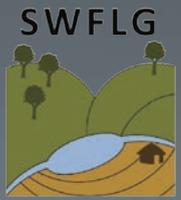




# SWFLG Briefing Note 13



## Biomass and Carbon Stock Monitoring

[WWW.WETLANDSANDFORESTS.HUD.AC.UK](http://WWW.WETLANDSANDFORESTS.HUD.AC.UK)

**WCC-PFM** 2015 DEC

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## Summary

The Wild Coffee Conservation by Participatory Forest Management project (2010 to 2016) is using participatory forest management to help conserve biodiversity in the forests of southwest Ethiopia. In seeking to assess the effectiveness of this method as an approach to conservation, the project undertook to monitor changes in biomass and carbon stocks, in lightly managed forest and in intensively managed forest. A baseline was established in 2010 in Sheko Woreda where the project began operations. Changes against that baseline were monitored in 2015, as the project moved into its final year of operations.

Over the six year period, lightly managed forest showed increases in biomass, carbon arrested and CO<sub>2</sub> sequestered. It also showed increases in species composition, diversity, density and basal area. In contrast, intensively managed forest showed decreases in total biomass, carbon arrested, CO<sub>2</sub> sequestered, species composition, diversity and density.

## Methodology

Over 100 sites were randomly selected in the 2010 baseline. These sites were revisited in the 2015 survey. Species composition, diversity, density, basal area, biomass, carbon stock and stem diameter frequency distribution were recorded in 2010 and in 2015. Survey plots and sub-plots were located at 100m intervals along the randomly selected transect lines, as illustrated in Figure 1. The larger plot size was used to count all plants with a Diameter at Stump Height (DSH) greater than 10cm and the smaller sub-plots were used to count all plants with a diameter at Stump Height below 10cm.

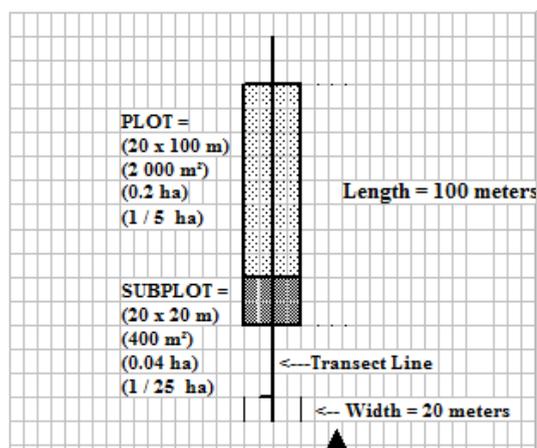


Figure 1: Plot design

## Differentiating between forest management types

Both the 2010 and 2015 surveys sought to differentiate between two types of forest management. One type is considered to be lightly managed at present, i.e. to have limited human interference. This is sometimes referred to as natural forest. The other type is considered to be intensively managed, i.e. to have frequent and quite aggressive human interference. This is sometimes referred to as coffee forest in reference to the primary crop grown and managed there. The surveys distinguish between these two types of forest and compare their results and management systems.

## Results

A total of 66 tree species and 36 seedling / sapling species were recorded in the intensively managed forest (IMF) stratum. 99% of the seedlings / saplings were *Coffea arabica*. In the lightly managed forest (LMF) 105 species of tree and 70 species of seedling / sapling were recorded. *Coffea arabica* comprised less than 4% of the seedlings / saplings. Table 1 presents the results from 2010 and 2015, for both types of forest. It shows whether there has been a positive or negative change in the six year interval between the surveys.

Parameters	Unit	IMF stratum		Change	LMF Stratum		Change
		2010	2015		2010	2015	
Density (DSH >10cm)	No ha <sup>-1</sup>	247	187	-60	276	296	20
Basal area (DSH >10cm)	m <sup>2</sup> ha <sup>-1</sup>	43	50	7	40	48	8
Density (DSH ≤ 10cm)	No ha <sup>-1</sup>	3216	3014	-202	3690	4027	337
Non coffee < 10 cm	No ha <sup>-1</sup>	442	46	-396	3558	3890	332
Coffee < 10 cm	No ha <sup>-1</sup>	2773	2968	195	132	137	5
Above Ground Biomass (all)	t ha <sup>-1</sup>	116	102.3	-13.7	101	123.8	22.8
Below Ground Biomass (all)	t ha <sup>-1</sup>	25	22.7	-2.3	22	27.2	5.2
Biomass (AGB + BGB)	t ha <sup>-1</sup>	141	125	-16	123	151	28
Total carbon stock	t C ha <sup>-1</sup>	71	62.5	-8.5	61.5	75.5	14
CO <sub>2</sub> sequestered	t ha <sup>-1</sup>	259	229	-30	225	277	52

Table 1: Summary of biomass, carbon and CO<sub>2</sub> sequestered in IMF and LMF

The changes in biomass, total carbon stock and CO<sub>2</sub> sequestered are presented graphically in Figures 2 and 3.

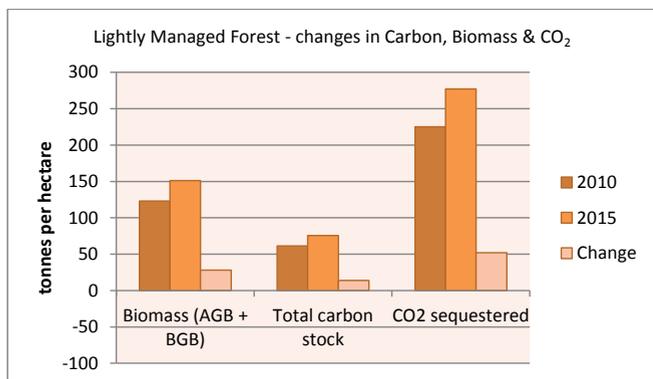


Figure 2: Lightly Managed Forest (LMF)

In addition to the increases in total biomass, carbon stored and CO<sub>2</sub> sequestered, the lightly managed forest (LMF) or natural forest showed an increase in species composition, diversity, density and basal area in the 2010 to 2015 inventory period. The mean density and basal area of tree species increased by 7.2% and 20% respectively. The stem diameter frequency distribution revealed the presence of good regeneration and recruitment, which are characteristic of healthy vegetation.

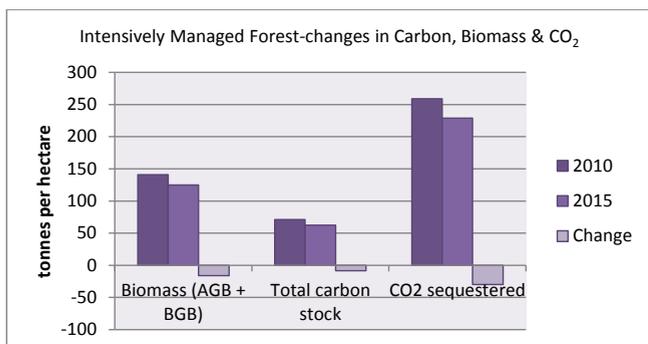


Figure 3: Intensively Managed Forest (IMF)

In contrast, the intensively managed forest showed a decrease in total biomass, carbon stored and CO<sub>2</sub> sequestered. Species composition, diversity and density had all decreased in the 2010 to 2015 inventory period. Mean tree density decreased by 24% overall, with coffee trees showing an increase of 14% and non-coffee trees showing a decrease of 90%. The stem diameter frequency distribution showed non continuous size class distribution with variable and fluctuating patterns, which suggests the presence of selective cutting to enhance the production of coffee and to obtain timber for construction and fuel wood. The death of mature trees may also be contributing to reduction in the carbon stock and to thinning of the canopy.

## Conclusions and Next steps

These results are encouraging for the WCC-PFM project as they suggest that lightly managed forests and natural forest under PFM are being protected and are showing good growth because of the careful management of these areas under PFM. In order for communities to continue to protect these forests they will need to continue to see the financial and social benefits of community management approaches under PFM. The project's successful introduction of cooperatives and forest use rights is thought to have helped but managed use of the natural forest will need to be continued and strengthened.

The bigger challenges are for the intensively managed forests. That species diversity should be declining and canopy loss increasing is not surprising. The challenge is to find ways in which the canopy can be maintained and management approaches developed which help maintain the ecological stability of this area and reduce the risks of disease outbreaks as well as generating similar levels of financial and social benefits.



Wild Coffee Berries in the Natural Forest

## South West Forests and Landscapes Grouping

SWFLG is an informal grouping of organisations which are interested in the development of an ecologically sound and socio-economically sensitive approach to the management of the south west landscapes of Ethiopia. The members of the grouping to date are: University of Huddersfield (UK), Ethio-Wetlands & Natural Resources Association and Sustainable Livelihood Action/Wetland Action EEIG (the Netherlands). They have been partners in projects funded by the EU and several other international donors since 1996 and have built up specific expertise in the areas outlined above.

The grouping currently has two projects in this area besides the recently completed NTFP-PFM Project. These are:

**Wild Coffee Conservation by Participatory Forest Management Project (WCC-PFM)** led by the University of Huddersfield with contributions from EWNRA and SLA and funding from the European Union, the Horn of Africa Regional Environment Centre and Network and the UK Government Darwin Initiative.

**REDD+ Participatory Forest Management in South West Ethiopia (REPAFMA-SW Ethiopia)** led by Ethio-Wetlands and Natural Resources Association in association with the Development Fund of Norway with contributions from SLA and UoH, and funding from NORAD.

*The Project is implemented with financial contributions from the European Union Delegation to Ethiopia, the Horn of Africa Regional Environmental Centre and the Darwin Initiative of the British Government. The authors are solely responsible for the views expressed in this document and they do not necessarily reflect those of the funders.*

## WCC-PFM Project Summary

The “Wild Coffee Conservation by Participatory Forest Management” (WCC-PFM) Project seeks to test and fine-tune PFM so that it can contribute to *in situ* conservation of wild coffee in the forests in southwest Ethiopia. At present the project is working in parts of Southern Nations, Nationalities and People’s Regional State (SNNPRS).

The focus of this approach to *in situ* conservation is the engagement of the communities so that they own and lead the process of PFM and forest management plan development and implementation. The plans include different forest management practices - development, protection and utilisation, including activities to ensure *in situ* conservation. The PFM process is driven by the way in which rights can be devolved to communities and forest-based enterprises developed which help forests become an attractive land use for communities, competing against other land uses and so “pay their way”.

Further details can be found at:

<http://wetlandsandforests.hud.ac.uk/forests.html>

All SWFLG Briefing Notes can be found at:

[http://wetlandsandforests.hud.ac.uk/wcc\\_publications.html](http://wetlandsandforests.hud.ac.uk/wcc_publications.html)

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## Project Funding Agencies



European Union,  
Environment Budget



Horn of Africa  
Regional Environment  
Centre and Network



Darwin Initiative of the  
UK Government

## Project Partners



The University of  
Huddersfield



Ethio-Wetlands and Natural  
Resources Association.



Sustainable Livelihood Action



Ethiopian Institute of  
Biodiversity



Southern Nations, Nationalities  
& Peoples Regional State,  
Bureau of Agriculture