activity 1.11 – IUCN will through the mapping of FLR opportunities provide information and recommendations on where and what type of agroforestry measures will be most appropriate

Activity 1.16 – IUCN will through the mapping of FLR opportunities provide information and recommendations on which forest areas are to be conserved and which should be restored as a matter of priority

# 3 | Forest landscape restoration interventions

## 3.1 Forest landscape restoration models

## 3.2 Design of technological packages

[The multi-criteria spatial analysis in combination with the current land-use land cover of the assessment area, will provide the input criteria needed to design the FLR transitions and will provide information on appropriate technologies needed to go from degraded and deforested state to restored and conserved state.]

## 3.3 Genetic Diversity and Species Selection

Maintenance of genetic diversity requires limiting the extent of cash crops and fast-growing timber species, within a predominantly natural forest which must retain an overall composition (10%) of local (slow growing) timber species, if necessary enriched by ANR. Fast growing fuelwood species such as *Acacia mangium, Gmelina arborea, Acacia A. auriculiformes* are identified as suitable tree types.

Substantial extension support is required by local farmers in all aspects of agroforestry; procurement and propagation of seedlings, silvicultural methods, crop management, harvesting and post harvesting methods, pest and disease control, maintenance of soil fertility, SALT methods and others.

Focus is on regeneration and restoration based on indigenous multi-purpose tree species that are already present in the landscape. An example of such is 'Inga', identified as a key local species in Gola Sierra Leone, successfully grown and propagated as a shade tree for coffee and cacao. Species selection for timber trees will come from community knowledge and follow local / domestic demand and preference for specific timber types coming from the local, urban or export markets. *Ceiba spp*., or *Musanga* are identified from Liberia as early colonizers of degraded land and Bambusa spp. or rattan as suitable NTFPs.

Propagation of plants such as, Piper Guinensis, Garcinia, Irvingia spp., Cola spp is also important (spice and stimulant NTFP species) and there is a growing market for the semi-solid crystal exudate from Daniellia ogea in Cote d'Ivoire (Liberia Sapo-Grebo report).

Expansion of cacao as a tree crop carries a particular element of risk, as its cultivation has devastated forests in Cote D'Ivoire and Ghana. Changes in market price may potentially encourage farmers to more resort to extensive (cacao) cultivation methods with a far less diverse mix of forest trees (e.g. more cacao, less timber species) and deforest more land to plant more cocoa and generate more income, with further forest loss and degradation.

# 4 | Evaluation of FLR actions

In order to evaluate the expected impacted of implementing the prioritized FLR actions an expert survey was developed. The survey focussed on five main categories:

1. Financial impact: questions on implementation costs, management costs, short-term profitability and long-term profitability.
2. Social impact: questions on short- and long-term jobs creation, household income and food security.
3. Gender dimension: questions on gender and income distribution and workload division.
4. Environmental impact: questions on carbon, erosion, water quality and biodiversity.
5. Scalability: questions related to resource availability and large-scale implementation

The same questions were used to evaluate each of the six prioritized FLR interventions. An overview of the survey questions for one of the interventions can be found in *Annex 1*.

The survey was developed in SurveyMonkey, and sent to experts in different fields related to FLR and rural development (such as agronomists, foresters, sociologists, economists, etc.) identified by the national focal points of the project. The survey was open from August until October 2020. A total of 36 experts completed the full survey. An additional 12 respondents filled out the survey partially; these answers were not considered here.

Answers were analysed through multi-criteria analysis. First, answers were given scores (see questionnaire in the annex X for the scores), then normalized a first time to develop financial, social, gender, environmental and scaling indicators (results presented in the following five figures), and then normalized a second time to provide equal weight to each indicator (results presented in the spider web diagrams).

The results for each category per FLR action are presented below (Figures C-G). The overall results are presented afterwards (Figures H1-H6). The annex provides an overview of the detailed answers for each survey question.

**Results per indicator**

**Financial indicator**: consist of four separate indicators (obtained by normalizing the answers to four survey questions, see Annex). The best score is given to actions expected by the respondents to have lower costs and higher revenues.

Figure C shows that overall there are no large differences between the different interventions, although ‘Enrichment planting and rehabilitation of home gardens’ received the highest score, and the implementation of ‘Rubber agroforestry’ the lowest. The difference is due to higher expected short-and long-term revenue, not because of expected higher costs in the rubber, and other, agroforestry systems.

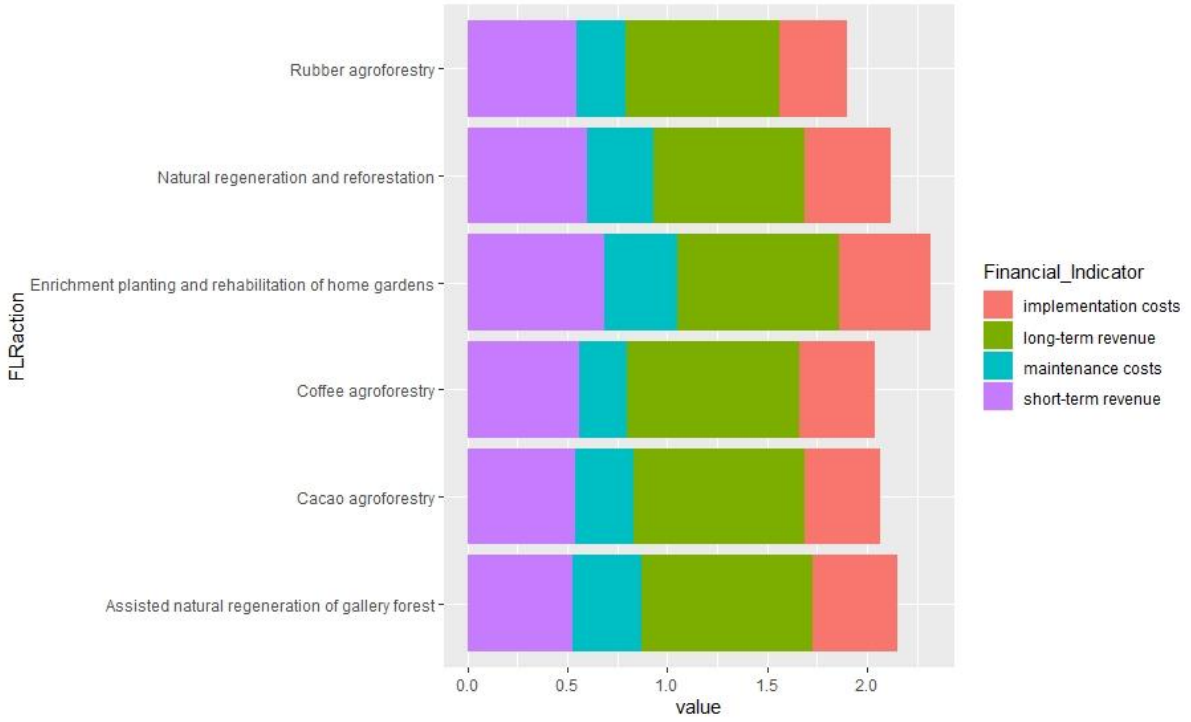



Figure C: Scores financial indicators per FLR intervention

**Social indicator**: consist of four separate indicators (obtained by normalizing the answers to four survey questions, see Annex). The best score is given to actions expected to have the highest impact on lowering household poverty, improving food security, and creating short and long-term jobs.

All restoration interventions are expected by the survey respondents to have a very positive impact on the social indicators. There are no real differences between the different interventions, although overall implementing a 'Cacao agroforestry system' is expected to have the highest positive social impact.

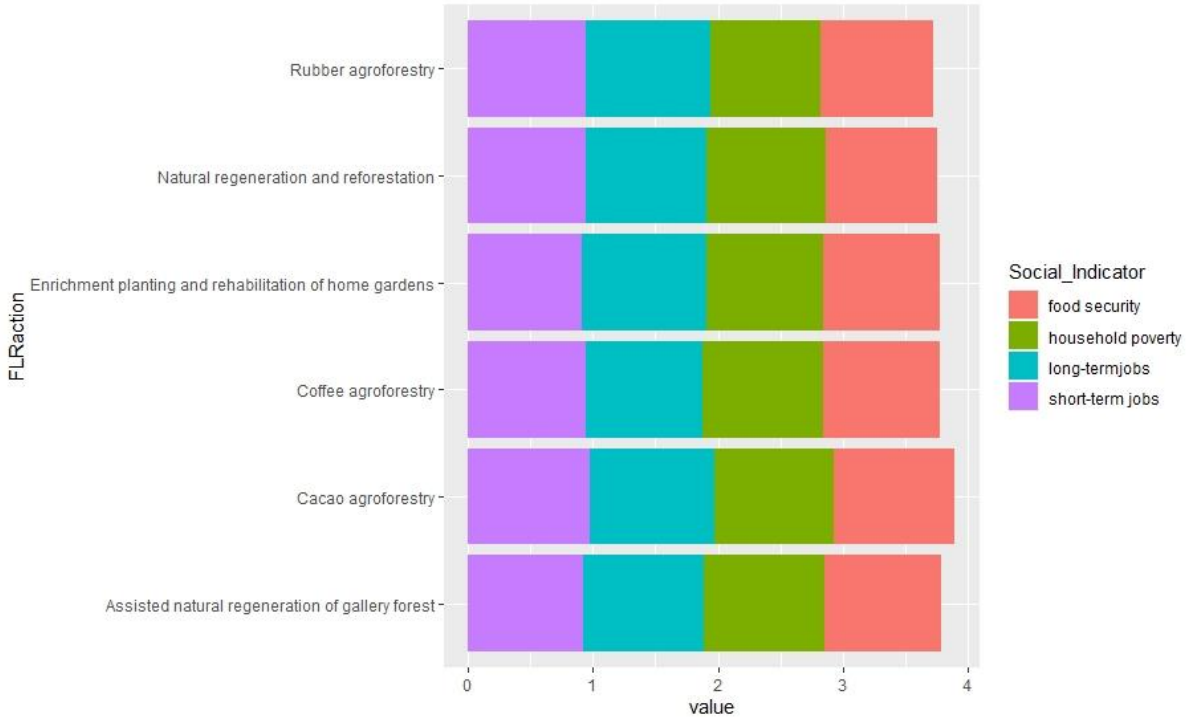



Figure D: Scores social indicators per FLR intervention

**Gender indicator**: consist of two separate indicators (obtained by normalizing the answers to two survey questions, see Annex)
The best score is given to those FLR interventions that do not overburden women (less work done by women), but that do assure an equal revenue share between men and women or more for women.
As can be observed from figure E, most respondents do expect that the majority of the work burden will fall on women. This is especially the case for 'Enrichment planting and rehabilitation of home gardens', where the score is even negative. However, most respondents do expect that revenues from the FLR interventions will be shared equally amongst men and women. The gender indicator shows thus both an expected negative, and an expected positive impact of the interventions.

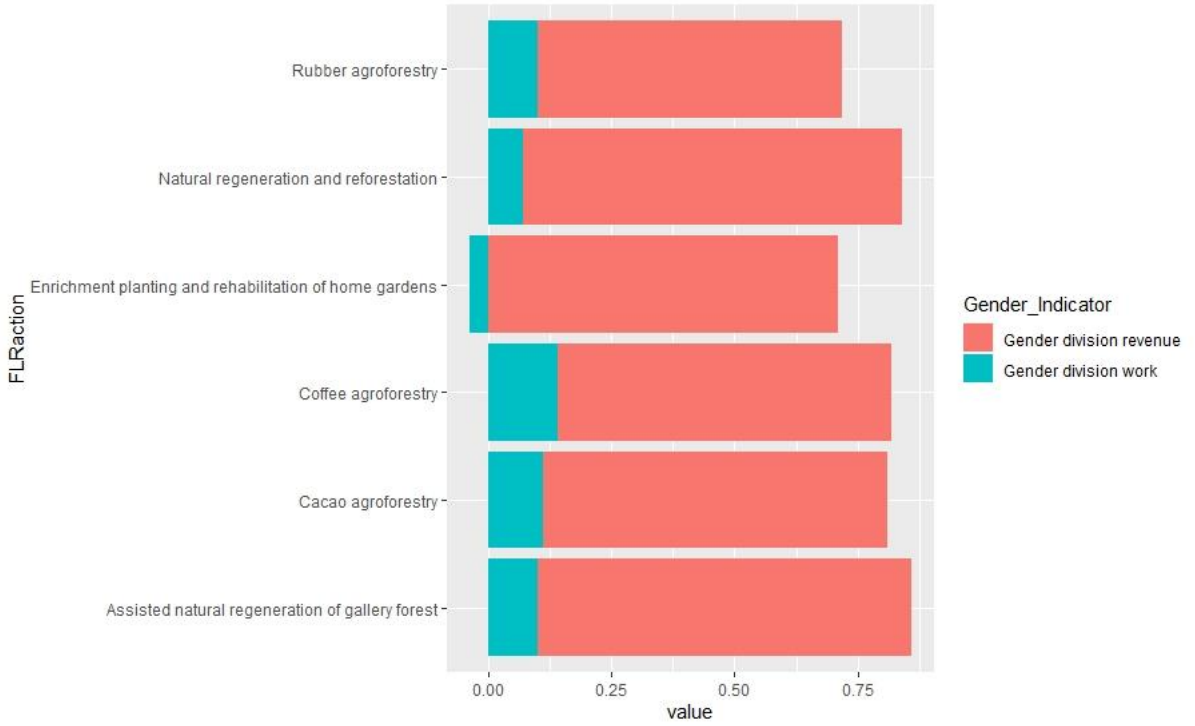



Figure E: Scores gender indicators per FLR intervention

**Environmental indicator**: Consists of four separate indicators (obtained by normalizing the answers to four survey questions, see Annex). The highest score is given to those interventions that are expected to have the highest impact on erosion reduction, the highest positive impact on biodiversity, the strongest increase in carbon sequestration and storage, and the highest impact on improved water quality. Survey respondents on average expect the interventions to have a positive impact on each of the four environmental impacts considered. 'Natural regeneration and reforestation' and 'Assisted natural regeneration of gallery forest' are considered to have overall the highest positive impact, whereas 'Enrichment planting and rehabilitation of home gardens' received comparatively the lowest score.

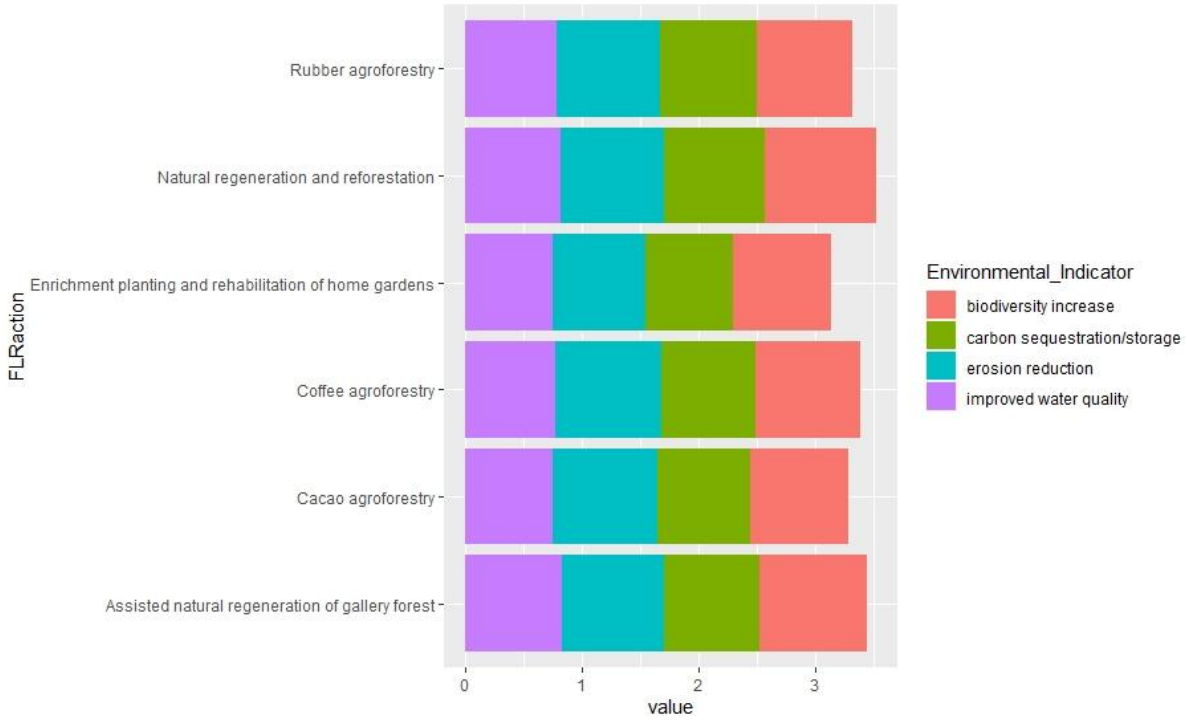



Figure E: Scores environmental indicators per FLR intervention

**Scaling indicator:** Consists of two separate indicators (obtained by normalizing the answers to two survey questions, see Annex).

The highest score is given to those interventions for which respondents considered that there are available necessary resources and for those interventions for which respondents considered that large scale implementation is feasible.
Overall respondents expect that scaling of the FLR interventions in possible as it is considered overall that resources are available and that it implementing these interventions on a large scale is very feasible. 'Natural regeneration and reforestation' and 'Assisted natural regeneration of gallery forest' received the highest scores for the scaling indicators. 'Enrichment planting and rehabilitation of home gardens' received comparatively the lowest score.

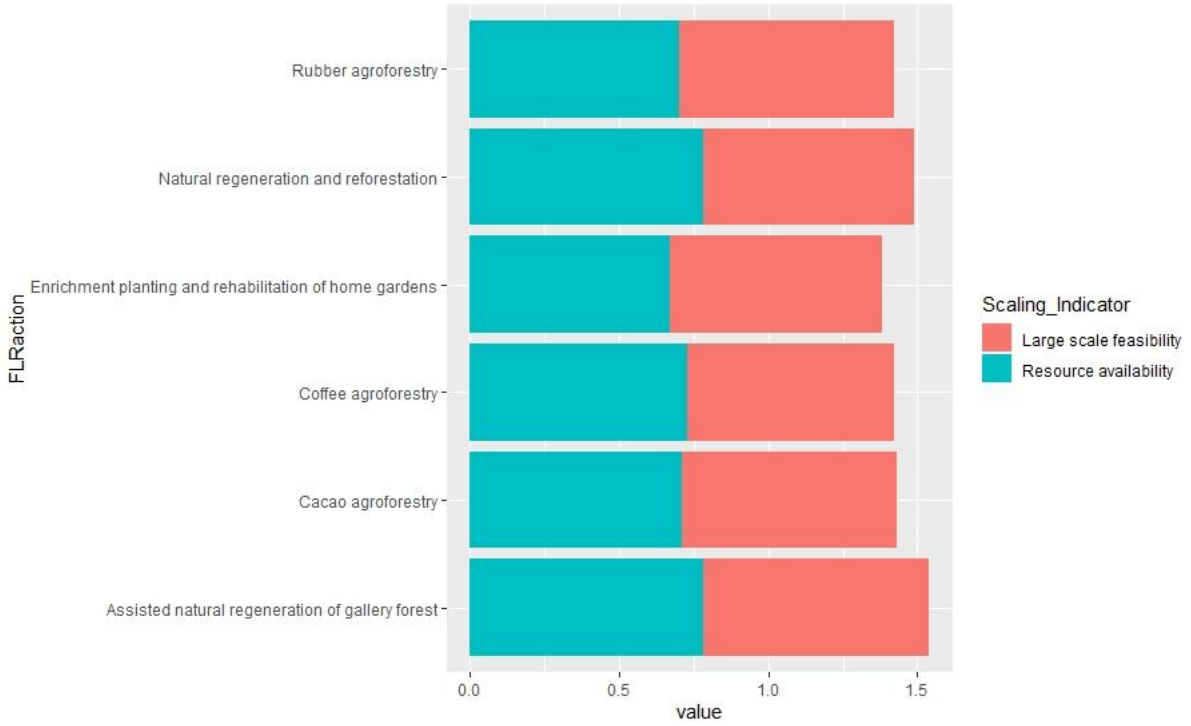



Figure G: Scores scaling indicators per FLR intervention

**Overall evaluation**

The following spider web graphs show the normalized scores for each of the five indicators (Figure H1-6).

For all the FLR interventions, the lowest scores are observed for the financial and the gender indicators, the social indicator receives for each intervention the highest score.

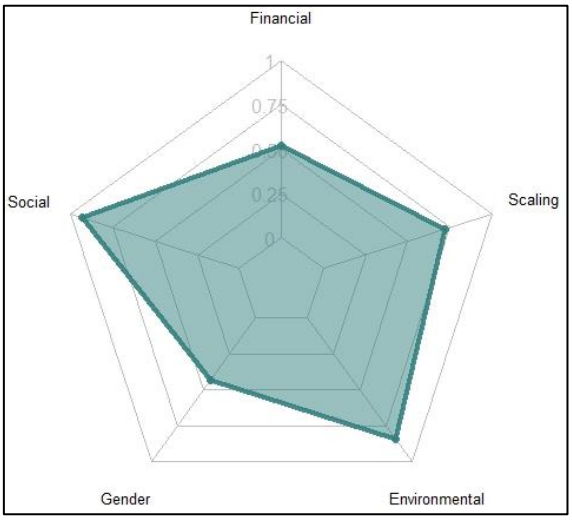



Fig. H2: Assisted natural regeneration

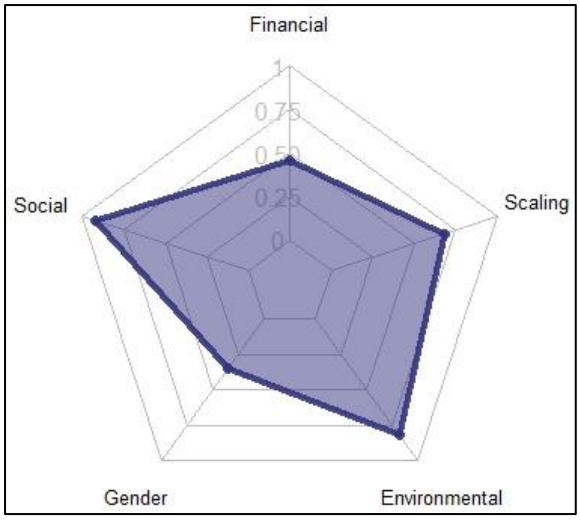



Fig. H3: Rubber agroforestry system

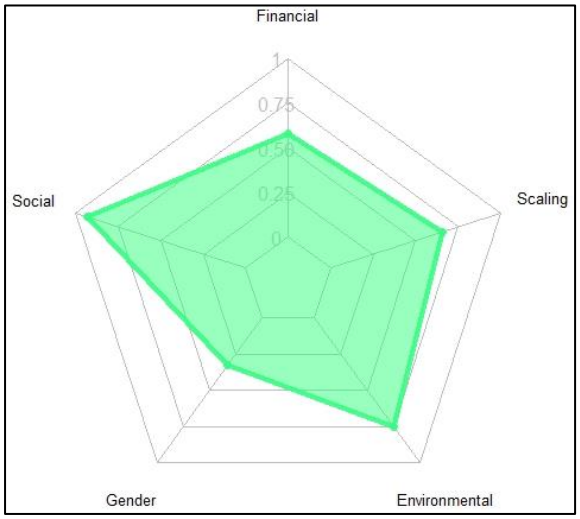



Fig H4: Enrichment planting and rehabilitation of home gardens

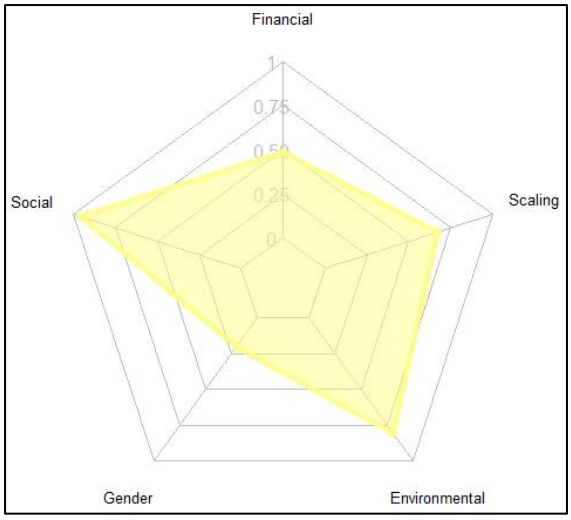



Fig. H5: Cacao agroforestry system

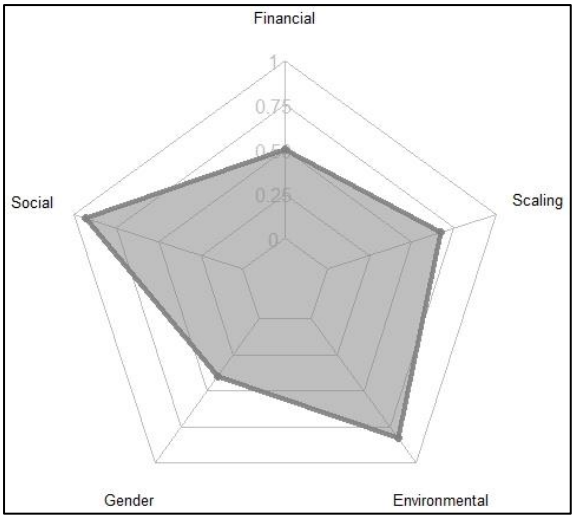



Fig H6: Coffee agroforestry system

Table RR provides an overview of the normalized scores for each overall indicator used (see also the spider webs above), as well as the sum of the individual scores. There is not a lot of variability among restoration actions in the average normalized score survey respondents gave to each indicator.

As was already observed in the spider webs, respondents gave lower scores to the financial indicator and the gender indicator, with gender scoring the lowest for all the interventions. However, the cacao agroforestry system does score significantly lower in the gender indicator compared to the other interventions.

Overall, considering the sum of the individual indicator scores, 'Natural regeneration and reforestation' and 'Assisted natural regeneration of gallery forest' received the highest score, 'Cacao agroforestry system' the lowest.

**Table results 5 indicators and sum**

| FLR technique | Indicator type (max. score = 1) | | | | | (max = 5) |
|---|---|---|---|---|---|---|
| | Financial | Social | Gender | Environmental | Scaling | SUM |
| Gallery forest | 0.52 | 0.93 | 0.43 | 0.84 | 0.72 | 3.44 |
| Reforestation | 0.52 | 0.92 | 0.41 | 0.86 | 0.70 | 3.41 |
| Enrichment | 0.58 | 0.93 | 0.33 | 0.75 | 0.66 | 3.25 |
| Rubber | 0.46 | 0.92 | 0.35 | 0.82 | 0.68 | 3.23 |
| Coffee | 0.50 | 0.93 | 0.40 | 0.83 | 0.67 | 3.33 |
| Cacao | 0.49 | 0.96 | 0.20 | 0.81 | 0.67 | 3.13 |

# 5 | Modelling and optimizing investment in livelihoods, ecosystem services and biodiversity impacts from different restoration transitions

[Quantified ecosystem service benefits expected of restoration interventions such as carbon sequestration, water quality and quantity, enhanced food systems and benefits for biodiversity]

FLR investments in developing agroforestry are expected to deliver a significantly beneficial impact on local livelihoods but will also vary according to the type of agroforestry model or intervention implemented, the relative proportions of cash crops involved (i.e. cacao, rubber, oil palm) whether fast growing timber species, multipurpose trees or slower growing native species are proposed, involving a longer delay period while the trees reach marketable sizes.

Demand for cash crops exists in the local and the export markets, and a proportion is also typically used in direct household consumption.

## 5.1 Ecosystem Services (carbon, water etc.)

All four landscapes contain high carbon forests of exceptionally high conservation importance from the global perspective of limiting GHG emissions into the atmosphere.

From a local stakeholder perspective, the priority ecosystem service is maintenance of an abundant fresh water supply, (possibly also including fresh water fish resources) and the regulatory effect of forest in minimizing the incidence of local flood events; ensuring local road networks remain open and viable during the year.

In terms of hydrology and geographic position in the landscape, both Wonegizi Ziama and the Diecke / West Nimba Mont Nimba complex are located on steeper land in the upper headwaters of river catchments, thus fulfilling both a regulatory and erosion protection function, reducing soil erosion rates and conserving water quality. Gola, and Sapo-Grebo-Krahn-Tai are in areas of relatively flat topography but within areas of very high erosivity hence the forest cover limits erosion rates and stabilizes stream and river banks (Fig 3.4).

The Wonegizi landscape (Proposed Protected Area and 5 km Peripheral Zone), occurs in the upstream part of the Lofa River basin, one of the nine river basins of the Mano River Union sub region. The health of the Lofa Basin partly depends on the health of the forests within the Wonegizi landscape where local land use practices (e.g. agriculture) make a significant contribution to the health of forests.

## 5.2 Biodiversity

The Upper Guinean forest in the four MRU countries, and in Liberia particularly, is the largest single area of high conservation value forest in West Africa, estimated to

account for 40 percent of the remaining total. The forest is of global significance as the last remaining habitat for a large number of mammals, primates, birds and plant species.

# 6 | Social Aspects of FLR

FLR is conceived of as a civil society / people / community centred participatory approach based on communities and settlements within or nearby the 5-kilometre buffer zones. For implementation, a long-term mechanism / platform is needed whereby all stakeholders can meaningfully participate in the decision-making process.

The ROAM process identifies opportunity areas for restoration and the most effective interventions that should be implemented according to the needs and objectives of local communities and landscape level actors. FLR therefore aims at using a collaborative and participatory land-use planning process, ensuring the involvement of local communities and other local stakeholders.

This involvement ranges from the identification of degradation proxies and criteria for selecting the appropriate agroforestry interventions for specific areas.

All the national ROAM reports detail extensive face to face participatory meetings at selected villages within the forest buffer zones, at which community representatives voiced concerns over land degradation and the scope and nature of counteractive measures that are preferred, to guarantee food security and sustainable livelihoods.

Livelihoods within and around the landscapes are invariably based on cultivation of a variety of food crops, grown mainly for household consumption (subsistence) but also including some cash crops. Intense cultivation of valley bottoms wetlands (‘swamp rice’ intercropped with vegetables) commonly found in Gola SL, Diecke, E Nimba, and Ziama is limited in extent and represents a much lower threat to the forest landscapes than the rotational upland farming methods common at Wolongizi Ziama.

The social challenges of FLR involve communities successfully making the transition from livelihoods based on subsistence farming of a number of food crops, with some surplus production for market to one based much more on intensifying cultivation of food crops and marketing cash crops and forest products. It is expected that implementing FLR activities within and by communities will need to be enshrined in clear agreements in which laws and regulations are balanced and agreed with by free prior and informed consent (FPIC).

The details and scope of decisions and commitments made at the national level may not be well understood locally and ensuring empowerment of local communities and local governments to successfully implement FLR remains a challenge. Addressing

weaknesses in local government and securing the shared participation of traditional authorities is a part of this process.

## 6.1 Stakeholder Mapping

Stakeholder identification and engagement has taken place extensively within each of the national ROAM consultative processes, taking the form of:

Transboundary FLR assessment workshops to identify and engage relevant stakeholders, build community awareness, and collect information on laws, policies, customs, and governance in the landscape(s)

Stakeholder consultation meetings to collect household and village data and inputs on legal, policy, and governance components of forest landscape restoration and methods of sustainable land management.

Validation workshops to support and sustain land use planning and land use negotiations with stakeholders and understand those with the rights or presence to manage land or natural resources in the local situation;

The potential for restoration actions to succeed is founded on community stakeholder engagement and identifying and mitigating legal, policy, custom and governance barriers.

## 6.2 Gender Analysis

The national reports included gender analysis, in villages sampled within the 5-kilometre buffer zones, as part of data collection for household survey questionnaires and focus group discussions to understand socio-economic roles and responsibilities.

Women's groups are frequently reported to be operating in the landscapes (Liberia report, S-GK-T) supported by local NGOs. Such groups can be further supported with skills and networking tools to access additional resources, such as hybrid seedlings, processing technology, and information about markets. Existing village savings and loans associations can also be supported within which women act as an effective catalyst for commercial activities supporting landscape restoration.

In Liberia, women's groups, constituted as Village Savings and Loans Associations (VSLA) are important traditional organisations which are able to provide credit.

## 6.3 Cultural dimensions

The considerable cultural shift in farming methods and livelihoods from rotational subsistence farming to intensive food crop production and the cultivation and sale of

cash crops from agroforestry will be entirely reliant on the availability of extension expertise to deliver capacity and ensure food security.

Efforts to limit or constrain hunting / trapping of bush-meat as a 'traditional' activity will need to be supported by investments in other income generating activities or potential food sources (see recommendations).

### 6.4 Marginalized Groups

The position of national government land policy and community attitudes will determine the extent to which non-national economic migrants are able to participate in future FLR activities.

This may be easier for former conflict refugees who have effectively become residents rather than seasonal migratory wage earners.

# 7 | Enabling Environment for FLR

The enabling environment refers to all collective factors (institutional, legal, social and cultural) that contribute to and facilitate achievement of the desired FLR outcomes. Typically, these are the direct result of policies and plans established by the national governments. The Forest Policy (2010) of Sierra Leone, for example, promotes an enabling environment for effective FLR by:

- Emphasizing the need to engage in land use planning for forestlands with relevant stakeholders. It seeks to develop institutional links with other government agencies responsible for land use and land use planning, civil society organization (CSO), and communities to harmonise land acquisition, land use planning and land tenure policies.
- Supporting the development of collaborative partnerships with rural communities and other relevant stakeholders for the sustainable management of Forest Reserve forests
- Ensuring a sustainable stream of economic, social and environmental benefits and promoting community forest management by supporting establishment, expansion and management of community forests for economic benefits and forest ecosystem health. Community forests are identified as those forestlands outside of Forest Reserves that are considered community property. Such lands were managed by the government for the communities and were historically referred to as "protected forests".

An enabling environment for implementing FLR interventions at the local level requires sustained support to farmers, advice and assistance in adopting agroforestry methods, new silvicultural practices and cultivation of cash crops using intensive rather than shifting cultivation farming methods. This involves coordination

and compliance with land use planning objectives at the local level, verifying there are clear agreements on location and extent of permitted activities.

National governments should lead by ensuring that land use / tenure rights for smallholders and communities are provided for while the MRU secretariat plays a crucial role by ensuring institutional actions and responses to political commitments made at the national level are coordinated and effectively supported locally.

## 7.1 National Strategies (NBSAP, NDCs, etc.)

MRU countries are signatory to various regional and international treaties, agreements and international obligations related to forestry and forest management, biodiversity and wildlife conservation. All 4 countries have ratified the UN Convention on Biodiversity (CBD), a multilateral treaty whose objective is to develop national strategies for the conservation and sustainable use of biological diversity.

The Convention requires that countries prepare a national biodiversity strategy and ensure that this strategy is mainstreamed into the planning and activities of all those sectors whose activities can have an impact (positive and negative) on biodiversity.

All 4 MRU countries have produced NBSAP strategy documents covering the present period, indicating priority actions that are planned or currently being undertaken.

Liberia NBSAP

Liberia's NBSAP focuses on forest conservation and protection by addressing the unsustainable extraction and collection of firewood and destructive production of charcoal.

Various estimates indicate that almost all the population of Liberia (up to 99%) is dependent on wood fuel (charcoal and firewood ) to satisfy basic needs for cooking and heating (UNEP 2004).The production of charcoal and firewood is an important source of employment and supplemental income for many families, accounting for as much as 40% of their total income .With the lack of electricity supply in the country and shortage of other alternative sources for household energy supply, the demand for wood fuel is expected to continue to increase.

Cote D'Ivoire NBSAP

Specific to this project, the NBSAP cites conservation of habitat plant species on Mont Nimba for a rare and endangered species of amphibian (the viviparous toad) as an objective.

Guinea NBDSAP

As high carbon value humid forests, preserving the ecological integrity of Ziama and Diécké is given critical importance for the mitigation of climate change, noting also that deforestation and forest degradation at these locations is accelerating rapidly. Strategic objectives by the NBSAP towards mitigation of currently ineffective forest management methods include:

Objective 11. Creation of new protected areas in forests, (forest) galleries, savannahs, mountains and continental waters (ponds, rivers, etc.) *to reach at least 17% of national territory*.

Goal 15. From 2011 to 2020 at the latest, resilience of ecosystems and carbon stocks is increased, through measures of forest conservation and restoration including the *restoration of at least 15% of degraded ecosystems*, thus contributing to the mitigation of climate change and against desertification.

15.3 Gender. Ensure women are participating in decision making in forestry at every level.

15.3. Creation and management of community forests (with the participation of rural women) in rural communities and villages. Creation of 186 community forests is planned.

Goal 5. From 2011 to 2020, the pace of degradation and fragmentation natural habitats, including forests, is significantly reduced to almost zero.

Strengthening the preservation of ecosystems for populations in mountainous area (i.e. Fouta Djallon, including Ziama).

Sierra Leone NBSAP

Includes pledges to develop woodlots and reduce pressure on native forest for fuelwood using fast growing species such as *Acacia mangium, Gmelina arborea, Acacia A. auriculiformes.*

Restoration of land degraded by mining

Forest and land degradation by mining has been one of the most environmentally destructive activities in Sierra Leone yet despite the huge damage to land and vegetation, very little restoration activities are under way.

Strategic Output B1

B1(i) Strongly enforce forest laws and regulations with penalties and fines levied on violators and encroachers

B1(iii) Support reforestation activities at community and grass root levels for terrestrial and mangrove forest

B1(iv) Sponsor and undertake research on forest regeneration with native tree species

The UNFCCC 2016 Paris Agreement and Intended Nationally Determined Contributions (INDCs)

All MRU countries have ratified the 2016 Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC), which deals with GHG emissions, their mitigation, methods of adaptation, and finance mechanisms. The Paris agreement requires countries to produce INDCs that detail steps taken or planned towards emissions reductions, adaptations to climate change impacts, and what support the country needs, or will provide, to address climate change. The INDCs combine the (top down) United Nations climate agreement with (bottom-up) elements through which countries put forward their agreements in the context of their own national circumstances, capabilities, and priorities, with the goal of reducing global greenhouse gas emissions enough to keep global temperature rise to 2 degrees Celsius.

Sierra Leone INDC

Sierra Leone's INDCs policy for climate change mitigation, adaptation, and enhancement of carbon stocks is based on shifting from 'a brown to a low carbon, climate resilient green economy'. Among the proposed mechanisms to implement this objective, (described in Strategy 4 of the Adaptation Component of the INDC) is restoration of degraded lands with high a productive potential.

This activity is related to the FLR opportunities identified in this report and can be used in recommendation for stakeholders to incorporate in their land-use agreements

Liberia INDC

Liberia's INDC policy is centred on promoting the use of renewables rather than wood as the primary source of energy. The energy sector is the highest contributor of GHG in Liberia emanating mainly from the use of traditional fuels such as firewood, charcoal and palm oil and the use of fossil fuels, especially petroleum products.

In 2004, it was estimated that over 95% of the population relied on firewood and charcoal for cooking and heating needs and palm oil for lighting, whether in urban or rural populations. The National Energy Policy (2009) also focuses on reduced reliance on traditional fuel and increased use of renewable energy sources.

Liberia is also implementing Reducing Emissions from Deforestation and Forest Degradation (REDD+) readiness activities, which seeks to increase the amount of forested land through reforestation of degraded lands.

Of relevance to this study, Liberia's INDC states as part of its climate change adaptation strategy, it will develop climate resilient crop/agroforestry diversification and livestock production systems.

Guinea INDC

Guinea's INDC includes a commitment to manage its forests sustainably in the future, including re-forestation programmes throughout the country of 10,000 ha per year, with sustainable management of replanted areas.

It is noted the main constraints (in the forest sector) include inadequacy of financial and human resources, gaps in scientific knowledge on the level of forest degradation and the low level of local community involvement in sustainable forest management.

It is also noted that for new reforestation programmes and sustainable management of replanted areas, the National Forest Fund and Environmental Protection Fund have a shortfall of resources to fulfil these commitments; a detailed assessment of the arrangements for topping up funds is required, to cover needs relating to the protection and enhancement of forest resources.

Both the forest enrichment planning (ANR) and community implemented mixed agroforestry activities proposed under this project are consistent with the above objectives.

Cote D'Ivoire INDC

Cote D'Ivoire's INDC policy commits the country to implementing a strategy of GHG emission reduction from deforestation and forest degradation in addition to achieving sustainable forest management and implementing ambitious reforestation policies (REDD+). A 28% decrease in emissions from the low-carbon scenario is planned, compared to the base scenario.

Development of the forest sector is planned through sustainable forest management, improved forest governance and the objective of reaching 20% forest cover of the national land area.

Of specific relevance to FLR objectives are plans for:

Restoration of 'classified forests' with the involvement of local communities - the rehabilitation of degraded lands and reforestation of savannah areas, and strengthening of carbon stocks in degraded forests through the promotion of village reforestation.

Establishing a payment-for-service incentive system (PES) to encourage village reforestation, conservation of natural forests in rural areas and support small producers adopt sustainable production practices.

## 7.2 Policy and Institutional Analysis

National forest policies and laws on forest sector management typically encompass all the principles that should ideally guarantee and sustain effective forest conservation and best practice, yet these are compromised and undermined at the local level by weak local government, and misunderstanding or misinterpretation of the enforcement of laws. Often this is caused by overlapping institutional jurisdiction of different departments and the failure to effectively integrate community involvement or the participation of traditional authorities. Most national forest policies are involved with implementing a number of forest sector strategies and policies that incorporate regional and international initiatives combating forest degradation. These including REDD+ and in Sierra Leone the Global Climate Change Alliance plus (GCCA+) which involves generating basic data on forest resources and the dynamics behind deforestation, strengthening institutions, adapting the policy and regulatory framework, and establishing various stakeholder mechanisms. The GCCA+ will strengthen the Forestry Division and the National Protected Area Authority (NPAA) to prepare the country for REDD+ mechanisms and promote low-carbon initiatives. The EU-Liberia Climate Change Alliance + (Liberia) Ministry of Environment and Forests support climate mitigation solutions as outlined in the INDC.

### 7.3 Tenure

Traditional, customary tenure is the common form under which rural land is used (rather than with any or registered title) in the four areas. Land use rights under CT are typically very indistinct and community perceptions of the area extent under their jurisdiction may also be very imprecise.

Conflicting estimates of land status under CT may result where land rights are conferred by use (i.e. simply by clearing forest for cultivation) or by inheritance. Land under CT may also be gifted or shared.

While smallholder farmers with a formal land title may be able to access the necessary finance for loans to support FLR and have security of tenure, customary tenure is normally not feasible as basis for credit guarantee.

Weak links between institutions and lack of coordination between government agencies at national and local levels to resolve conflicting policies, mandates and land use practices can contributed to ambiguity in land tenure, conflicting land uses, and unsustainable management practices. In Sierra Leone, the Forestry Division is responsible for the management of the Forest Reserve, while the Ministry of Mines

and Mineral Resources can issue licenses for prospecting and mining without the need for consultation before licences are issued. The Ministry of Lands may recognise individual rights to land under a 12-year adverse possession claim and grant title without approval from the Forestry Division, even where those lands may be located in Forest Reserve areas. These and other areas of potential conflict and lack of coordination need to be addressed in order to provide security of land tenure.

### 7.4 Readiness diagnostic

With national level agreements and international commitments now signed and in place, the focus is on ensuring FLR readiness at the local level including:

- Establishing, agreeing and signing community land use agreements
- Establishing of stakeholder platforms including trans-boundary members
- Means of effectively engaging with and supporting local farmers

# 8 | Financing forest landscape restoration

A number of different finance investment instruments are available for ANR and intensive production of 'zero-deforestation' cash crops. This includes 'green financing' which has been successfully used in public-private partnerships based on equitable trade principles to guarantee certain levels of income return to cultivators.

There are various possible options for national governments to establish incentives: the facilitation of public-private sector opportunities, the issue of green bonds in forestry, setting of carbon tax agreements, or proposing the payments for environmental services (PES) agreements from companies.

Proposals for a PES agreement are discussed relating to the presence of Arcelor Mittal mining company activities in East Nimba.

The recent expansion of smallholder tree crops (cacao) has been identified as driving large-scale deforestation, systematic decline of (cacao) crop quality, decreasing yields, and deterioration of soil quality in Cote D'Ivoire and Ghana.

Avoiding these problems, caused by unregulated and unplanned expansion of cacao farming needs parallel adoption of intensive production methods for food crops such as SALT and use of nitrogen fixing crops to ensure continued soil fertility without deforestation. Specific methods are needed for agroforestry (i.e. shade-growing) at scale to ensure sustained cocoa yields and effective soil conservation.

Providing and disseminating tree crop management solutions requires ability and mechanisms to build capacity, disseminate knowledge and the finance to access high-quality seedlings, if large scale agroforestry projects are to succeed.

In locations where mining has impacted the forest (S-GK-T, Gola-SL), typically by deforestation and degradation from the spread of mine tailings, a financing option remains to require that any future activities or licensing depends on compliance with regulations and requires restoration of previously degraded lands.

# 9 | Key findings

On the basis of MCA analysis of and spatial criteria, FLR opportunities have been identified for the transboundary sites that prioritize different interventions according to geophysical conditions including actual and potential future risks of degradation.

Interventions may consist of large-scale FLR approaches where degraded or remaining relict forest patches are 'set aside' from cultivation, and restored through enrichment planting (ANR) or more intensive methods involving propagation of cash crops through agroforestry methods. Different agroforestry models are available in which a larger or smaller percent of land is occupied by cash crops (i.e. cocoa, coffee, oil palm rubber and cashew) and cultivated closely among native tree species. Labour requirements for protecting, tending, cultivating and harvesting cash crops generally imply this model takes needs to take place within relatively close physical proximity to settlements and also that the sites are accessible by secondary roads and footpaths to transport good to market when needed.

Forest restoration with specific local tree species, 'Inga' (Gola, Sierra Leone) already being supported by a local NGO, is showing promising results of intercropping with the Inga as a shade tree and source of nutrient for field crops

For the consolidation of degraded forest and relict patches of forest the FLR opportunity exists to replant / reseed degraded forest within an area that has otherwise been cleared for smallholder farming or shifting cultivation. These patches typically contain trees that are important sources of seed and seedlings of the predominant tree local species.

Assisted natural regeneration can be conducted in such a way as to gap-fill areas between adjacent relict patches to join and consolidate smaller forest patches creating linkages, creating larger homogeneous forest blocks that can be interconnected to form the basis for future forest and biodiversity conservation planning.

## 9.1 Recommendations

Financial and political support to the restoration interventions will require new and innovative administrative and institutional arrangements to effectively facilitate and administer the changes that enable local communities incorporate new silvicultural and agroforestry practices in their livelihoods.

Success in implementing FLR investments in mixed agroforestry and ANR models requires certain changes and improvements to the way in which forest land has typically been managed, involving:

a) Revision of forest laws and policies to facilitate FLR locally.
b) Increasing the coordination and monitoring role of community stakeholders. clarifying their roles, rights and responsibilities

c) Providing clear and coherent information for smallholder farmers on rights and responsibilities in developing agroforestry in trans-boundary areas
d) Establishing a trans-boundary working group structure
e) Improving weak local implementation and/or enforcement of laws

Weak linkages and lack of effective coordination between government institutions and agencies at national and local levels is detailed in the national ROAM reports, leading to a lack of understanding and ambiguity of land tenure, land use agreements, and unsustainable management practices.

Effective mechanisms are needed for collaborative planning and monitoring progress towards objectives as a lack of coordination among stakeholders leads to uncertainties and conflicts over policies, mandates and land use practices

While more collaborative mechanisms (target settings, joint implementations, a coordination task force across departments) would resolve many of these deficiencies at the national level, a *transboundary working group structure* and a functional stakeholder platform may be the most effective means of achieving best project outcomes – ensuring efficient resource use and promoting understanding on the terms of implementing agroforestry at the local level, that also define the role and responsibilities of traditional authorities.

There is a requirement to update and revise policies and laws governing land use in trans-boundary forests, implementing mechanisms, sanctions and penalties. This is necessary as a participatory consultative process with full community involvement in decision making at all levels to ensure progress towards effective land governance.

# 10 | Action Plan

FLR under the Bonn Challenge is a top down but also a bottom up strategy, dependent on effective farmer engagement and role sharing between stakeholders in the local communities where it takes place. With support of the national governments, coordinated and facilitated by the MRU secretariat, farmers in the target areas can be assisted to shift from deforesting livelihoods based on extensive rotational fallow to ones based on silviculture, agroforestry and tree crops. Methods of subsistence cultivation need also to be promoted that do not require shifting cultivation to maintain or improve soil fertility.

Actions plans for FLR from the national reports propose all or some of the following actions.

**Financing:** identify potential funding sources, negotiate, conclude appropriate agreements and prepare implementation plans

**Economic planning:** Develop a full value chain analyses and business plans for the three main agroforestry tree crops: cacao, rubber, oil palm

**Assisted Natural Regeneration:** conduct a species selection of native trees: identify, select, characterize, validate and make use of appropriate species for site restoration.

**Conduct an assessment of likely social impacts of FLR:** evaluate the quantitative and qualitative aspects of proposed FLR interventions and extent of impacts of their benefits and costs of interventions

**Evaluate currently existing subsistence cropping practices**: examine useful and valuable characteristics and innovations in homes garden cultivation and their potential for expansion.

**Evaluate existing conflicts of interest** and technical challenges; and feasibility

**Conduct due diligence assessments:** evaluate and confirm local national and international acceptability of benefits/costs (ecological and social)

The following may also be considered:

- Establish a trans-boundary forest land restoration forum at each of the four sites.

With the possible exception of Wolongozi–Ziama, national reports make no mention of coordination or communication in forest planning and management between countries. From a top down perspective, with a common landscape and shared ecosystem over a relatively small area, there are advantages for national governments to develop FLR as a joint activity through a trans-boundary forest

restoration forum ('TBFRF'), with operational and governance mechanisms and an official mandate and function.

The chair of such a forum would revolve with each of the two-member countries at each location taking responsibility for one year in turn, serving as a means to ensure full participation, engagement and involvement of trans-boundary stakeholders and communities.

MRU working through provincial forest department agencies would set up a permanent secretariat to support the TRFRF, delivering resources and capacities to provide permanent functions.

Forum membership should include all government stakeholders, both local and national, and representatives of all organisations, relevant companies (if any) and communities located within (or adjacent to) the 5-kilometre buffer zones.

MRU would ideally support national forest departments formulate a decree giving legal standing to the forum and define its function, with a full and detailed list of specific actions to be implemented under an action plan along with target dates for implementation.

The forum would propose responsibilities / authorities of forestry staff, border guards, police, community and traditional leaders for ensuring local compliance with FLR related regulations. MRU should identify needs, priorities and funding requirements / opportunities and provide consistent strategic direction for the forum to implement FLR activities.

The forum would require ability and authorisation to propose effective local regulations with clear and consistent procedures, for example resolving conflicts and arbitrating in disputes in addition to acting as a focus for exchange of information and knowledge.

From the bottom up, smallholder subsistence farmers are unlikely to have any prior or sufficient knowledge of tree crop cultivation and will require considerable guidance from agroforestry extension workers. The TBFRF forum would facilitate exchange of agroforestry and silvicultural best practice guidelines for each trans-boundary site.

The extension workers would also guide adoption of a wide variety of new practices, community climate smart agriculture, SALT techniques. and advise in the use of organic rather than nitrogen fertilizers to maintain soil fertility.

Local investments are needed to support the establishment of plant and seedling nurseries.

The forum would provide guidance on alternative income generating activities through activities other than hunting in particular forest-related activities (beekeeping, game farming, etc.) and potentially also fish farming projects. Together with bee keeping and honey production, fishing is reported as particularly successful in S-GK-T.

Improved food security through use of intensive farming methods, will potentially generate a market surplus.

Harmonize land laws and policies at the trans-boundary sites.

- Conduct review of regulatory guidelines

A clear and comprehensive policy, legal and institutional framework is needed covering the range of agricultural and forest activities involved in FLR. Lack of synchronization between regulations may lead to confusion amongst those charged with implementation and the community commitment to change long held destructive agricultural practices (i.e. long fallow shifting cultivation) may suffer as a consequence.

Existing regulations related to agricultural practices (e.g. forest clearing, use of fire) community forest management, local felling and trade in timber species, trade in NTFPs) would need review and harmonisation according to FLR objectives.

These would specifically set limits to tree crop farming, especially cocoa, unregulated expansion of which has caused extensive deforestation and land degradation (noted in the area of Sapo NP) in the region.

- Macro land use planning needs to guide and project investments

Innovative financing mechanisms for FLR are required, including public-private partnerships to provide the capital to finance extension support and resources in developing integrated agroforestry land use models over large areas. Such support will include establishing agroforestry farmer training field schools, extension services and clear guidelines on all methods in the cycle, whether tree crop cultivation, propagation of seeds and saplings under ANR or use of nitrogen fixing legumes and climate smart methods to maintain soil fertility under intensive permanent smallholder farming for food crops.

Examples are available from Cote D'Ivoire of small scale farmers able to capture and keep the added value from production and sale of an environmentally sound and sustainable green product (cacao) where technical assistance has come from NGOs and donor (GIZ) funds were available.

Obtaining, directing and sustaining investments for FLR requires private sector confidence that MRU governments will produce and support development plans that include market and value chains for the range of sustainably grown tree crops, timber and other forest products that are produced.

Conduct detailed site level mapping, planning and establish baseline data for MRV.

Evaluate and map all optimum locations for commodity tree crop establishment; establish ownership / tenure and build database.

Production of detailed opportunity maps for restoration of degraded areas is cited in the national reports as a key element that is currently missing. Such information

would also form the baseline for micro level land use planning. Micro land use planning is necessary to develop and implement community development plans incorporating agroforestry activities.

At implementation, a further level of detailed site assessment of the sites would be needed, ideally supported by drone acquired maps from ortho-photographs to precisely identify and quantify areas for restoration at the site level and tailor actions and interventions with the participation of local stakeholders to the mix of conditions verified at each location.

With the future need for MRV, and M & E, this information would provide a baseline and detailed record necessary to monitor and measure progress over time towards successful completion of FLR objectives.

FLR in the Sapo-Grebo-Tai area requires improvement in the reliability of existing forest resource inventory data, re-assessment of degradation over the wider landscape level and identification of areas which are the highest priority to function as forest and biodiversity conservation corridors.

# Annexes

## Annex 1 – Social-environmental economic questionnaire

## (example for one intervention, but questions the same for all six interventions considered).

Note: in bold and between brackets is the score given to each answer for the development of the MCA and the normalization.

Questionnaire FLR action 1

Assisted natural regeneration by enrichment planting with forest indigenous tree species that can provide non-timber forest products. This restoration intervention will take place on degraded and degrading water heads and stream/river banks in the project landscape(s) located in your country.

(**questions financial indicator**)

1. In your experience, would you consider the costs related to implementing this FLR action (i.e. the costs incurred in the first year and including land preparation, labour, inputs among others):

- ☐ Very high (**1**)
- ☐ High (**2**)
- ☐ Moderate (**3**)
- ☐ Low (**4**)
- ☐ Very low (**5**)
- ☐ Don't know (***I***)

2. In your experience would you consider the costs related to the annual maintenance and/or production costs of this FLR action (e.g. harvest costs, inputs, maintenance of trees, etc., these are the costs incurred after the implementation of the new system) to be:

- ☐ Very high on a continuous basis (year by year) (**1**)
- ☐ Very high in the beginning, but decreasing with the years (**2**)
- ☐ High on a continuous basis (year by year) (**3**)
- ☐ High in the beginning, but decreasing with the years (**4**)
- ☐ Moderate on a continuous basis (year by year) (**5**)
- ☐ Moderate, but decreasing with the years (**6**)
- ☐ Moderate, but increasing with the years (**7**)

- ☐ Low on a continuous basis (year by year) (**8**)
- ☐ Low, but increasing with the years (**9**)
- ☐ Very low on a continuous basis (year by year) (**10**)
- ☐ Very low, but increasing with the years (**11**)
- ☐ Don't know (**/**)

3. According to you, is this FLR action profitable in the short term? Does this system generate revenue in the short term (first couple of years including the implementation year)?

- ○ Yes, it is very profitable (**3**)
- ○ Yes, it is moderately profitable (**2**)
- ○ Yes, but the profitability is low (**1**)
- ○ No, this FLR action is not profitable (**0**)
- ○ Don't know (**/**)

4. According to you, is this FLR action profitable in the long run? Does this system generate revenue after the first couple of years?

- ○ Yes, it is very profitable (**3**)
- ○ Yes, it is moderately profitable (**2**)
- ○ Yes, but the profitability is low (**1**)
- ○ No, this FLR action is not profitable (**0**)
- ○ Don't know (**/**)

(**questions social indicator**)

5. Do you consider that the implementation of this system will have a positive impact on household poverty?

- ○ Yes, this FLR action will have a positive impact on household poverty (**2**)
- ○ Yes, this FLR action will have a low, but positive impact on household poverty (**1**)
- ○ This FLR action will have no impact on household poverty (**0**)
- ○ No, this FLR action will have a negative impact on household poverty (**-1**)
- ○ Don't know (**/**)

6. Do you consider that the implementation of this FLR action will have a positive impact on household food security?

- ○ Yes, this FLR action will have a positive impact on food security (**2**)
- ○ Yes, this FLR action will have a low, but positive impact on food security (**1**)

- This FLR action does not have an impact on food security (**0**)
- No, This FLR action has a negative impact on food security (**-1**)
- Don't know (**/**)

7. Do you consider that the implementation of this FLR action will create new paid jobs in the short-term (during the implementation phase in the first year)?

- Yes (**1**)
- No (**0**)
- Don't know (**/**)

8. Do you consider that the implementation of this FLR action will create new paid jobs in the long-term (during the maintenance and production phase, after the first year)?

- Yes (**1**)
- No (**0**)
- Don't know (**/**)

(**questions gender indicator**)

9. Do you consider those who will carry out the work to implement this FLR action in the target landscape(s) in your country will be:

- Only women (**-2**)
- Mostly women (**-1**)
- Men and women equally (**0**)
- Mostly men (**1**)
- Only men (**2**)
- Don't know (**/**)

10. Do you consider that the benefits generated by this FLR action in the target landscape(s) in your country will go to:

- Only women (**2**)
- Mostly women (**1**)
- Men and women equally (**3**)
- Mostly men (**-1**)
- Only men (**-2**)
- Don't know (**/**)

(**questions environmental indicator**)

11. Do you consider that this FLR action reduce annual soil erosion rates (annual soil loss) in the target landscape(s) in your country?

- Yes, this FLR action will create a high reduction in soil erosion (**3**)
- Yes, this FLR action will create a moderate reduction in soil erosion (**2**)
- Yes, this FLR action will create a low reduction in soil erosion (**1**)
- No, this FLR action will not have an impact on soil erosion (**0**)
- Don't know (***/***)

12. Do you consider that this FLR action will have a positive impact on biodiversity in the target landscape(s) in your country?

- This FLR action will have a high positive impact on biodiversity, both on fauna and flora (**6**)
- This FLR action will have a high positive impact on biodiversity, but only on the flora (**5**)
- This FLR action will have a moderate positive impact on biodiversity, both on fauna and flora (**4**)
- This FLR action will have a moderate positive impact on biodiversity, but only on the flora (**3**)
- This FLR action will have a low, but positive impact on biodiversity, both fauna and flora (**2**)
- This FLR action will have a low, but positive impact on biodiversity, but only flora (**1**)
- This FLR action does not have a positive impact on biodiversity (**0**)
- Don't know (***/***)

13. Can you rate the positive impact of this FLR action on carbon sequestration and storage:

- Very high (**5**)
- High (**4**)
- Moderate (**3**)
- Low (**2**)
- Very low (**1**)
- Don't know (***/***)

14. Would you consider the impact of FLR on improving water quality (for example through reduced sediment or fertilizer run-off) in the target landscape(s) in your country to be:

- ☐ Very high (**5**)
- ☐ High (**4**)
- ☐ Moderate (**3**)
- ☐ Low (**2**)
- ☐ Very low (**1**)
- ☐ No impact (**0**)
- ☐ Don't know (***/***)

(**questions scaling indicator**)

15. Do you consider that all the necessary resources (inputs, labour, technical knowledge) are available in the target landscape(s) in your country to implement this FLR action?

- ○ Yes (**1**)
- ○ No (**0**)
- ○ Don't know (***/***)

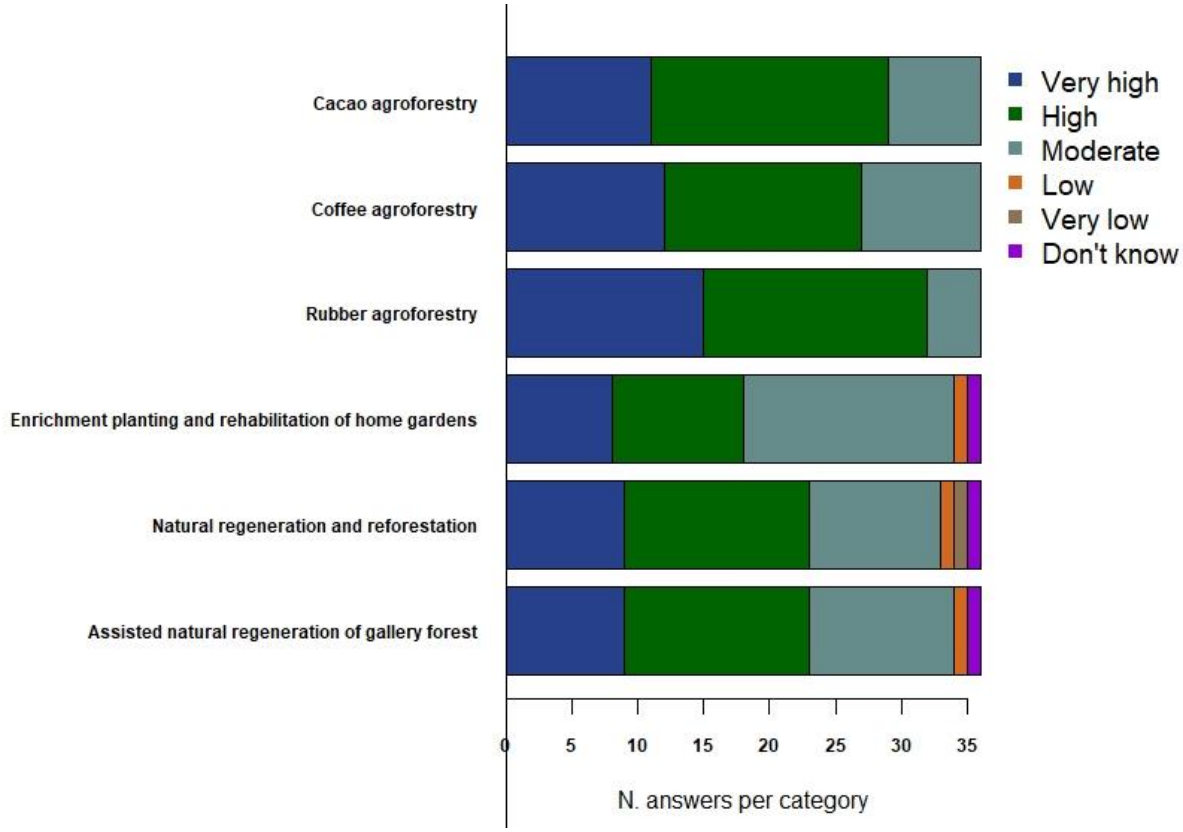
16. In your opinion, is it feasible to implement this FLR action on a large scale in the target landscape(s) your country?

- ☐ Very likely (**2**)
- ☐ Likely (**1**)
- ☐ Neither likely nor unlikely (**0**)
- ☐ Unlikely (**-1**)
- ☐ Very unlikely (**5**)
- ☐ Don't know (***/***)

**Number of respondents per answer per category for all questions**

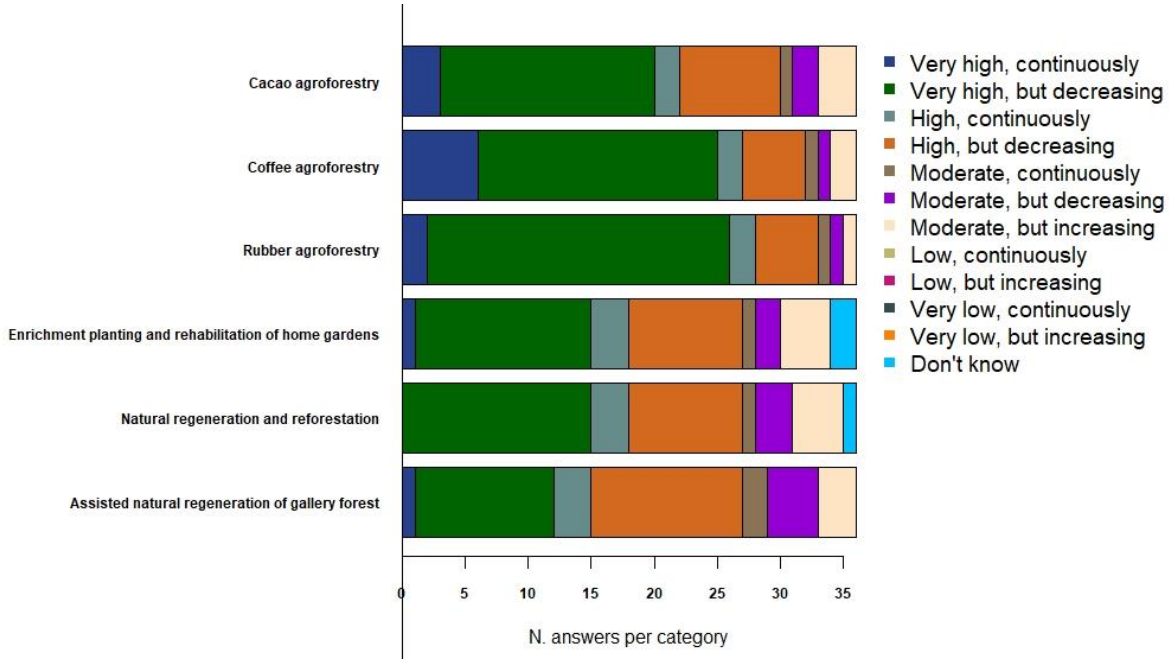
**I. Questions financial indicator**

1. Short-term costs (Figure + Table)



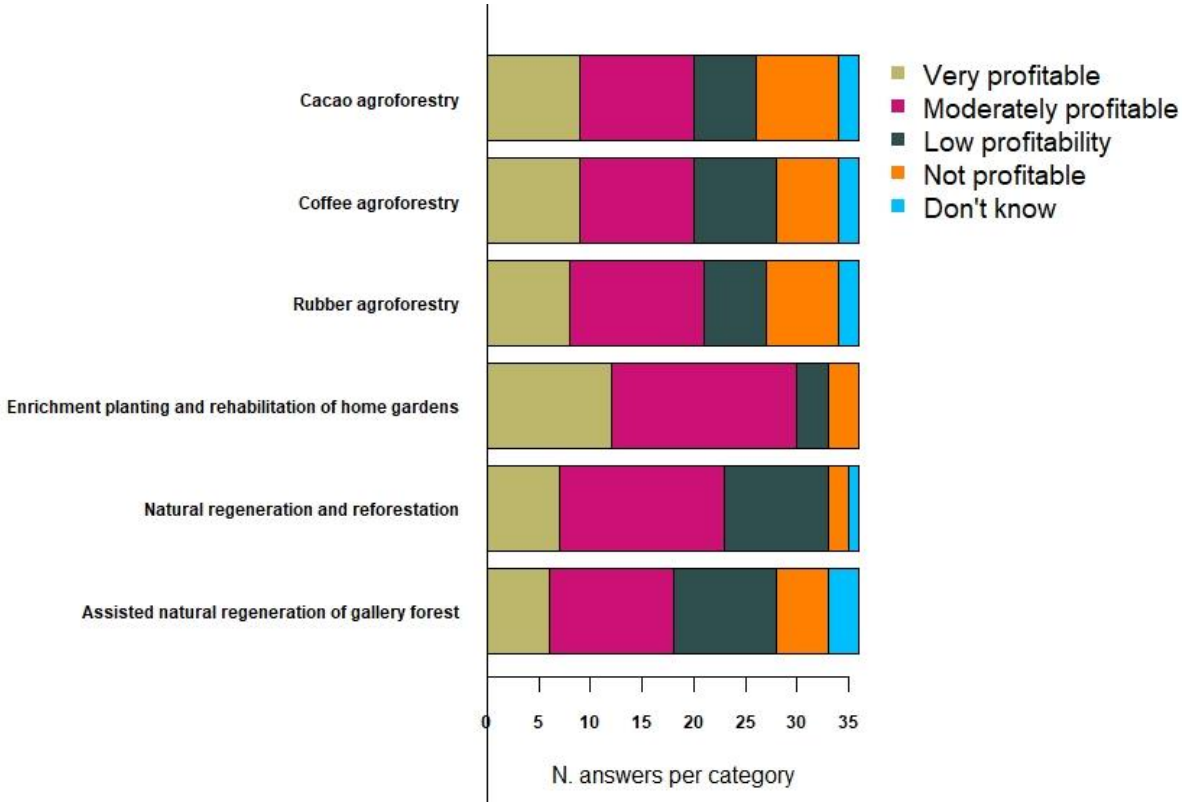

| | Very High | High | Moderate | Low | Very Low | Don't know |
|---|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | 9 | **14** | 11 | 1 | 0 | 1 |
| Natural regeneration and reforestation | 9 | **14** | 10 | 1 | 1 | 1 |
| Enrichment planting and rehabilitation of home gardens | 8 | 10 | **16** | 1 | 0 | 1 |
| Rubber agroforestry | 15 | **17** | 4 | 0 | 0 | 0 |
| Coffee agroforestry | 12 | **15** | 9 | 0 | 0 | 0 |
| Cacao agroforestry | 11 | **18** | 7 | 0 | 0 | 0 |
| Total per category | 64 | ***88*** | 57 | 3 | 1 | 3 |

2. Long-term costs (Figure + Table)



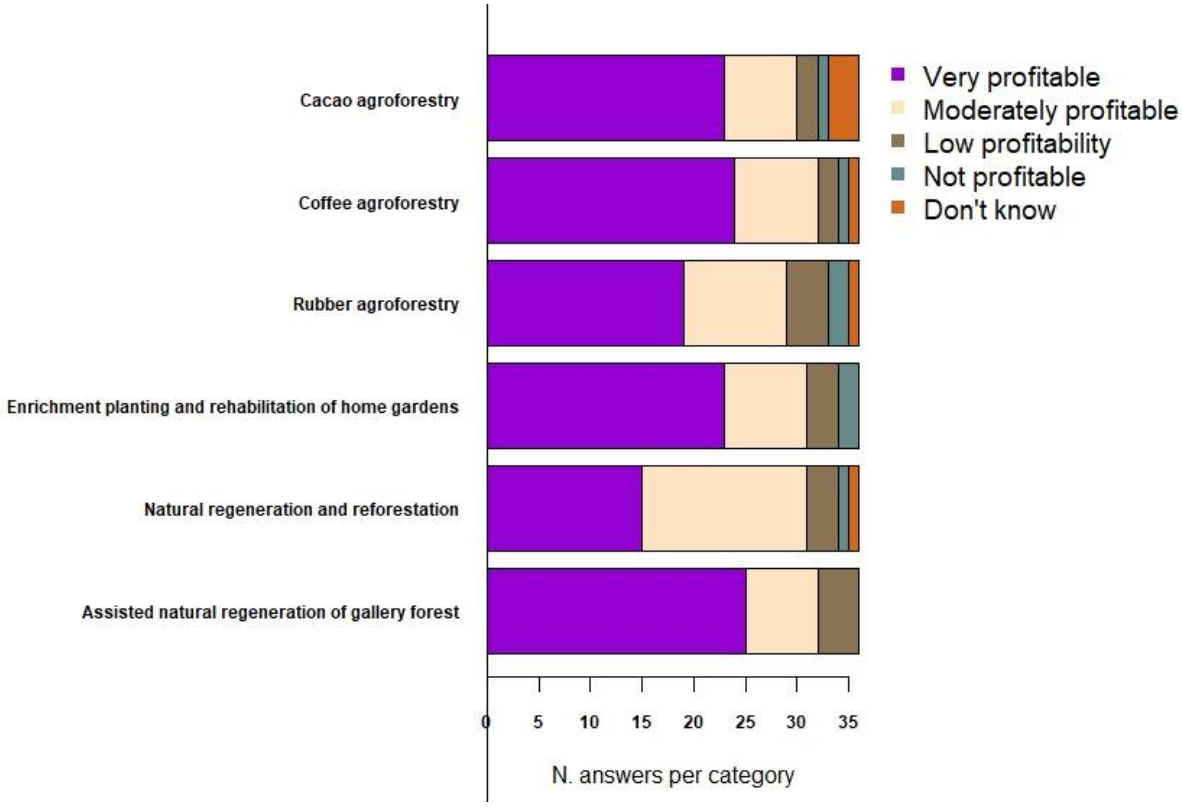

| | Assisted natural regeneration of gallery forest | Natural regeneration and reforestation | Enrichment planting and rehabilitation of home gardens | Rubber agroforestry | Coffee agroforestry | Cacao agroforestry | Total per category |
|---|---|---|---|---|---|---|---|
| Very high, continuously | 1 | 0 | 1 | 2 | 6 | 3 | 13 |
| Very high, but decreasing | 11 | **15** | **14** | **24** | **19** | **17** | ***100*** |
| High, continuously | 3 | 3 | 3 | 2 | 2 | 2 | 15 |
| High, but decreasing | **12** | 9 | 9 | 5 | 5 | 8 | 48 |
| Moderate, continuously | 2 | 1 | 1 | 1 | 1 | 1 | 7 |
| Moderate, but decreasing | 4 | 3 | 2 | 1 | 1 | 2 | 13 |
| Moderate, but increasing | 3 | 4 | 4 | 1 | 2 | 3 | 17 |
| Low, continuously | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Low, but increasing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Very low, continuously | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Very low, but increasing | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Don't know | 0 | 1 | 2 | 0 | 0 | 0 | 3 |

3. Short-term profit (Figure + Table)




| | Very profitable | Moderately profitable | Low profitability | Not profitable | Don't know |
|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | 6 | **12** | 10 | 5 | 3 |
| Natural regeneration and reforestation | 7 | **16** | 10 | 2 | 1 |
| Enrichment planting and rehabilitation of home gardens | 12 | **18** | 3 | 3 | 0 |
| Rubber agroforestry | 8 | **13** | 6 | 7 | 2 |
| Coffee agroforestry | 9 | **11** | 8 | 6 | 2 |
| Cacao agroforestry | 9 | **11** | 6 | 8 | 2 |
| Total per category | 51 | ***81*** | 43 | 31 | 10 |

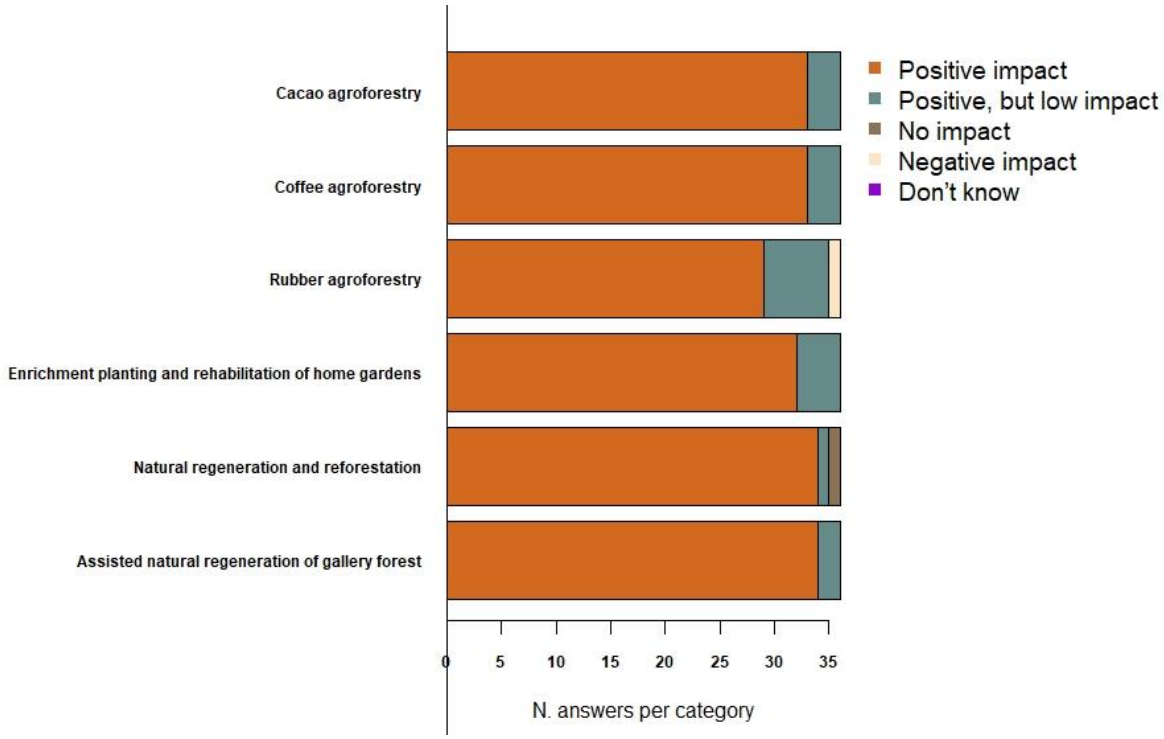
4. Long-term profit (Figure + Table)




| | Very profitable | Moderately profitable | Low profitability | Not profitable | Don't know |
|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | **25** | 7 | 4 | 0 | 0 |
| Natural regeneration and reforestation | 15 | **16** | 3 | 1 | 1 |
| Enrichment planting and rehabilitation of home gardens | **23** | 8 | 3 | 2 | 0 |
| Rubber agroforestry | **19** | 10 | 4 | 2 | 1 |
| Coffee agroforestry | **24** | 8 | 2 | 1 | 1 |
| Cacao agroforestry | **23** | 7 | 2 | 1 | 3 |
| Total per category | ***129*** | 56 | 18 | 7 | 6 |

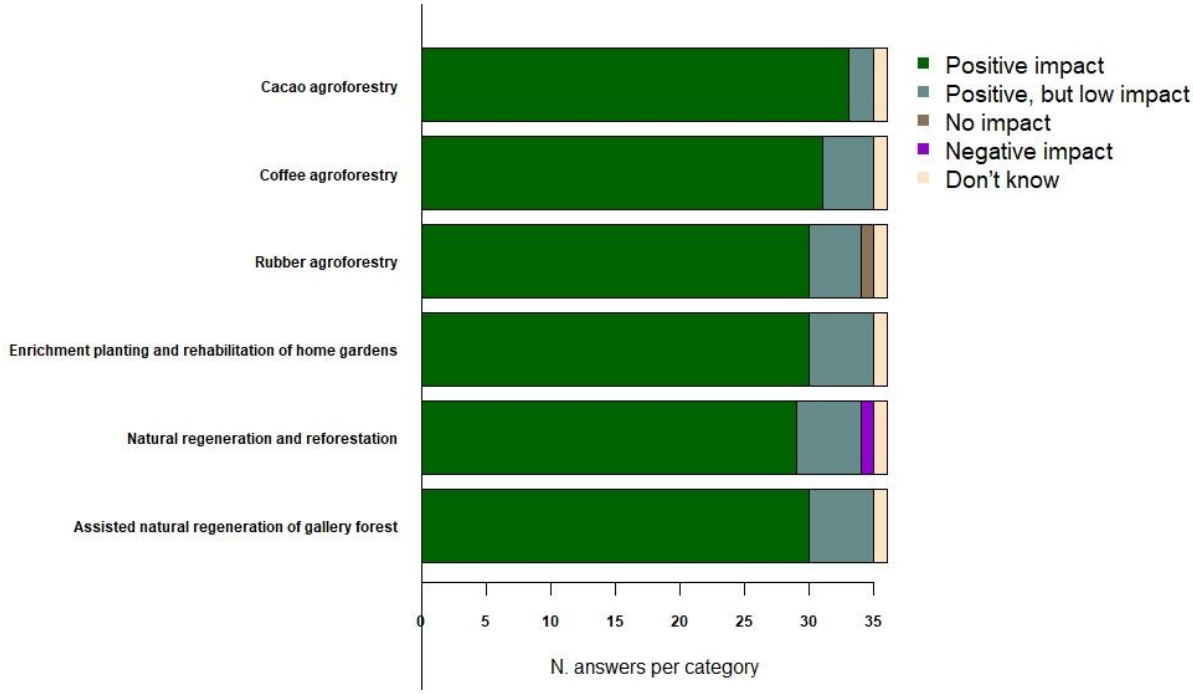
## II. Questions social indicator

5. Impact household poverty (Figure + Table)



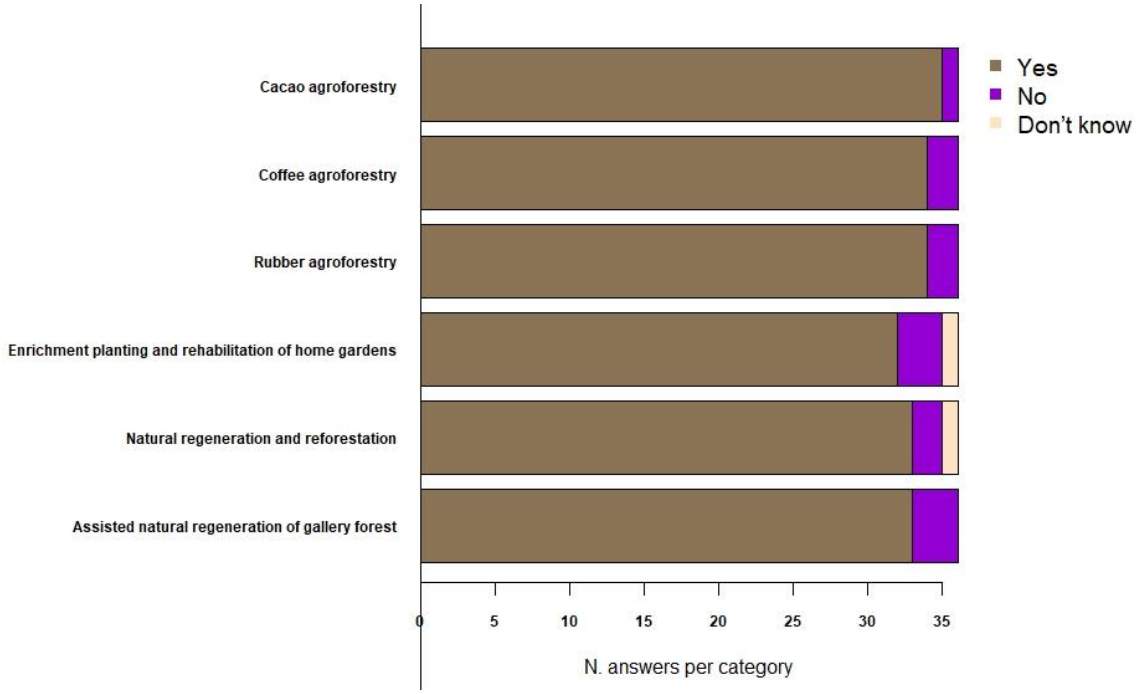

| | Positive impact | Positive, but low impact | No impact | Negative impact | Don't know |
|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | **34** | 2 | 0 | 0 | 0 |
| Natural regeneration and reforestation | **34** | 1 | 1 | 0 | 0 |
| Enrichment planting and rehabilitation of home gardens | **32** | 4 | 0 | 0 | 0 |
| Rubber agroforestry | **29** | 6 | 0 | 1 | 0 |
| Coffee agroforestry | **33** | 3 | 0 | 0 | 0 |
| Cacao agroforestry | **33** | 3 | 0 | 0 | 0 |
| Total per category | ***195*** | 14 | 1 | 1 | 0 |

6. Impact food security (Figure + Table)



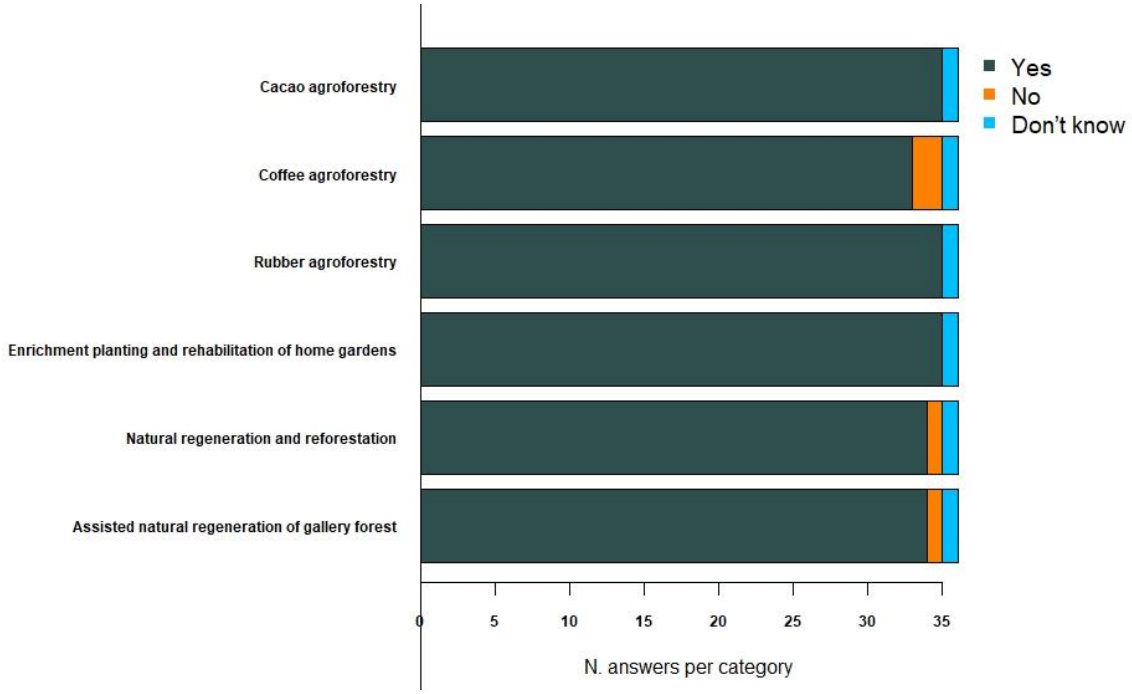

| | Positive impact | Positive, but low impact | No impact | Negative impact | Don't know |
|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | **30** | 5 | 0 | 0 | 1 |
| Natural regeneration and reforestation | **29** | 5 | 0 | 1 | 1 |
| Enrichment planting and rehabilitation of home gardens | **30** | 5 | 0 | 0 | 1 |
| Rubber agroforestry | **30** | 4 | 1 | 0 | 1 |
| Coffee agroforestry | **31** | 4 | 0 | 0 | 1 |
| Cacao agroforestry | **33** | 2 | 0 | 0 | 1 |
| Total per category | ***183*** | 25 | 1 | 1 | 6 |

7. Job creation short-term (Figure + Table)




| | Yes | No | Don't know |
|---|---|---|---|
| Assisted natural regeneration of gallery forest | **33** | 3 | 0 |
| Natural regeneration and reforestation | **33** | 2 | 1 |
| Enrichment planting and rehabilitation of home gardens | **32** | 3 | 1 |
| Rubber agroforestry | **34** | 2 | 0 |
| Coffee agroforestry | **34** | 2 | 0 |
| Cacao agroforestry | **35** | 1 | 0 |
| Total per category | ***201*** | 13 | 2 |

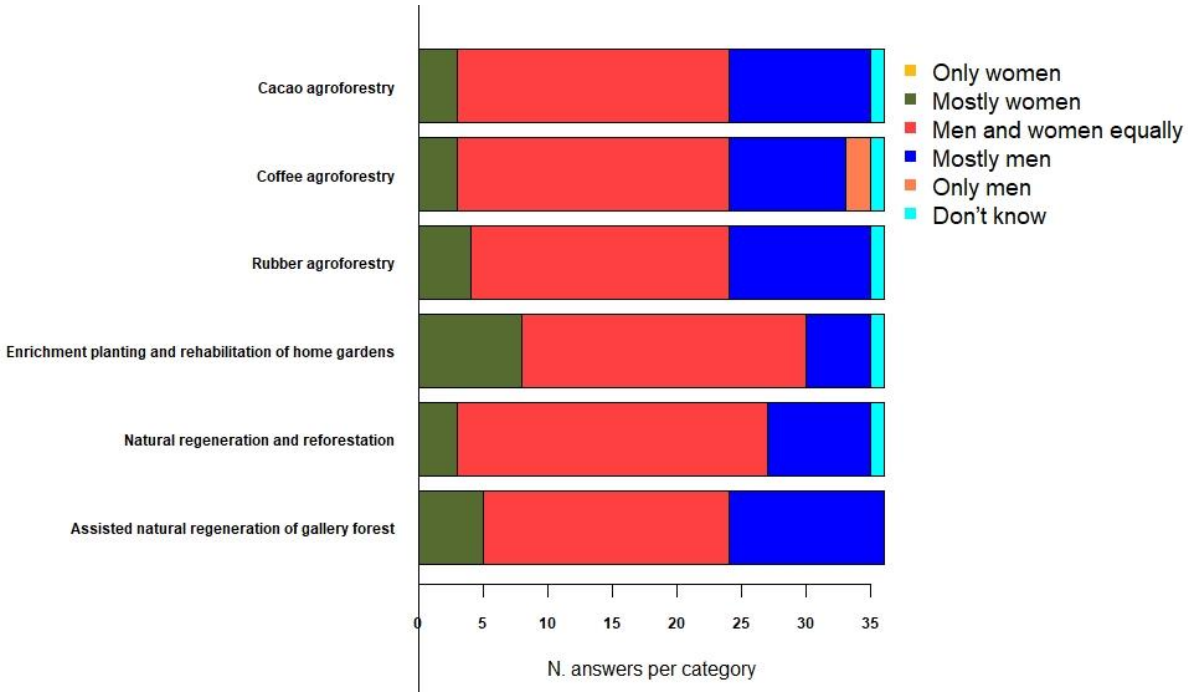
8. Job creation long-term (Figure + Table)




| | Yes | No | Don't know |
|---|---|---|---|
| Assisted natural regeneration of gallery forest | **34** | 1 | 1 |
| Natural regeneration and reforestation | **34** | 1 | 1 |
| Enrichment planting and rehabilitation of home gardens | **35** | 0 | 1 |
| Rubber agroforestry | **35** | 0 | 1 |
| Coffee agroforestry | **33** | 2 | 1 |
| Cacao agroforestry | **35** | 0 | 1 |
| Total per category | ***206*** | 4 | 5 |

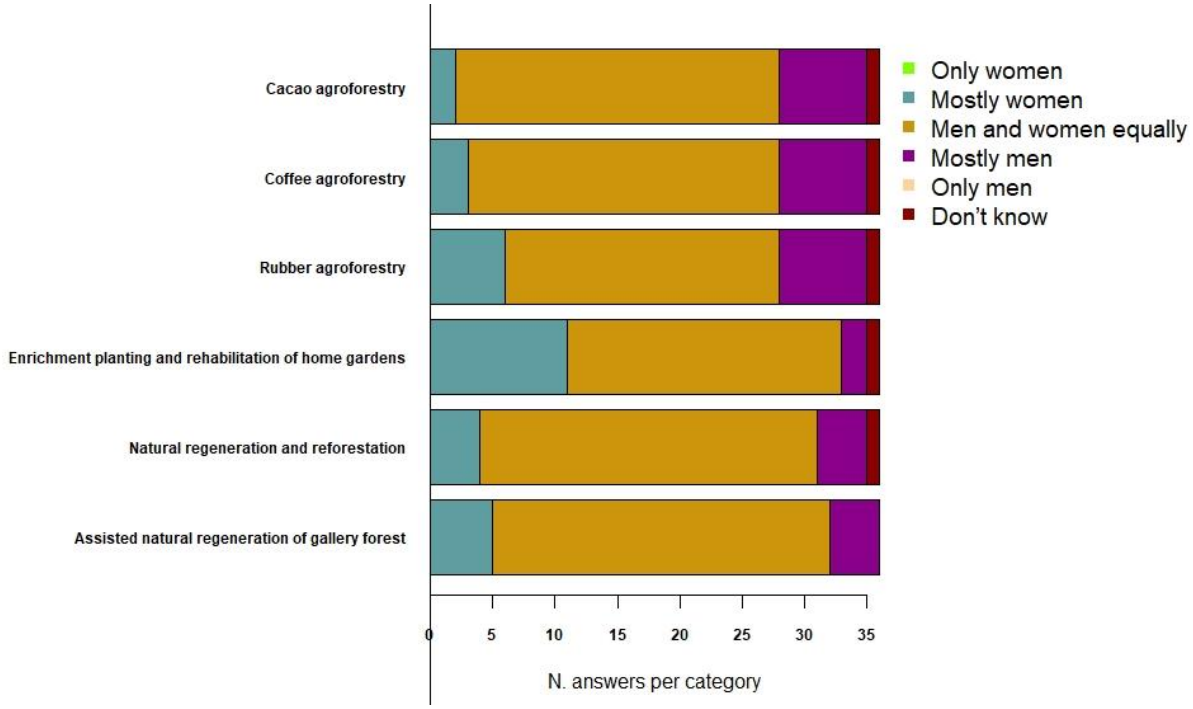
## III. Questions gender indicator

9. Gender work division (Figure + Table)




| | Only women | Mostly women | Men and women equally | Mostly men | Only men | Don't know |
|---|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | 0 | 5 | **19** | 12 | 0 | 0 |
| Natural regeneration and reforestation | 0 | 3 | **24** | 8 | 0 | 1 |
| Enrichment planting and rehabilitation of home gardens | 0 | 8 | **22** | 5 | 0 | 1 |
| Rubber agroforestry | 0 | 4 | **20** | 11 | 0 | 1 |
| Coffee agroforestry | 0 | 3 | **21** | 9 | 2 | 1 |
| Cacao agroforestry | 0 | 3 | **21** | 11 | 0 | 1 |
| Total per category | 0 | 26 | ***127*** | 56 | 2 | 4 |

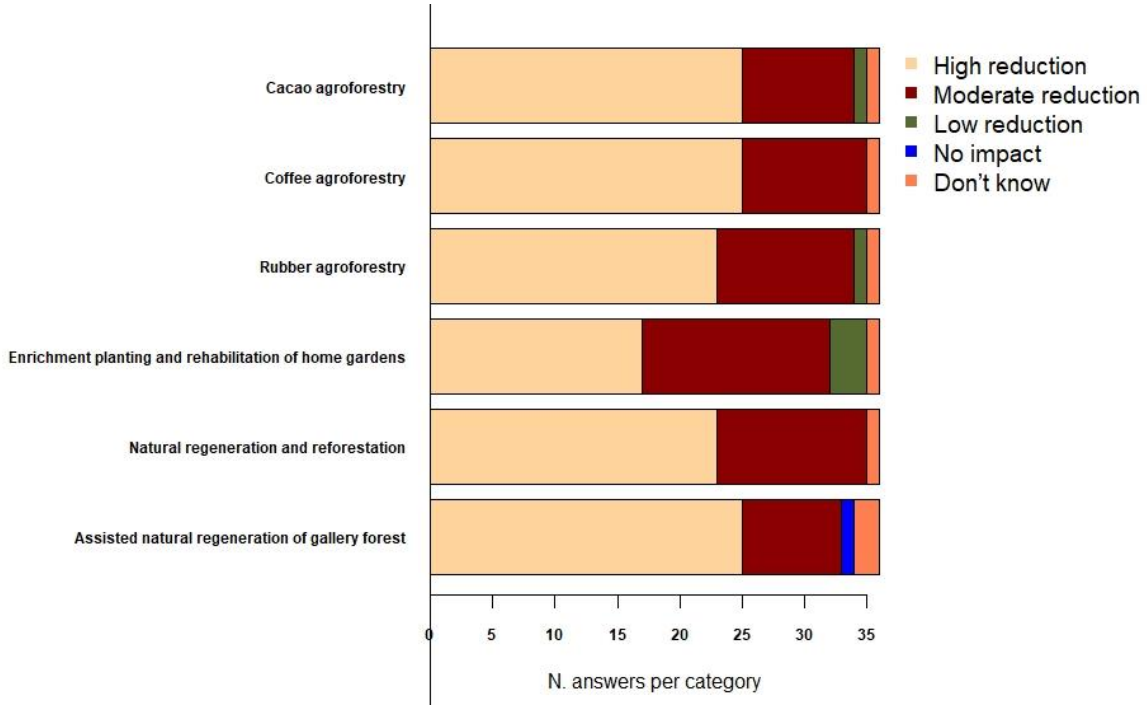
10. Gender revenue division, (Figure + Table)




| | Only women | Mostly women | Men and women equally | Mostly men | Only men | Don't know |
|---|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | 0 | 5 | **27** | 4 | 0 | 0 |
| Natural regeneration and reforestation | 0 | 4 | **27** | 4 | 0 | 1 |
| Enrichment planting and rehabilitation of home gardens | 0 | 11 | **22** | 2 | 0 | 1 |
| Rubber agroforestry | 0 | 6 | **22** | 7 | 0 | 1 |
| Coffee agroforestry | 0 | 3 | **25** | 7 | 0 | 1 |
| Cacao agroforestry | 0 | 2 | **26** | 7 | 0 | 1 |
| Total per category | 0 | 31 | ***149*** | 31 | 0 | 4 |

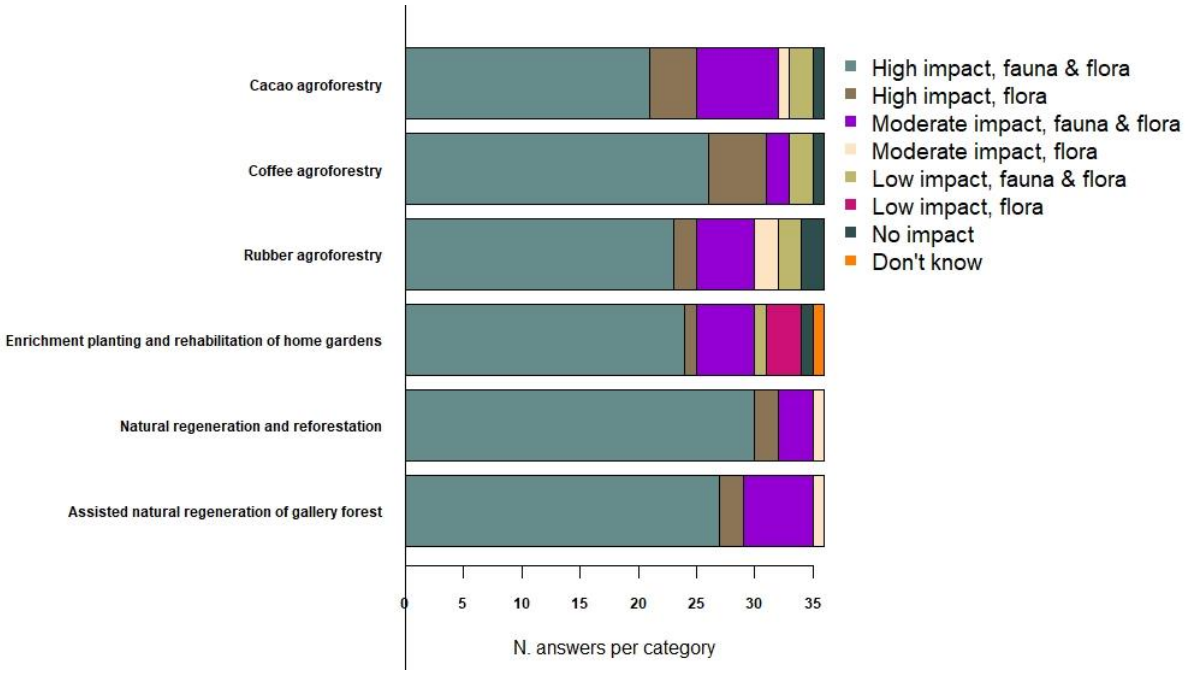
## IV. Questions environmental indicator

11. Erosion control (Figure + Table)



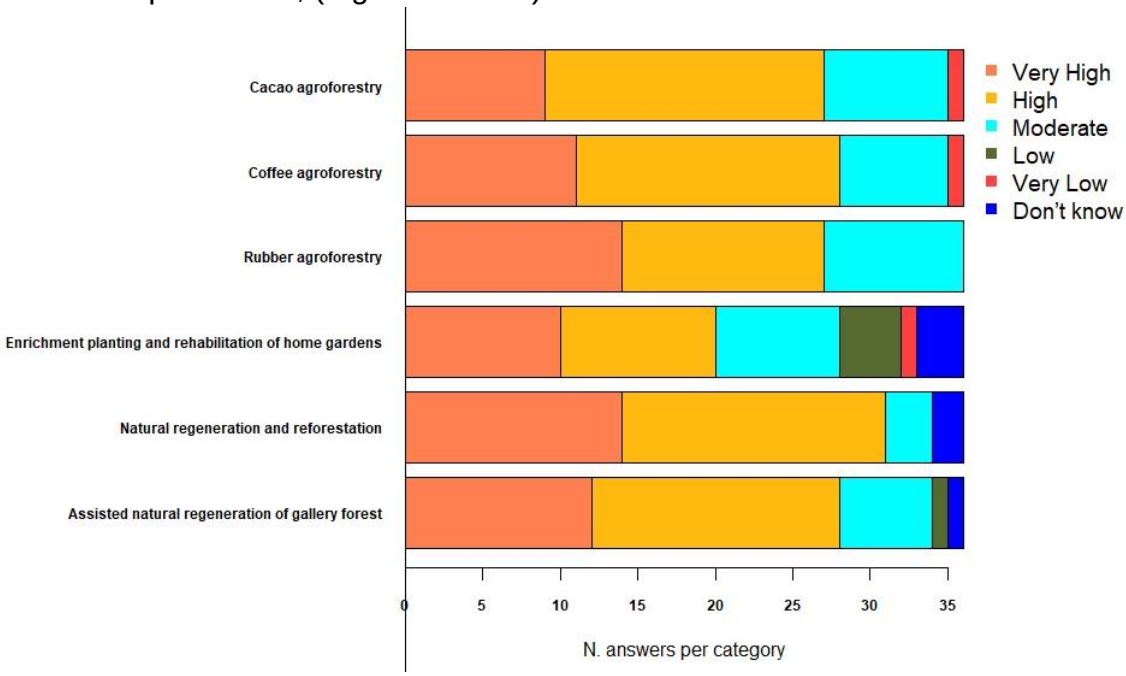

| | High reduction | Moderate reduction | Low reduction | No impact | Don't know |
|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | **25** | 8 | 0 | 1 | 2 |
| Natural regeneration and reforestation | **23** | 12 | 0 | 0 | 1 |
| Enrichment planting and rehabilitation of home gardens | **17** | 15 | 3 | 0 | 1 |
| Rubber agroforestry | **23** | 11 | 1 | 0 | 1 |
| Coffee agroforestry | **25** | 10 | 0 | 0 | 1 |
| Cacao agroforestry | **25** | 9 | 1 | 0 | 1 |
| Total per category | ***138*** | 65 | 5 | 1 | 6 |

12. Biodiversity conservation (Figure + Table)



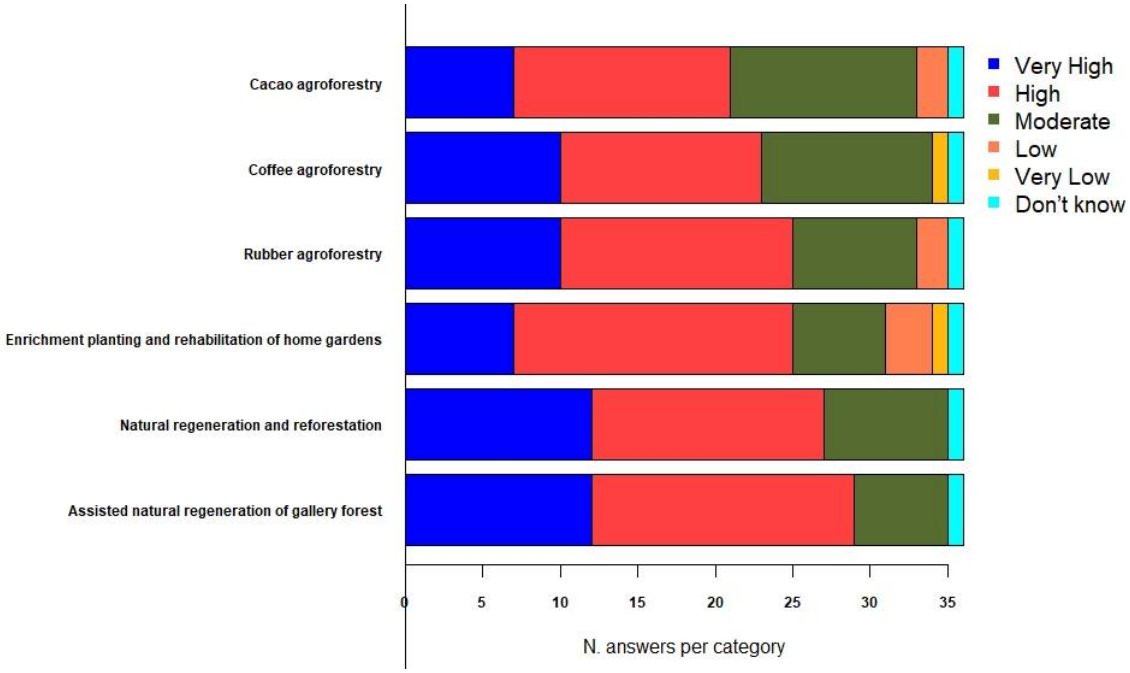

| | High impact, fauna & flora | High impact, flora | Moderate impact, fauna & flora | Moderate impact, flora | Low impact, fauna & flora | Low impact, flora | No impact | Don't know |
|---|---|---|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | **27** | 2 | 6 | 1 | 0 | 0 | 0 | 0 |
| Natural regeneration and reforestation | **30** | 2 | 3 | 1 | 0 | 0 | 0 | 0 |
| Enrichment planting and rehabilitation of home gardens | **24** | 1 | 5 | 0 | 1 | 3 | 1 | 1 |
| Rubber agroforestry | **23** | 2 | 5 | 2 | 2 | 0 | 2 | 0 |
| Coffee agroforestry | **26** | 5 | 2 | 0 | 2 | 0 | 1 | 0 |
| Cacao agroforestry | **21** | 4 | 7 | 1 | 2 | 0 | 1 | 0 |
| Total per category | ***151*** | 16 | 28 | 5 | 7 | 3 | 5 | 1 |

13. Carbon sequestration, (Figure + Table)




| | Very High | High | Moderate | Low | Very Low | Don't know |
|---|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | 12 | **16** | 6 | 1 | 0 | 1 |
| Natural regeneration and reforestation | 14 | **17** | 3 | 0 | 0 | 2 |
| Enrichment planting and rehabilitation of home gardens | **10** | **10** | 8 | 4 | 1 | 3 |
| Rubber agroforestry | **14** | 13 | 9 | 0 | 0 | 0 |
| Coffee agroforestry | 11 | **17** | 7 | 0 | 1 | 0 |
| Cacao agroforestry | 9 | **18** | 8 | 0 | 1 | 0 |
| Total per category | 70 | ***100*** | 41 | 5 | 3 | 6 |

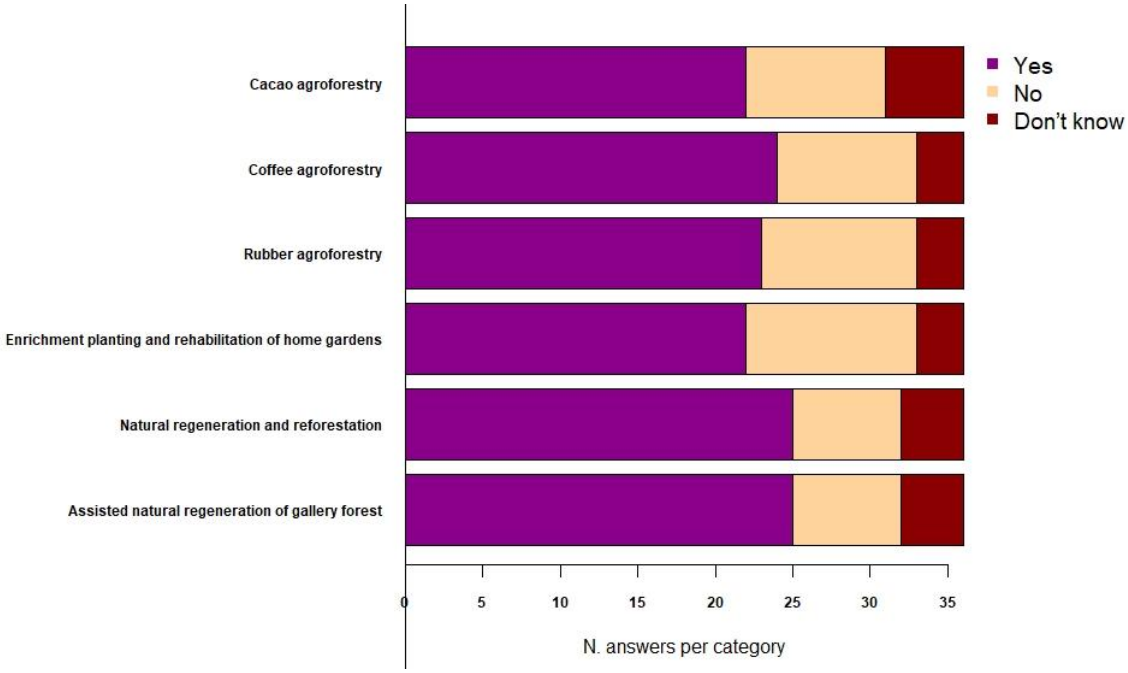
14. Water quality, (Figure + Table)




| | Very High | High | Moderate | Low | Very Low | Don't know |
|---|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | 12 | **17** | 6 | 0 | 0 | 1 |
| Natural regeneration and reforestation | 12 | **15** | 8 | 0 | 0 | 1 |
| Enrichment planting and rehabilitation of home gardens | 7 | **18** | 6 | 3 | 1 | 1 |
| Rubber agroforestry | 10 | **15** | 8 | 2 | 0 | 1 |
| Coffee agroforestry | 10 | **13** | 11 | 0 | 1 | 1 |
| Cacao agroforestry | 7 | **14** | 12 | 2 | 0 | 1 |
| Total per category | 58 | ***92*** | 51 | 7 | 2 | 6 |

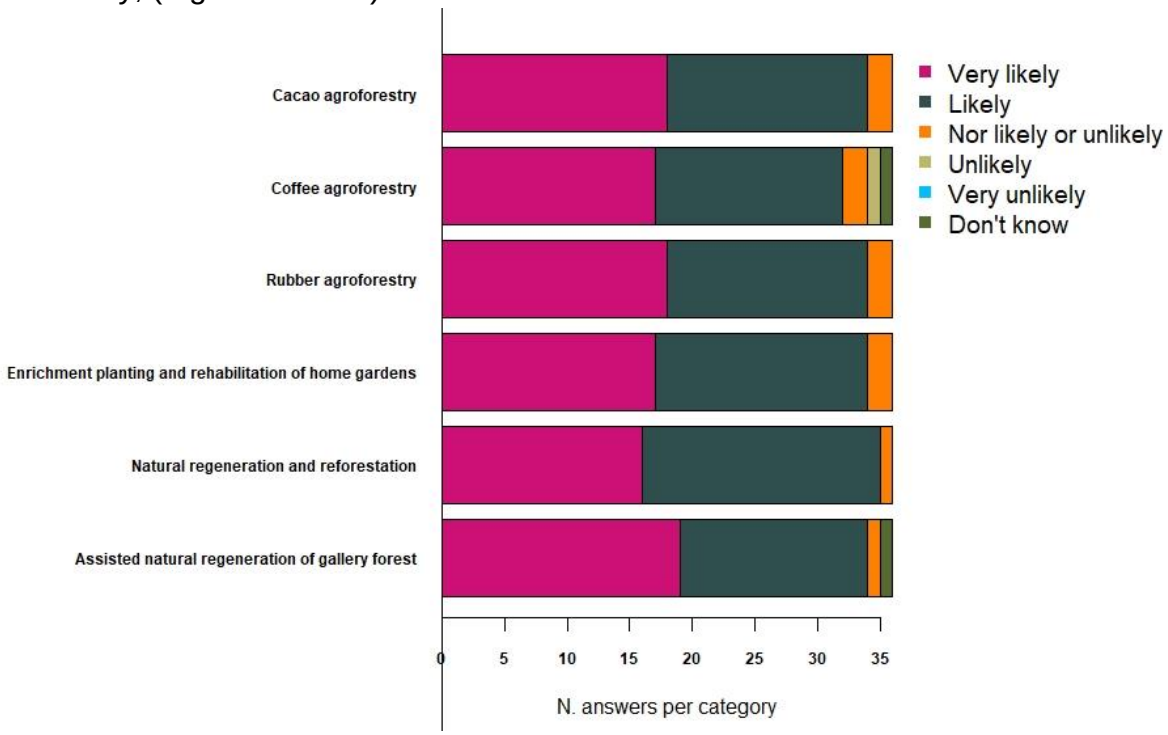
## V. Questions scaling indicator

15. Input availability, (Figure + Table)




| | Yes | No | Don't know |
|---|---|---|---|
| Assisted natural regeneration of gallery forest | **25** | 7 | 4 |
| Natural regeneration and reforestation | **25** | 7 | 4 |
| Enrichment planting and rehabilitation of home gardens | **22** | 11 | 3 |
| Rubber agroforestry | **23** | 10 | 3 |
| Coffee agroforestry | **24** | 9 | 3 |
| Cacao agroforestry | **22** | 9 | 5 |
| Total per category | ***141*** | 53 | 21 |

16. Scalability, (Figure + Table)




| | Very likely | Likely | Nor likely or unlikely | Unlikely | Very unlikely | Don't know |
|---|---|---|---|---|---|---|
| Assisted natural regeneration of gallery forest | **19** | 15 | 1 | 0 | 0 | 1 |
| Natural regeneration and reforestation | 16 | **19** | 1 | 0 | 0 | 0 |
| Enrichment planting and rehabilitation of home gardens | **17** | **17** | 2 | 0 | 0 | 0 |
| Rubber agroforestry | **18** | 16 | 2 | 0 | 0 | 0 |
| Coffee agroforestry | **17** | 15 | 2 | 1 | 0 | 1 |
| Cacao agroforestry | **18** | 16 | 2 | 0 | 0 | 0 |
| Total per category | ***105*** | 98 | 10 | 1 | 0 | 2 |

# References