Comparison of basal area estimated with Angle Count Method and Fixed Area Plots

(A case study in tropical peat swamp forest)

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Bogor & Jakarta, Indonesia
16–22 March 2014

Project title:

Development of an integrated forest carbon monitoring system with field sampling and remote sensing

Counterparts:

- Department II of the Biology Faculty, University of Munich, Germany
- Centre for International Co-Operation in Sustainable Management of Tropical Peatland (CIMTROP) - University of Palangka Raya, Indonesia

Project Team Members from Goettingen:
Prof. Christoph Kleinn, Lutz Fehrman, Cesar Perez, Paul Magdon, Yanti Sarodja, Edwine Purnama, Mats Mahnken

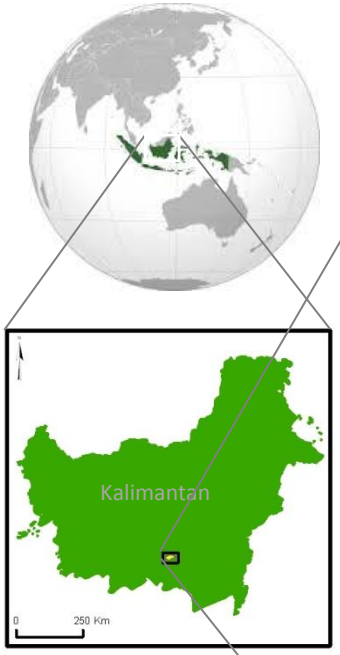
DFG Deutsche Forschungsgemeinschaft **Project KL 894 / 17**

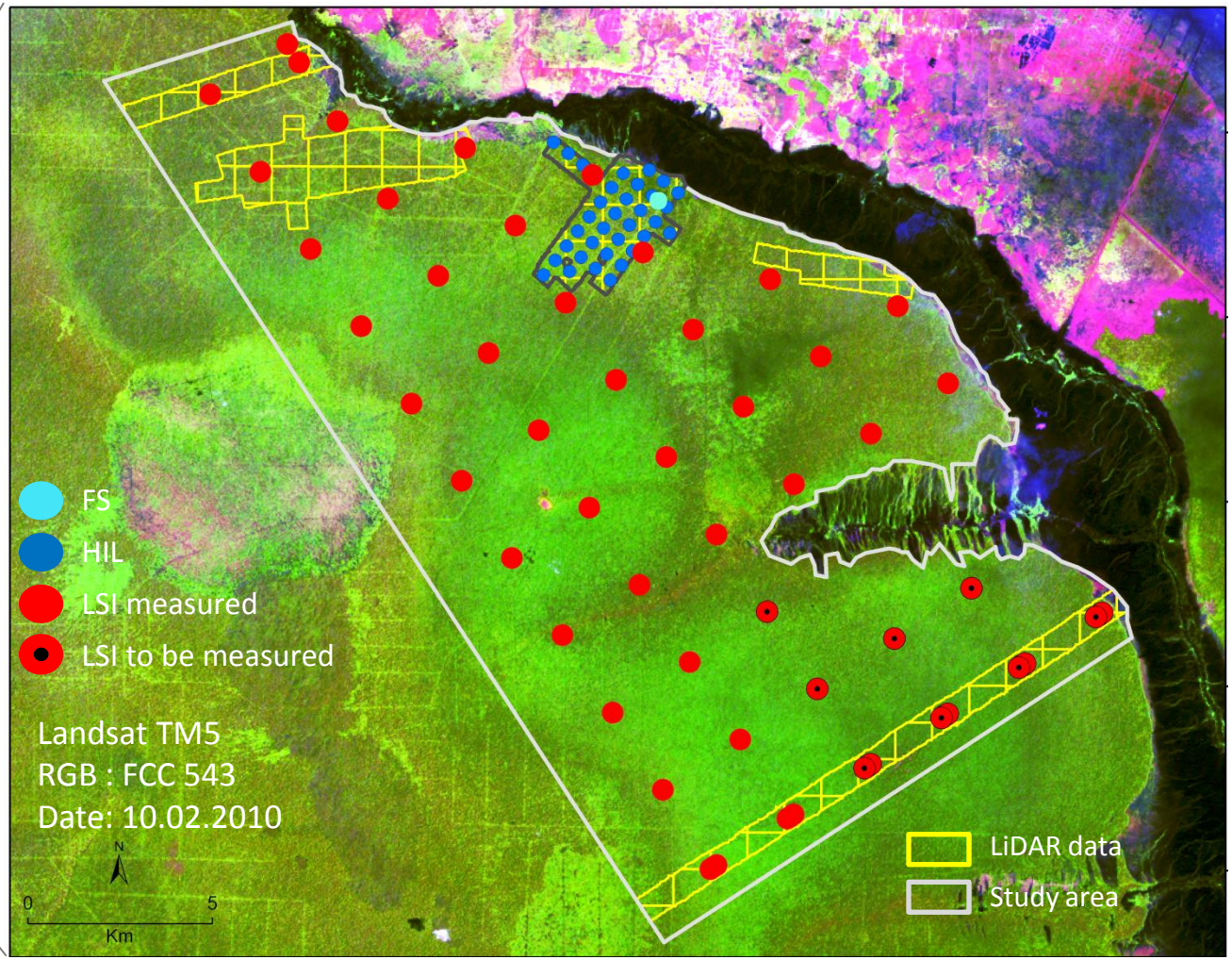
Project objective

General objective:
Methodological improvement of the Above Ground Carbon monitoring of tropical peat swamp forests with sample based field observations and Remote Sensing data

Key issue: Carbon Monitoring with emphasis on the precision of the estimation and accuracy of carbon regionalization

Study area

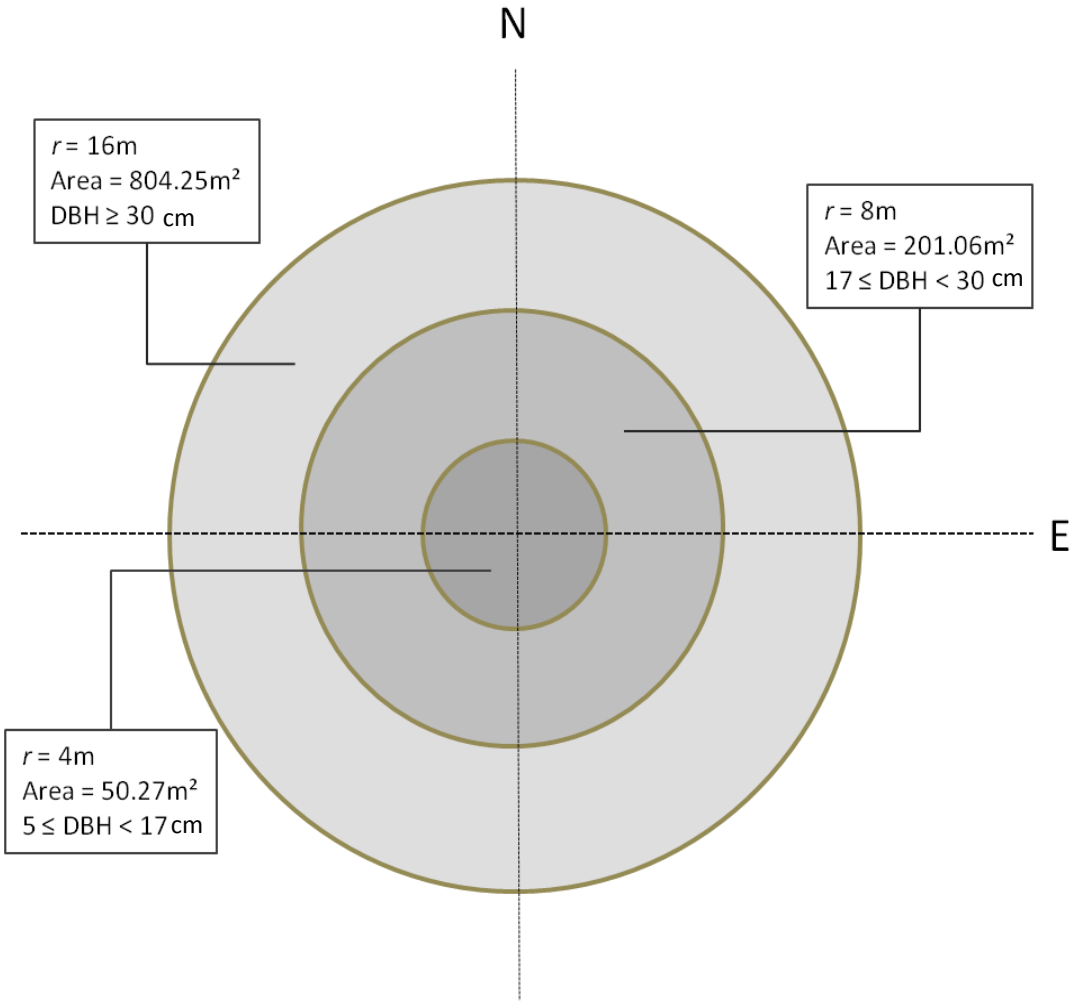




Total number of observations per design:
FS = 3525
HIL= 717
LSI = 987

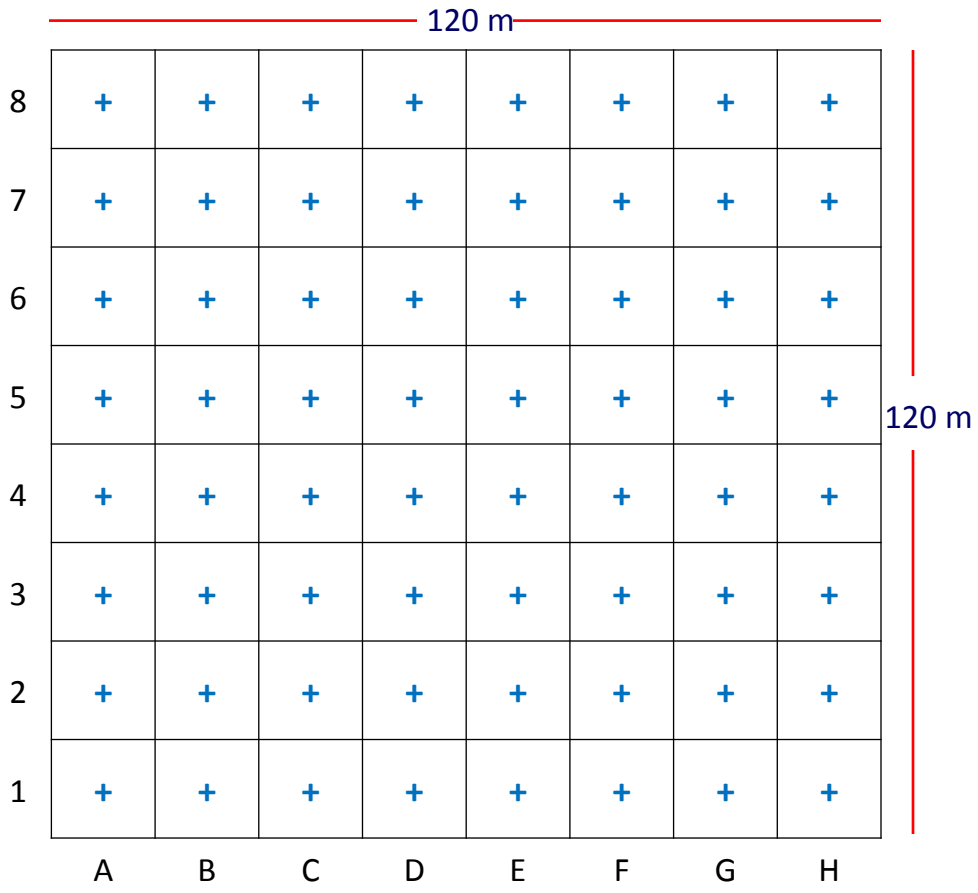
1. Large Scale Inventory Design (LSI) - 31113 ha - 46 plots
2. High Intensity LiDAR Design (HIL) - 869 ha - 35 plots
3. Full Census Design (FS) 1,44 ha - 1 plot

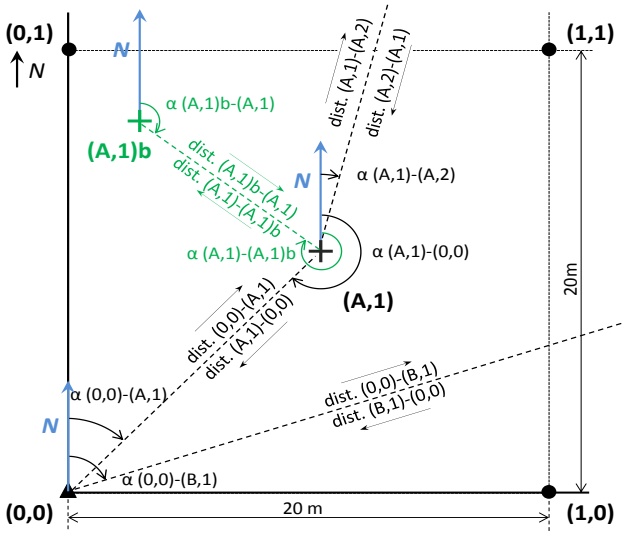
Plot Design: LSI & HIL



- Consist of 3 concentric circular plots with different radius
- Apply different DBH thresholds to select the trees to be measured in each circle
- Developed based on information from previous studies

Full Census Plot Design





- In each quadrant, the position from where all trees can be observed is called station
- All trees with DBH ≥ 5cm are measured

Variables measured

Plot information	X and Y GPS coordinates and its estimated accuracy Basal Area Number (BAN) and Basal Area Factor (BAF) Crown closure
Tree variables	Tree azimuth Horizontal distance DBH (1.3 m height) Tree height Crown width Diameter Over Deformation (DOD) DOD height measurement Species local name Dead tree Damage tree Direction of leaning tree

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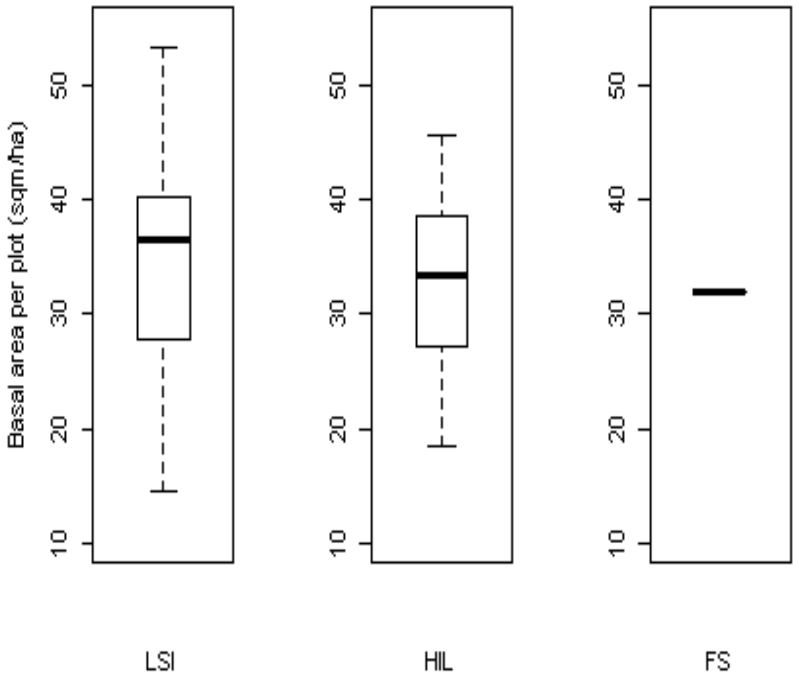
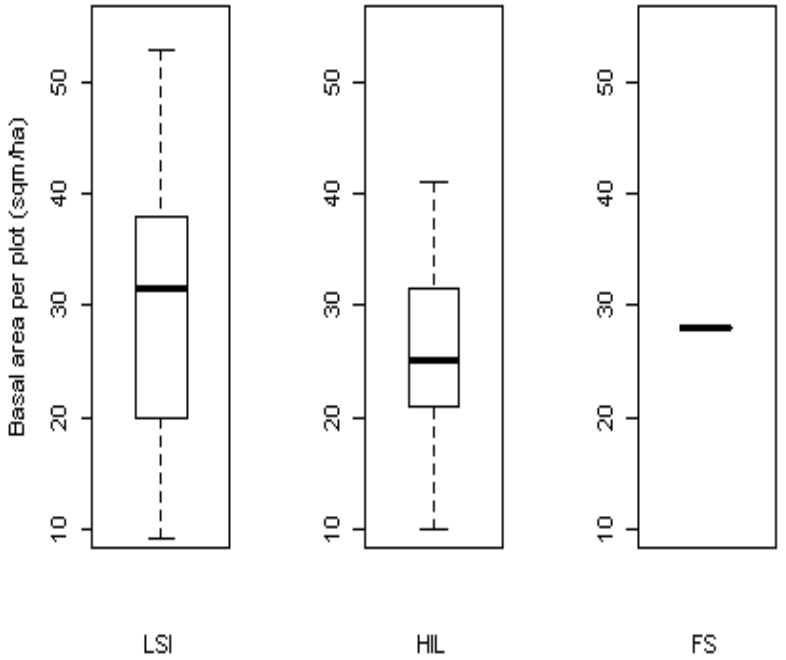
Background



Basal area from fix area plot



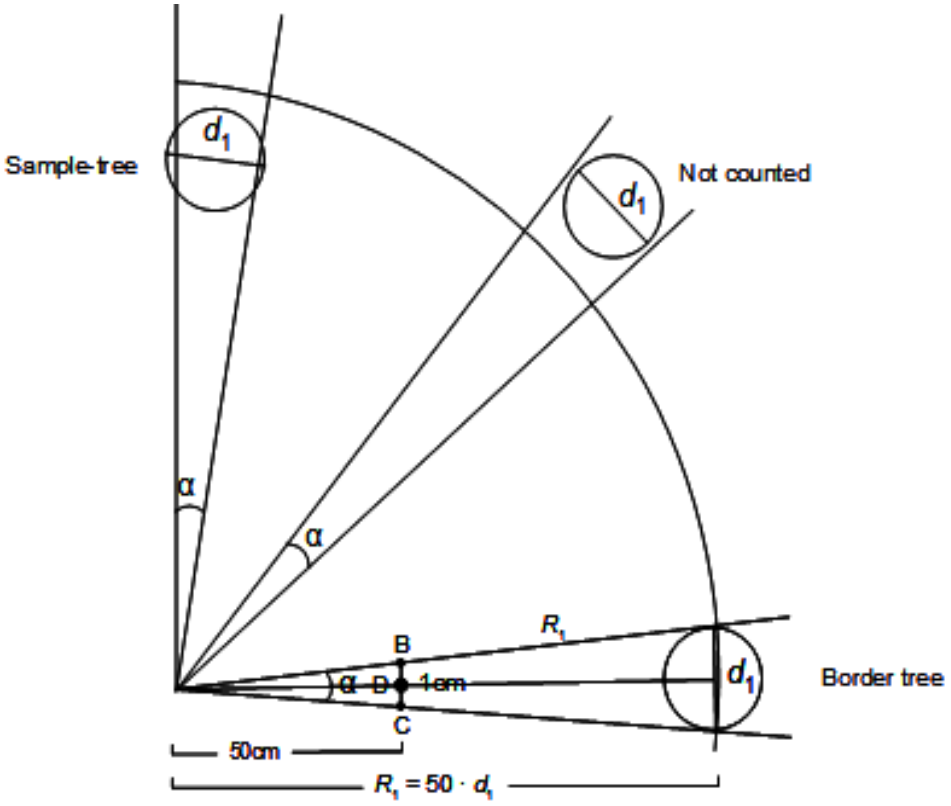
Basal area from angle count method

- Basal area of angle count method is lower than the one of fix area sampling plot
- By changing the sampling design, the basal area also changes

Background

- Fixed area plot is sampling proportional to area and it observe a complete sample of all trees inside the plot (Eastaugh, 2014)
- The angle count method is sampling proportional to basal area. This method is efficient and easy to implement
- Angle count method assumes total visibility of objects; overlooking objects leads to a non-detection bias (Bitterlich, 1984)

Angle Count Method



Source: AWF Wiki

- Basal area is estimated from a central point where an observer counts the selected trees with 360 degree sweep
- Tree X is counted as selected when its DBH is wider than the respective opening angle (determine by the BAF)
- The counted selected trees is multiplied by the basal area factor to convert to BA/ha

The equation of angle count theory (Bitterlich, 1984):

G = BAN * BAF

G = the basal area density around a point in the forest

BAN = the number of trees counted from that point

BAF = basal area factor

Objective & Research question

Objective

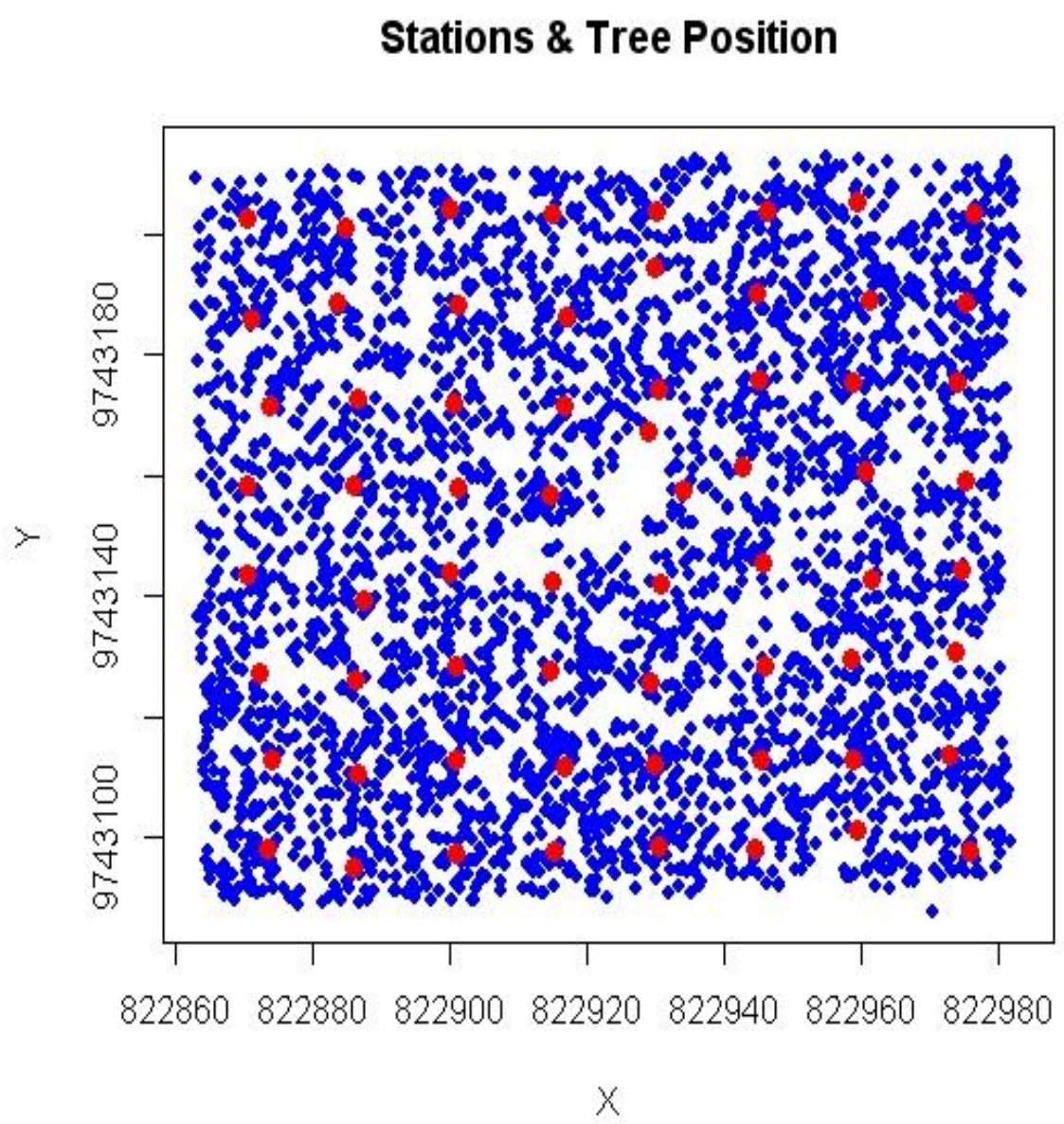
To investigate the suitable basal area factor for the forest type of the study area:

- Based on the visibility of trees within the forest
- Based on a simulation
- Based on the desired number of trees per plot

Research question

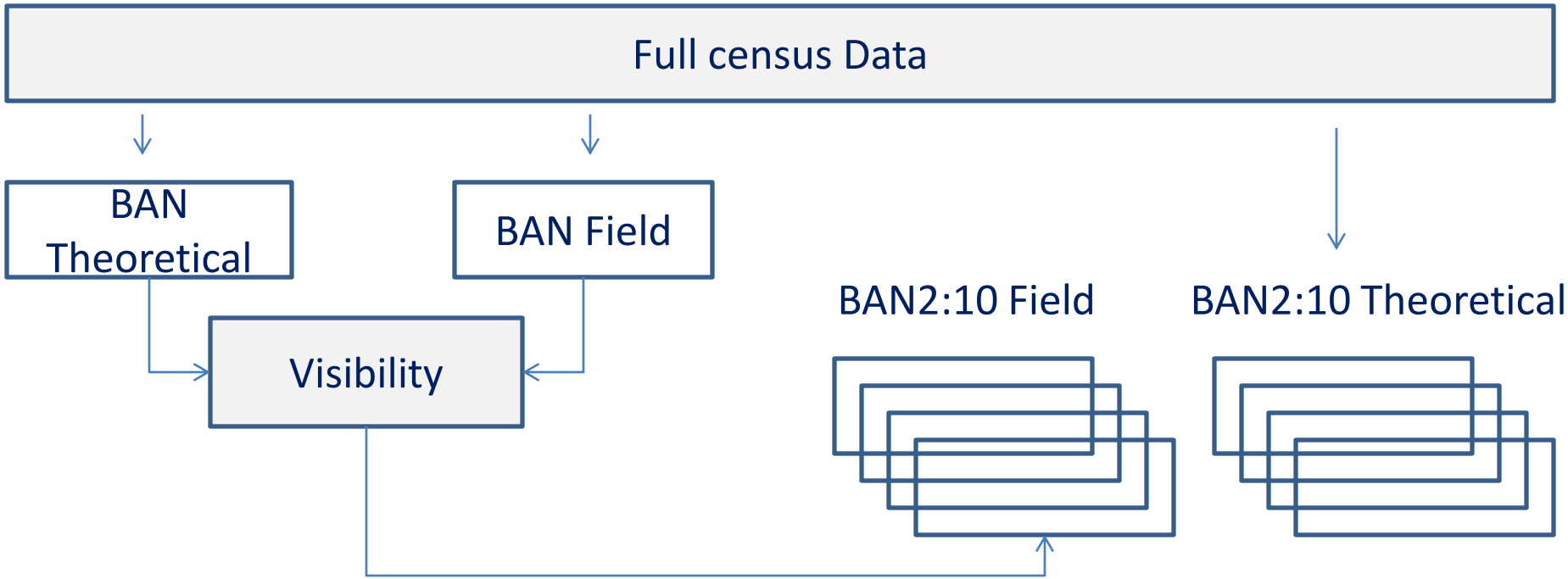
What is the suitable basal area factor for the forest type of the study area?

Methods



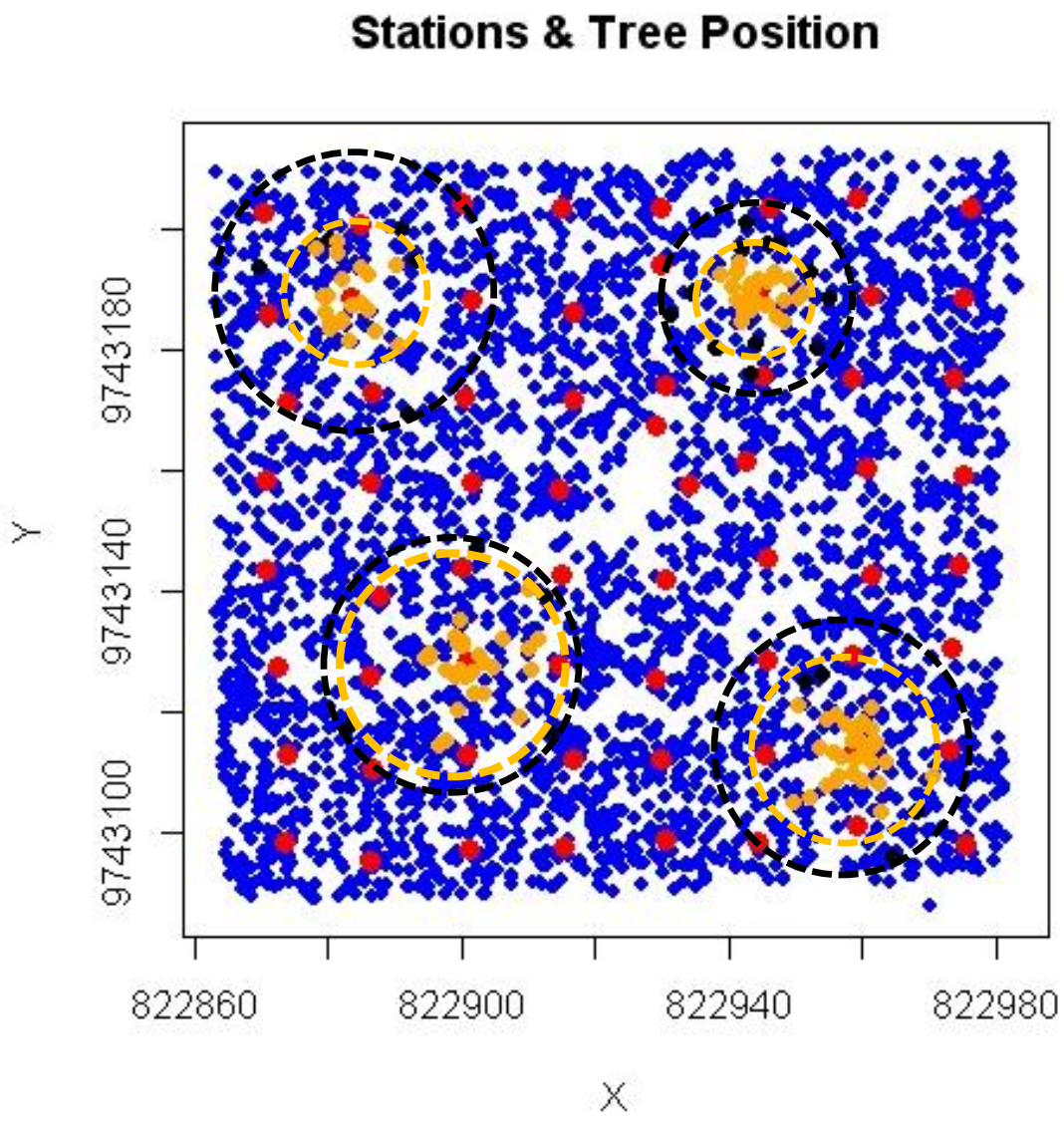
- Simulation of BAN is carried out in FS plot
- The euclidian distance between the station and each tree is calculated
- Tree is tallied (theoretically) if tree radii ≤ the euclidian distance
- Simulation of the BAN Theoretical using BAF 1 to 10

Methods



- Calculate visibility using the Difference between:
  Max distance BAN Theoretical – Maximum distance BAN Field
- Simulation of the BAN Field using BAF [2 : 10] and the estimated visibility

Results

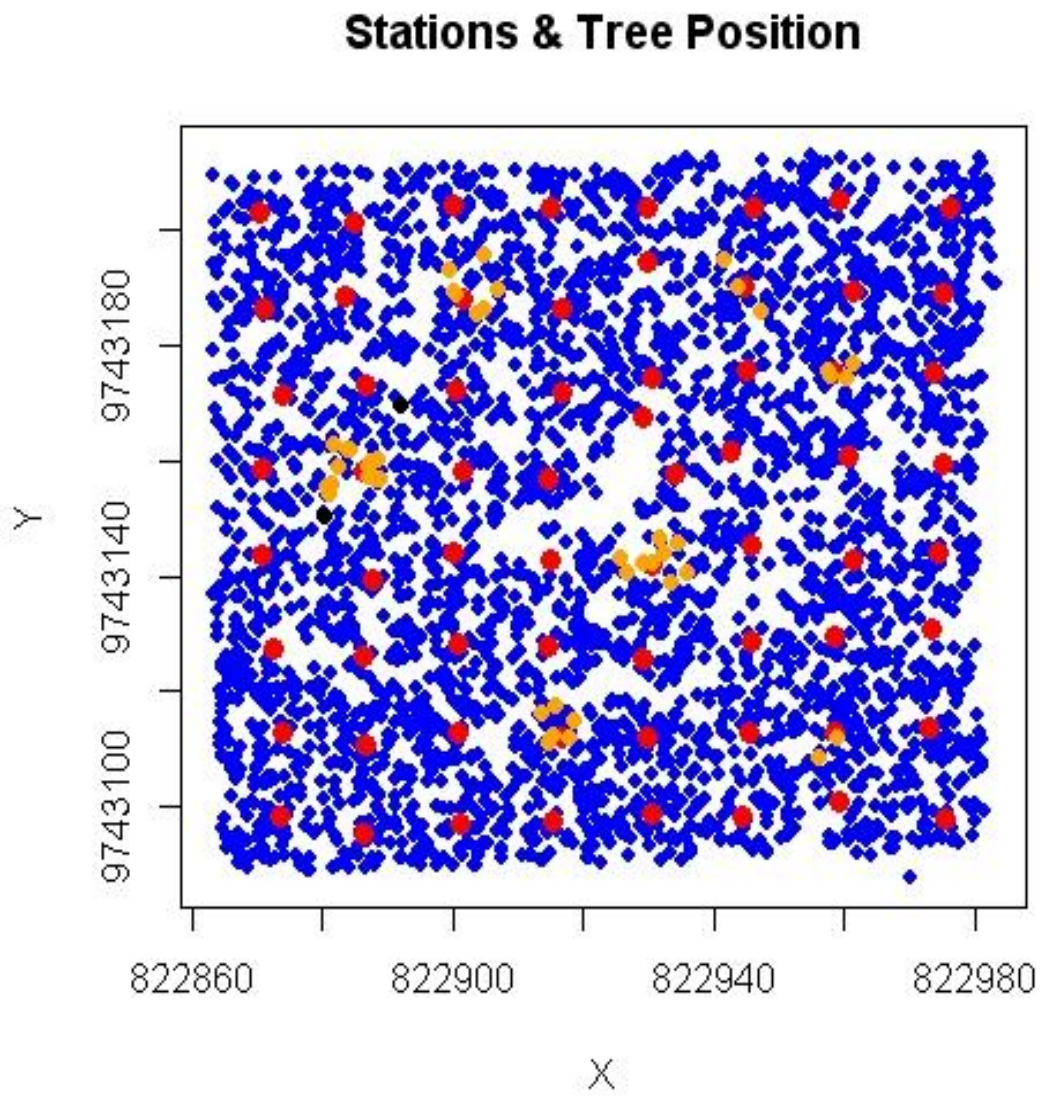


- Tree position
- Station Position
- The theoretical radii
- The visibility radii

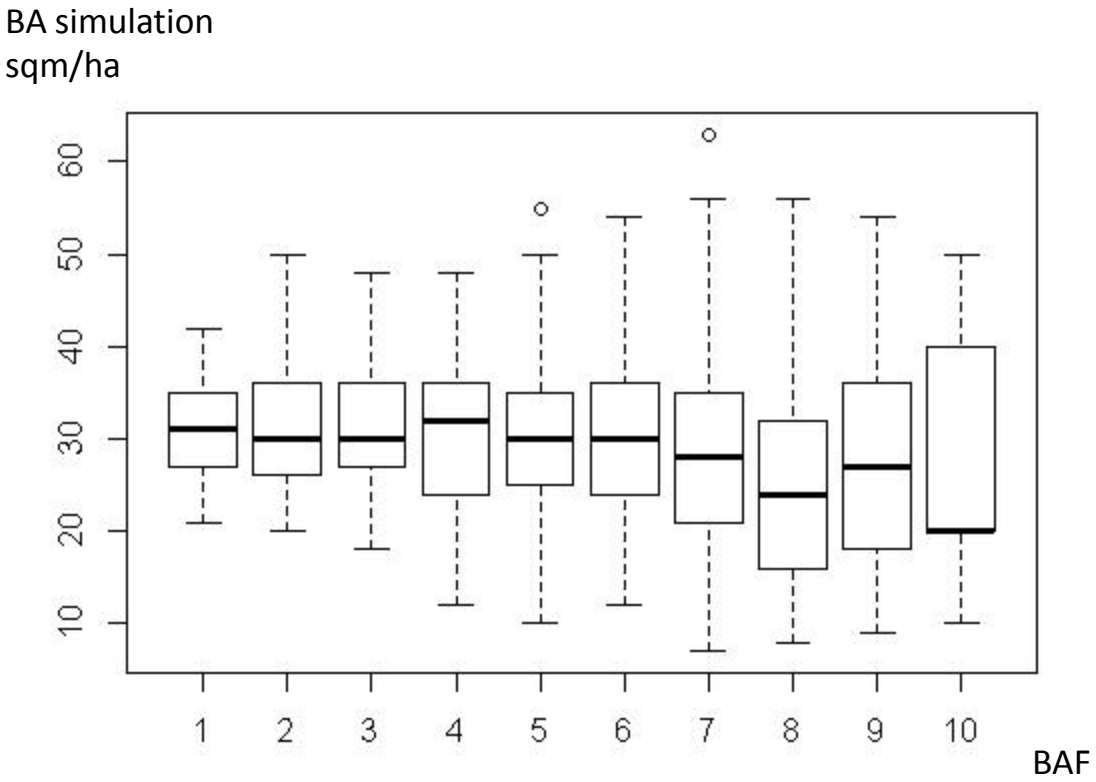
The theoretical selected number of trees is larger than the number of trees tallied in the field

Mean visibility: 12.7 meter

Results

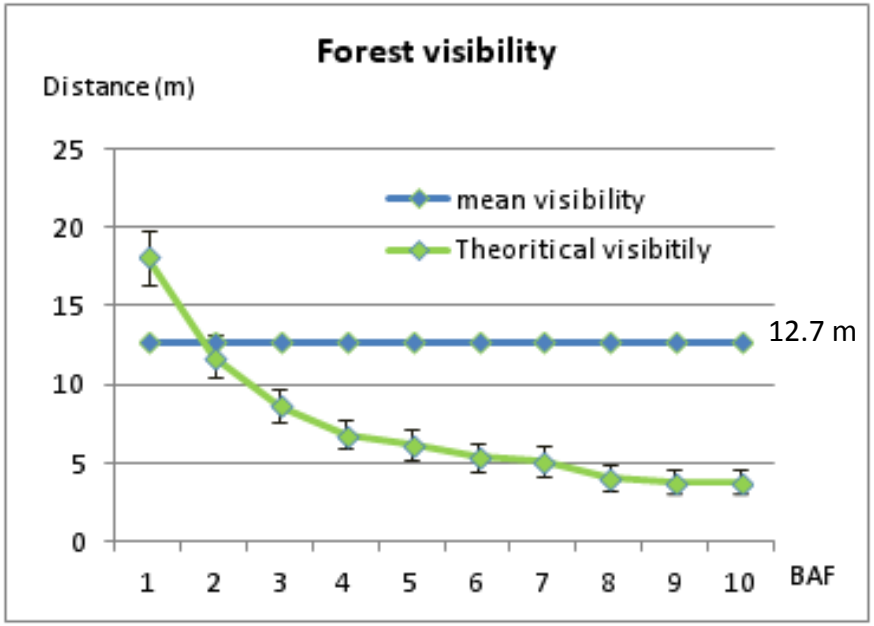

Stations & Tree Position
Y
9743100
9743140
9743180
822860
822900
822940
822980
X

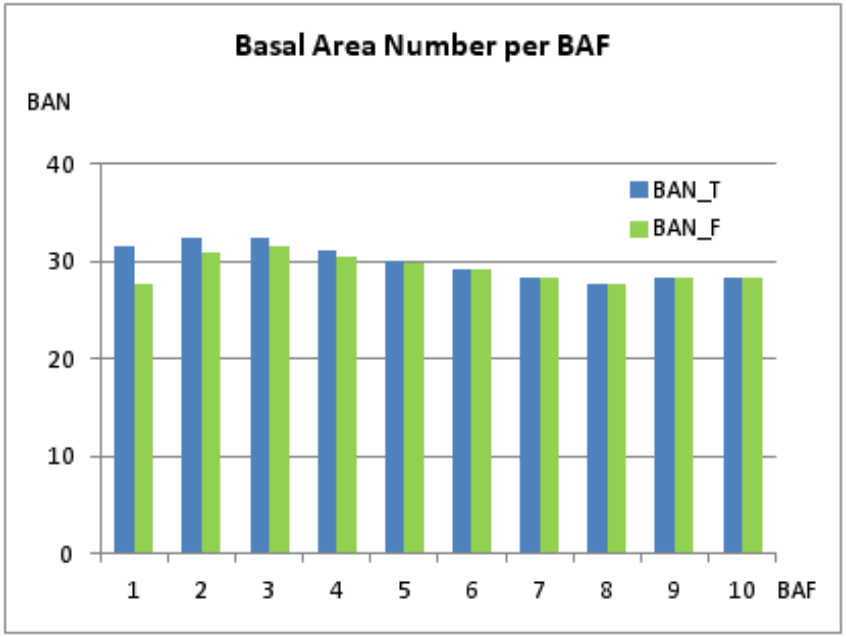
Variability of mean basal area per BAF

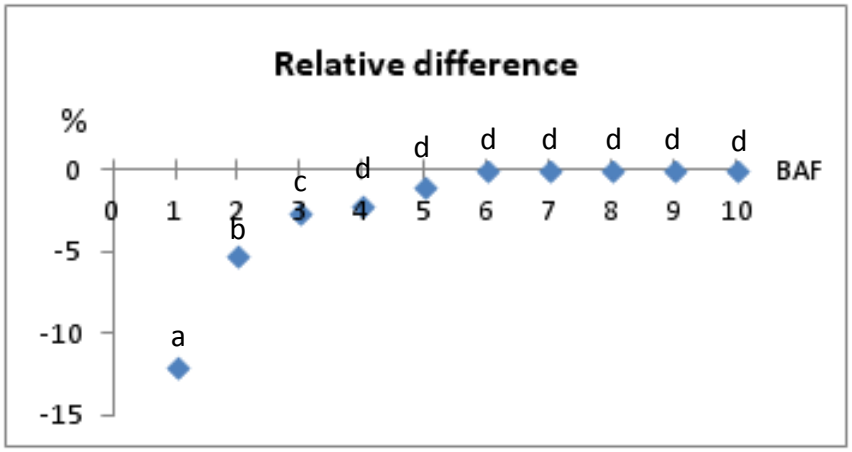


The higher the basal area factor, the higher the variability

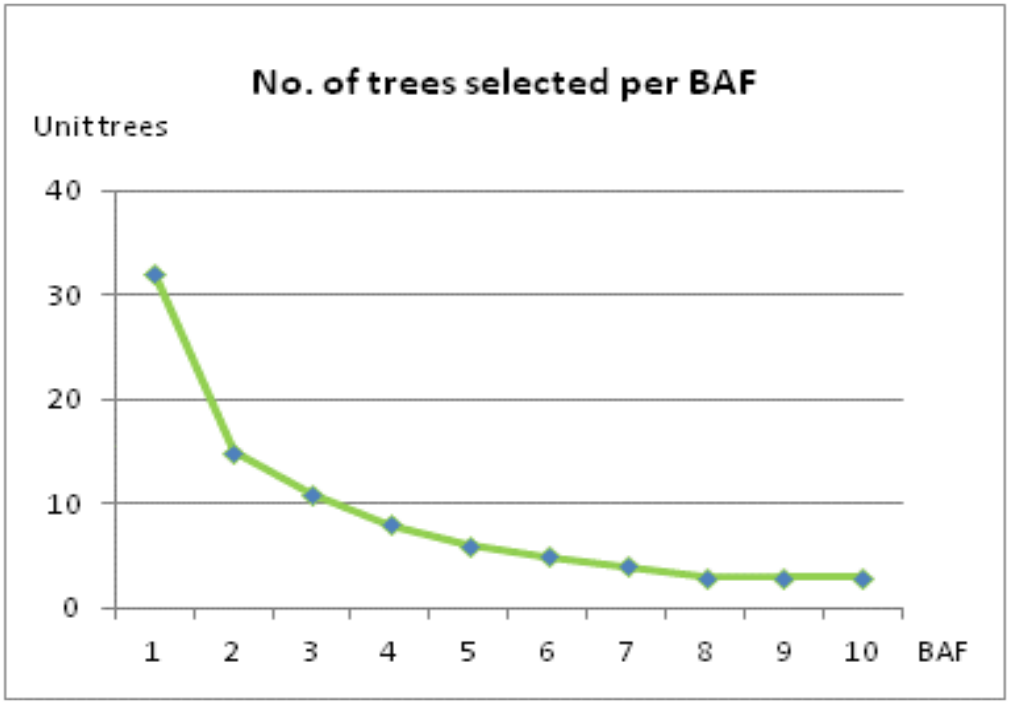
Results


Forest visibility
Distance (m)
25
20
15
10
5
0
mean visibility
Theoritical visibitily
12.7 m
1
2
3
4
5
6
7
8
9
10
BAF


Basal Area Number per BAF
BAN
40
30
20
10
0
BAN_T
BAN_F
1
2
3
4
5
6
7
8
9
10
BAF


Relative difference
%
0
-5
-10
-15
a
b
c
d
d
d
d
d
d
d
0
1
2
3
4
5
6
7
8
9
10
BAF

Results



Selection of the Basal Area Factor (Bitterlich, 1984):

$$BAF = \frac{\text{estimated average stand basal area/hectare}}{\text{desired average tree count per point}}$$

Conclusions

- The difference between fixed area plot and angle count method is due to the visibility
- Different criteria to determine the suitable basal area factor were evaluated:
  - ❖ Unbiasness → BAF > 3
  - ❖ Error/Variability → BAF 1 – 3
  - ❖ Rule of thumb→ BAF 1 – 3
- Theoretically, the suitable BAF to be used in Sabangau forest is BAF 2 or larger
- But regarding the desired number of tree count per point, the suitable BAF for the study area is between BAF 2 and 3
- Angle count method is an efficient technique to measure basal area but not under all condition







Thank You!


Terima kasih!