

## 1. Introduction

### 1.1 Background

Agroforestry systems are gaining traction in the recent years due to their multifaced benefits. These systems can enhance food security, promote sustainable land use, and combat climate change through mitigating its impact (1).

### 1.2 Objective

This study aims to estimate carbon sequestration potential of a silvopastoral system and simulate future possible policy scenarios to meet NI LULUCF emission reduction targets.

## 2. Methods

### 2.1 Study area

The study was based on data from an experimental trial established at Loughgall, NI using 2006 IPCC default values (2).



This site includes 3 replications (R) of 3 land uses. The three land use types are: I) silvopastoral system with ash trees (*Fraxinus excelsior* L.), II) planted woodland with ash trees, and III) permanent grassland (Figure 1). They were established in 1989 as part of the UK National Network Experiments (NNE) at Loughgall, Northern Ireland (3).

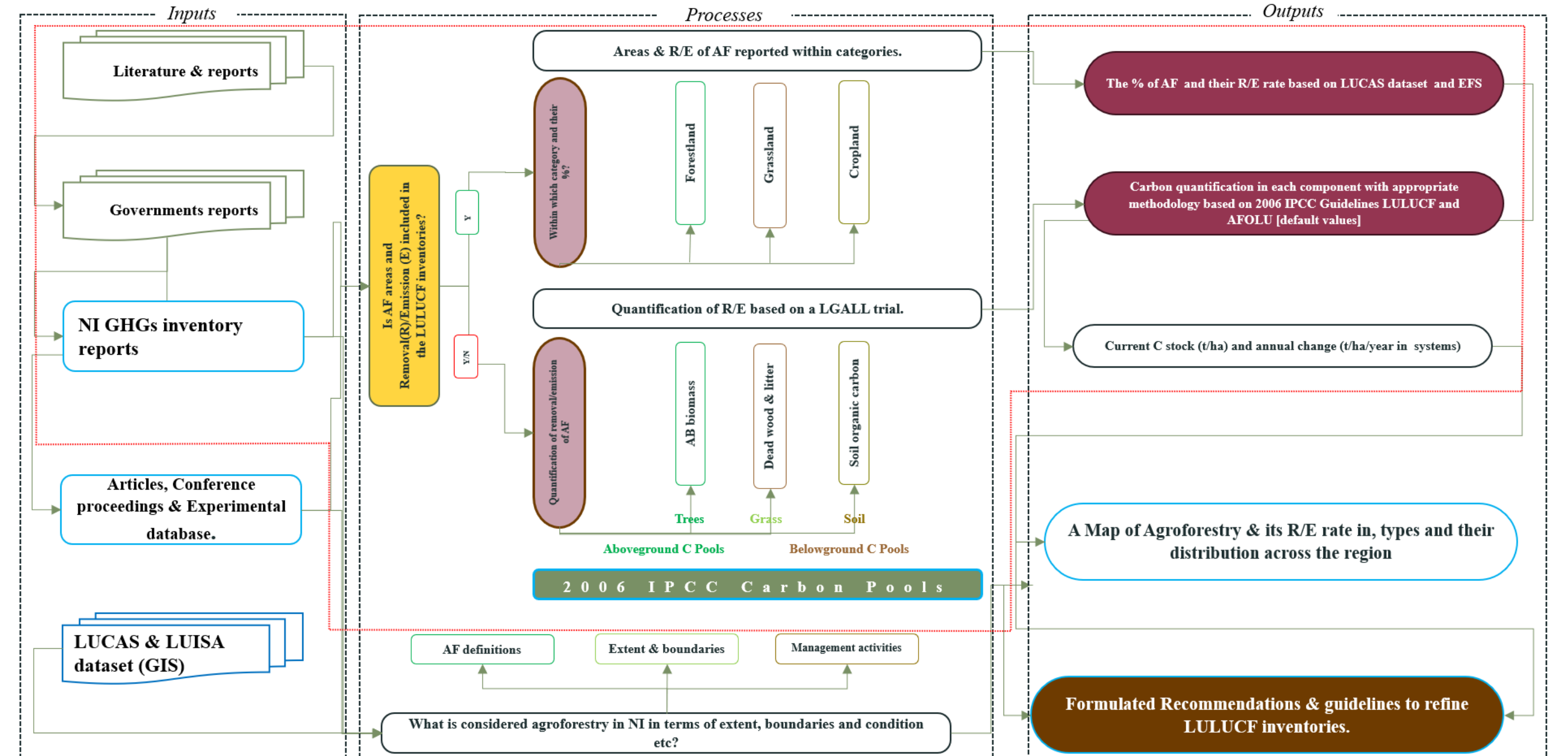


Figure 1. map of the site and methodology flowchart

## 3. Results

### 3.1 C removal potential by the system

The annual carbon removal rates were 2.5, 1.3, and 2.9 t C ha<sup>-1</sup> yr<sup>-1</sup> for aboveground biomass, belowground biomass, and soil organic carbon pools, respectively. The total carbon removed by these pools over a 25–27 year period was 62.5, 32.9, and 78.1 t C ha<sup>-1</sup>, respectively.

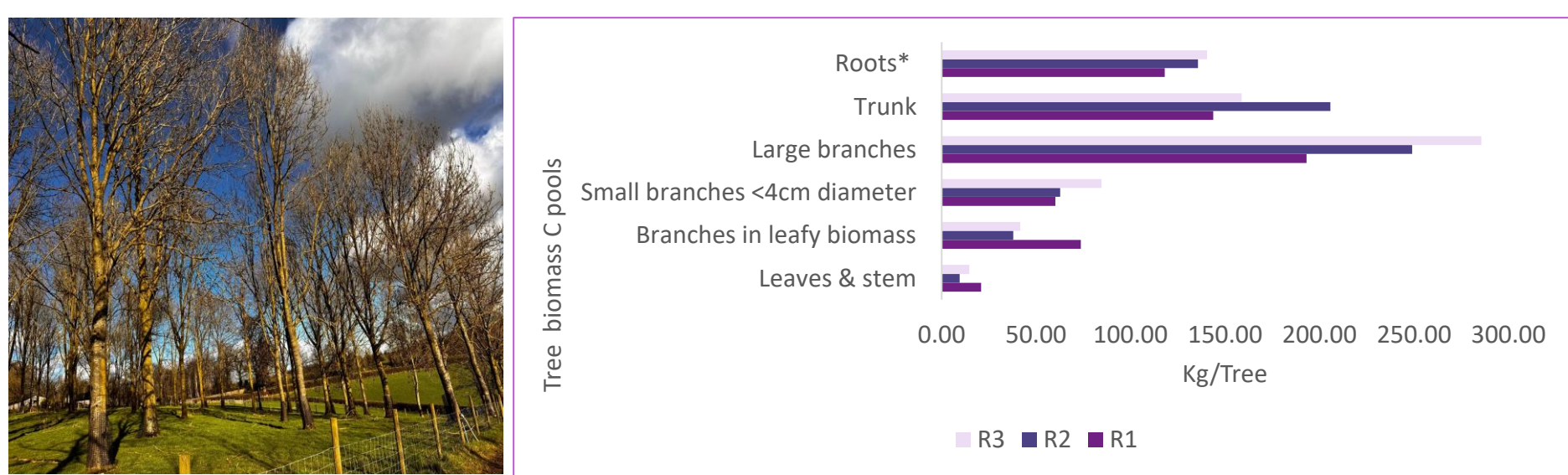


Figure 2. NI measured tree biomass carbon

Therefore, trees and soil under a silvopastoral system could sequester up to 95.4 and 78.1 t C ha<sup>-1</sup> at years 25 and 27, respectively (Table 1 and Figure 2).

Table 1. C sequestration rate under silvopastoral system

C Pool	Year	C & CO <sub>2</sub> annual removal rates			Literature
		t C ha <sup>-1</sup>	t C ha <sup>-1</sup> yr <sup>-1</sup>	t CO <sub>2</sub> ha <sup>-1</sup> yr <sup>-1</sup>	
Biomass	Above Ground	62.5	2.5	9.1	Oe
	Below grown	32.9	1.3	4.8	Oe
SOIL	Organic Carbon	78.1	2.8	10.6	(3)
	Total	173.5	6.7	24.6	

Oe: own estimation based on the experimental dataset

The whole system has an annual removal rate of 6.7 t C ha<sup>-1</sup> and could sequester up to 173.5 t C ha<sup>-1</sup> over the 25-year period.

### 3.2 Scaling up - NI Agroforestry

Based on the estimated carbon removal rates of the silvopastoral system under experimental conditions and the total area of agroforestry (Figure 3) in the region (around 18.8 thousand hectares),

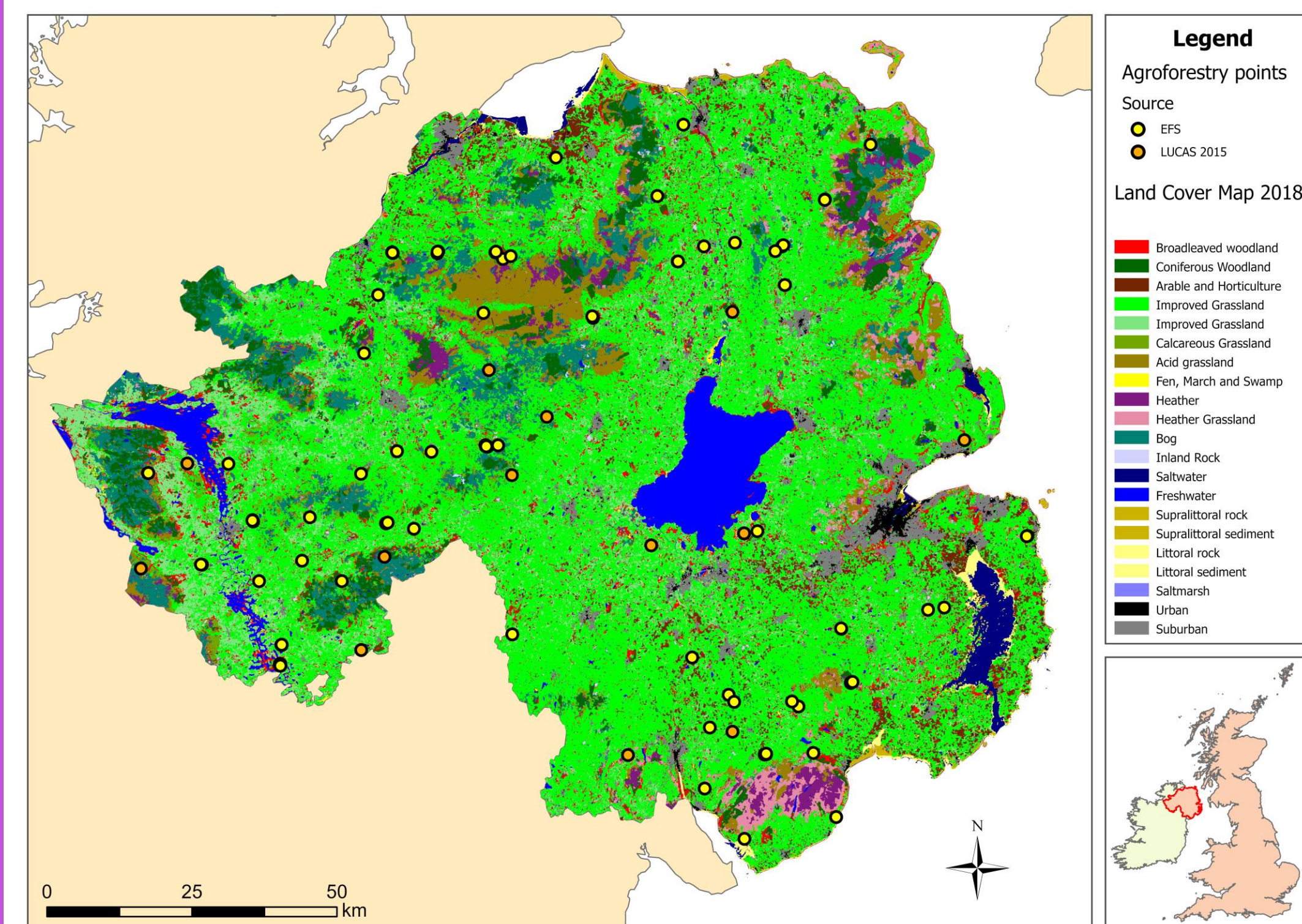


Figure 3. NI Land cover map and agroforestry areas

these systems might have sequestered around 1.8 Mt of biomass carbon and 1.4 Mt of soil organic carbon, assuming all trees across the region are growing under the same conditions as in the experimental trial.

### 3.3 NI AFOLU GHG emissions

Northern Ireland's AFOLU (Agriculture, Forestry, and Other Land Use) sector accounts for 35.7% (8.1 out of 23 Mt CO<sub>2</sub> eq) of the total region's GHG emissions (Figure 4). In October 2023, the government set out emissions reduction targets to reduce sector emissions by 6.2 and 3.1 Mt CO<sub>2</sub> eq by 2030 and 2024, respectively (4).



Figure 4. NI LULUCF, Agriculture, AFOLU and Total GHG emissions

### 3.4 Policy scenarios

Taking into account the NI Climate Change Committee's recommendations on tree planting deployment rates to meet 2030 and 2040 targets (Table 2),

Table 2. AFOLU– NI's Climate Change Committee (CCC) proposed emissions reduction targets.

AFOLU subsectors		1990	2019	2030	2040
Agriculture emissions	GHGs (Mt CO <sub>2</sub> e )	5.5	5.9	4.6	3.7
	% change from 1990		+6%	-16%	-33%
LULUCF	GHGs (Mt CO <sub>2</sub> e )	2.8	2.4	1.9	-0.6
	% change from 1990		-15%	-34%	-122%

an average of 3400 ha per year is needed to achieve the sector's emission reduction goal (4).

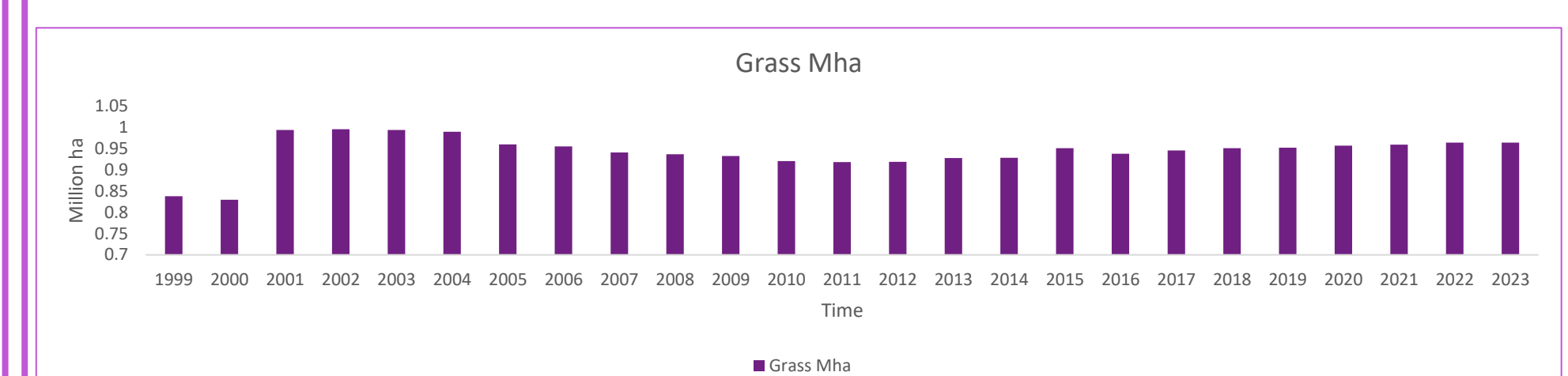


Figure 5. NI grassland areas (1999 -2013)

Planting trees at this rate would require allocating around 84.9 kha of land which is equivalent to converting around 8.8% of the current grassland to silvopastoral systems, which would sequester approximately 29.7 Mt CO<sub>2</sub> in the next 25-30 years.

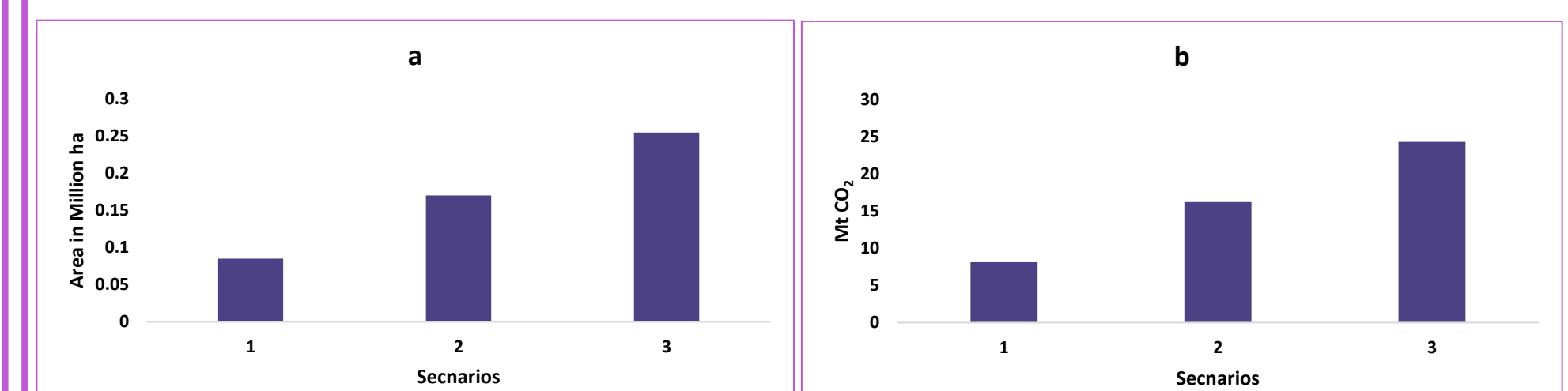


Figure 6. The portion of grassland (a) could be converted under different tree planting scenarios and their C removal potential (b).  
\*(1) Mean tree planting rate proposed by CCC, 2) doubling and 3) tripling

Doubling the area (17.6% or 169.6 kha) would remove around 59.4 Mt CO<sub>2</sub>, while tripling it would remove up to 89.1 Mt CO<sub>2</sub>.

## 4. Discussion

Considering that the annual average CO<sub>2</sub> removal rate of the system is 13.9 t CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup>, converting only 8.8% of current NI grassland this year into a silvopastoral agroforestry system would only remove around 0.7 Mt CO<sub>2</sub>. This represents only about 24% of the sector's targeted emission reduction target by 2040. While doubling and tripling the area converted would remove around 1.5 and 2.3 Mt CO<sub>2</sub> in the next 16 years, achieving 49.% and 73.6% of the 2040 reduction target, respectively. Therefore, further research should focus on using improved estimates for area, removals, and emissions factors to refine both LULUCF and AFOLU inventory.

### Take – Home Points

- Such system could sequester up to 0.6 kt CO<sub>2</sub> ha<sup>-1</sup>
- 2<sup>nd</sup> scenario would achieve around 49 % of the sector emissions reduction target.
- 3<sup>rd</sup> one would achieve around 73% of the target

### References



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