

WORKSHOP IMPROVING BIOMASS ESTIMATION METHODS FOR THE AMAZON

São José dos Campos, 16 Oct 2015



The National Forest Inventory:

Field campaigns, data access and the compatibility with other initiatives

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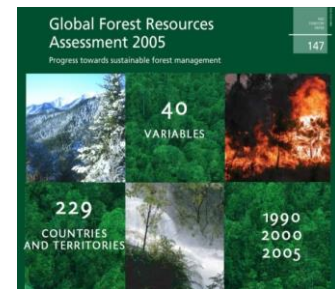
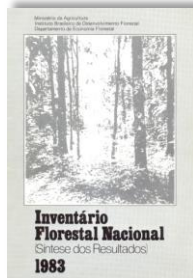
Ministério do
Meio Ambiente

1. Motivation for the NFI
2. NFI sampling design: How we do it
3. Expected Outputs & Outcomes
4. Implementing status
5. Final remarks



Introduction: motivation for the NFI

- Brazil is a forest country (54.4%)
- The national and global importance of forest
- Demand for accurate, reliable and updated information on forests at national level
- International agenda on Forests: reports, reports and reports
- 27 States: a need for a standard methodology
- NFI as participatory process
- Information for decision making and policies' design



NFI Objective

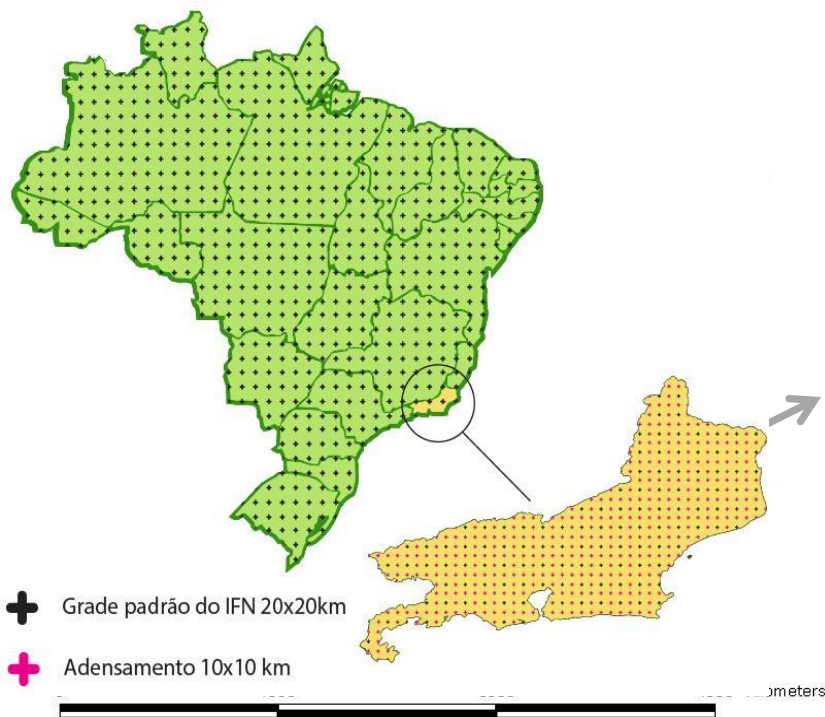


The main purpose of the NFI is to generate information on forest resources, both natural and plantations, to support the formulation of public policies and projects aiming at forest resources use and conservation.

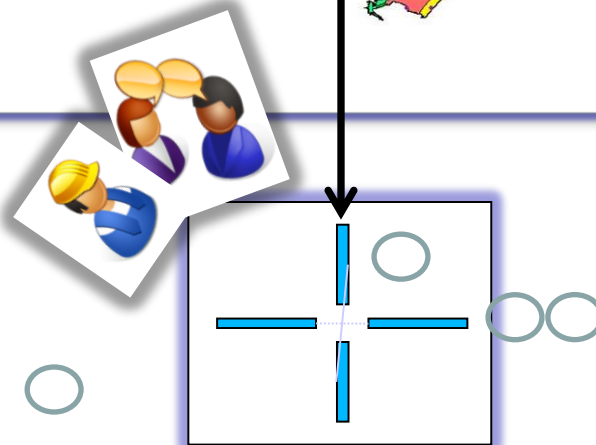
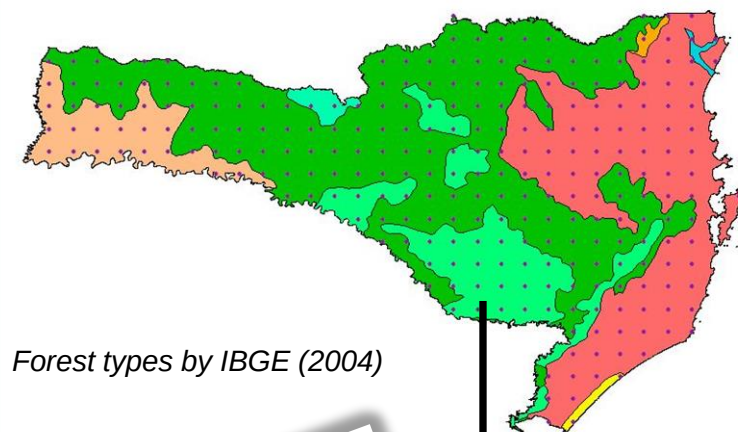


NFI Sampling design (Field Sample Plots)

1 – A national grid of sistematic sample points : 20 km x 20 km



2 – All forest types sampled



3 - Field Sample Plot for tree measurements and land use assessment



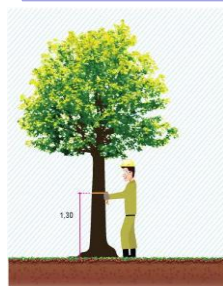
What do We do in the field?

1

We measure trees

Data on forest quality and condition

- ✓ Tree Diameter
- ✓ Tree Height
- ✓ Species name
- ✓ Soil sample
- ✓ Necromass
- ✓ Tree health
- ✓ ...
- ✓ ...



We interview people

How important is the forest for you?

- ✓ Forest products
- ✓ Environmental services
- ✓ Perception on forests
- ✓ Forest income
- ✓ Climate change
- ✓ Demand for forest plantations
- ✓ ...

2



Plot configuration

Attributes recorded in field:

(DBH>10 cm) and nested subplots for DBH>5 cm

Species name (botanical samples)

DBH, height

Health and vitality

Dead wood

Litter

Soil samples

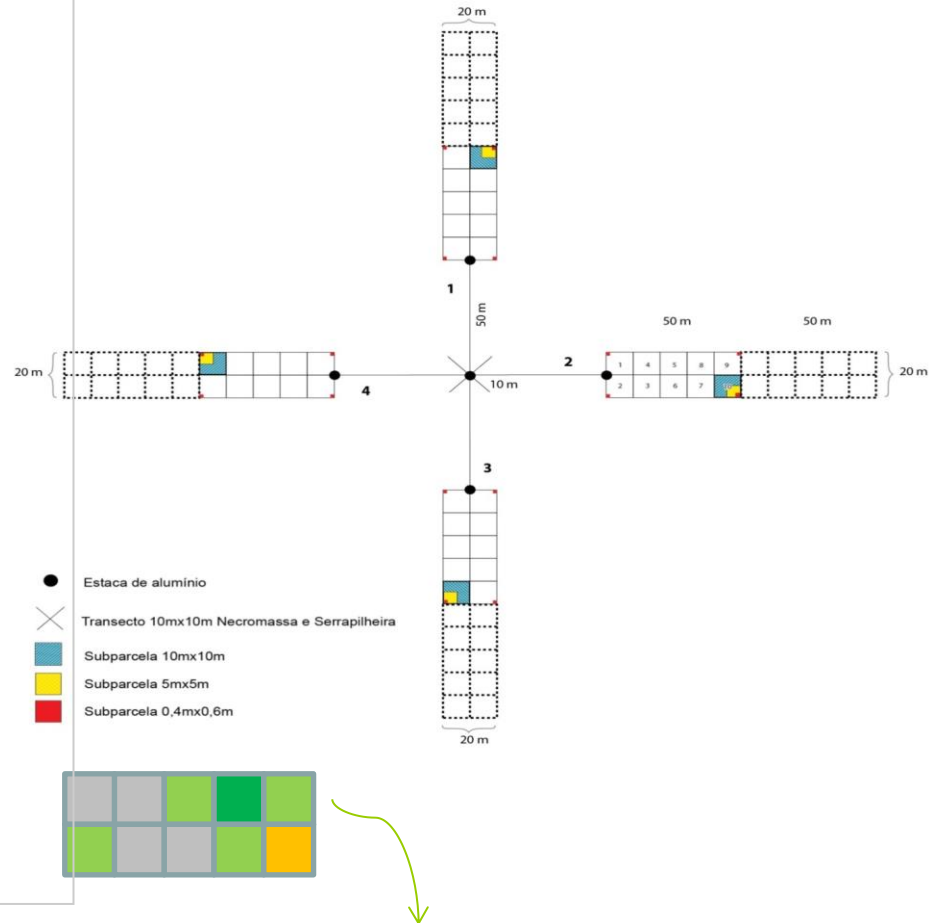
Evidences of logging / fire

Status forest/non forest

Land use classes

Field Manual

Amazon biome: larger plot 20m x 100m (DBH>40 cm)



- ✓ Sistematic sampling
- ✓ Cluster of 4 plots;
- ✓ Ratio estimate;

$$\hat{V}(\bar{y}_R) = \frac{(1-f_1)}{\bar{A}^2 n} \cdot \frac{\sum_{i=1}^n (A_i \bar{y}_i)^2 - 2 \bar{y}_R \sum_{i=1}^n A_i^2 \bar{y}_i + \bar{y}_R^2 \sum_{i=1}^n A_i^2}{n-1} + \frac{f_1(1-f_2)}{n^2 \bar{A}^2 m} \sum_{i=1}^n A_i^2 \hat{\sigma}_{2i}^2$$

Field campaigns



- *Brazilian Forest Service plan the sampling (areas and sampling points);*
- *Hired companies*
- *Bidding process (Amazon x rest of the country)*
- *BFS provide training for companies' teams*
- *Teams of 5 persons*
- *2-4 cluster per field team/week*
- *Quality Control is made the BFS*
- *Data is sent to BFS*
- *Botanical samples sent to herbarium*
- *Soil samples sent to Labs*
- *Herbarium and Soil Labs sent results to BFS*
- *BFS integrate and process data*



What are the expected NFI (Qualitative) outputs?

1

Botany/Biodiversity

- What are the tree species?
- How are they distributed?
- How are they being used by the people?
- Endangered species, commercial species
- 1931 species and counting
- New tree species and new occurrences
- The knowledge about the flora is increasing!
- *For biomass: species variable*



What are the expected NFI (Quantitative) outputs?

2

Carbon/biomass/volume stock

- How much carbon do our forests store? (*39-93 PgC; Houghton et al., 2001*)
- How is the biomass distributed over the territory and gradients?
- What are the uncertainties related to these results?
- Can we improve the estimates done so far?

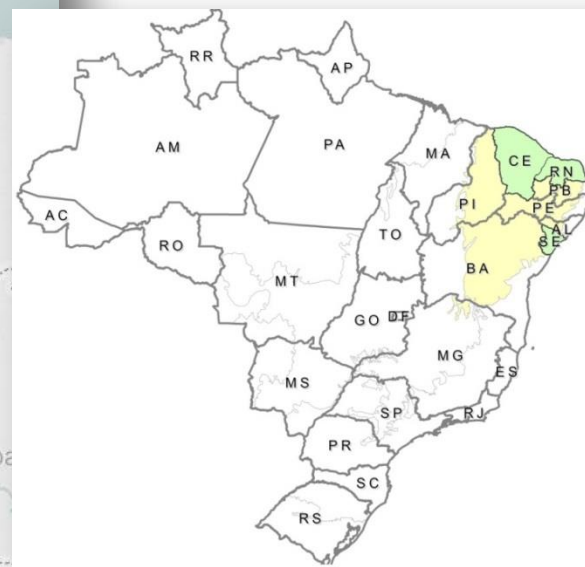
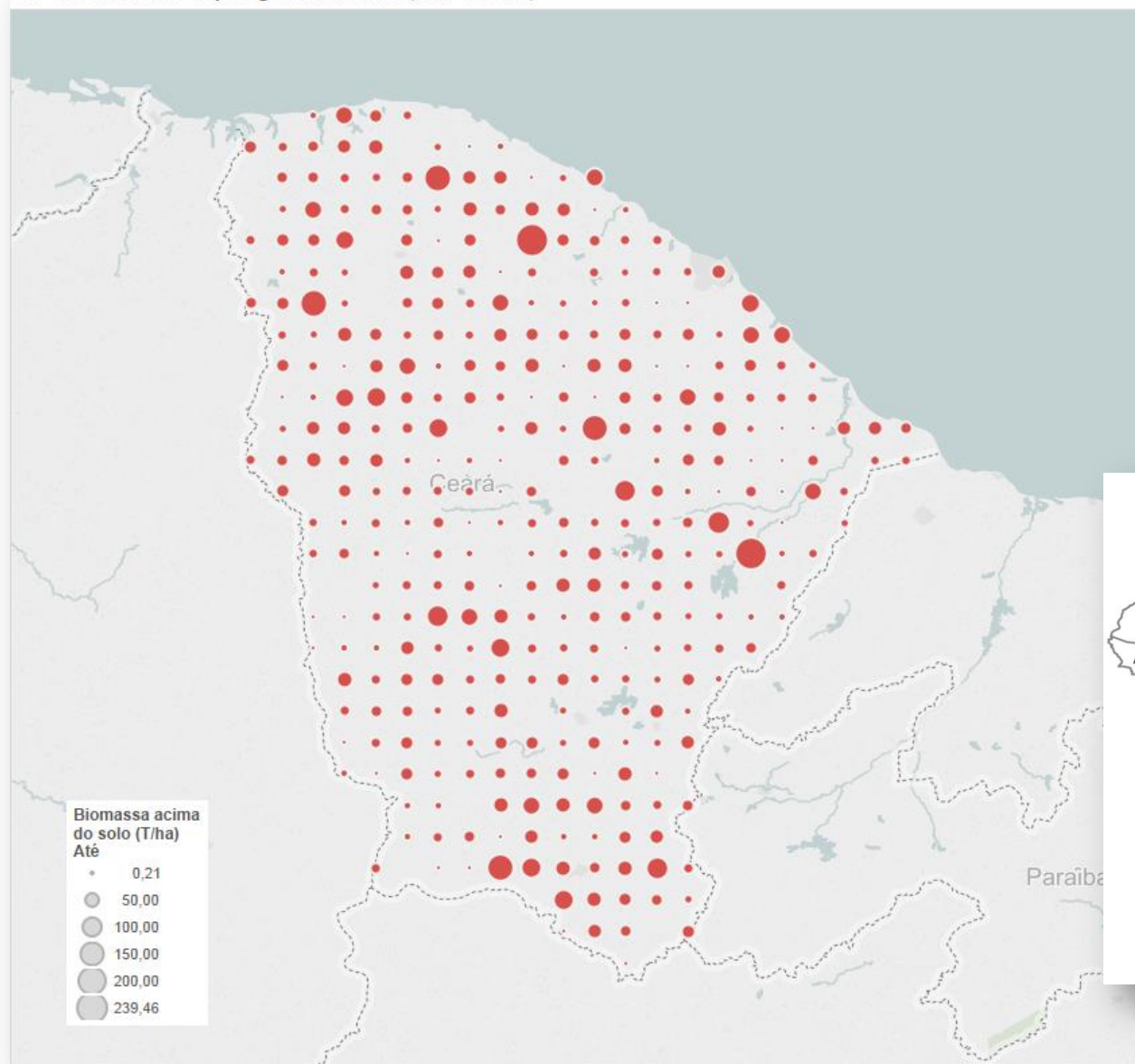


Variable	Phytocological region in Santa Catarina		
	Seasonal Forest	Mixed Forest	Dense Forest
DBH (cm)	19.55 ± 0.74	20.42 ± 0.60	18.13 ± 0.32
Stem height (m)	4.97 ± 0.20	4.98 ± 0.21	8.57 ± 0.15
Total height (m)	10.00 ± 0.46	9.08 ± 0.40	10.60 ± 0.22
N of trees (n ha ⁻¹)	422.37 ± 31.57	559.87 ± 42.39	629.44 ± 27.12
Basal Area (m ² ha ⁻¹)	18.30 ± 1.58	24.76 ± 2.17	21.72 ± 1.13
Number of species	38.37 ± 2.02	36.62 ± 1.86	59.12 ± 2.07
Stem volume (m ³ ha ⁻¹)	77.75 ± 10.11	97.13 ± 8.66	92.78 ± 7.60
Biomass (Mg ha ⁻¹)	125.66 ± 13.47	131.05 ± 10.71	127.00 ± 8.52
Carbon stock (Mg ha ⁻¹)	62.83 ± 6.73	65.53 ± 5.35	63.50 ± 4.26

Source: IFF/NFI-SC; (Vibrans et al, 2012)

Biomass for Ceará State - IFN-CE (n = 372 clusters)

IFN-CE Biomassa - Tipologias Florestais (DAP $\geq$ 5 cm)

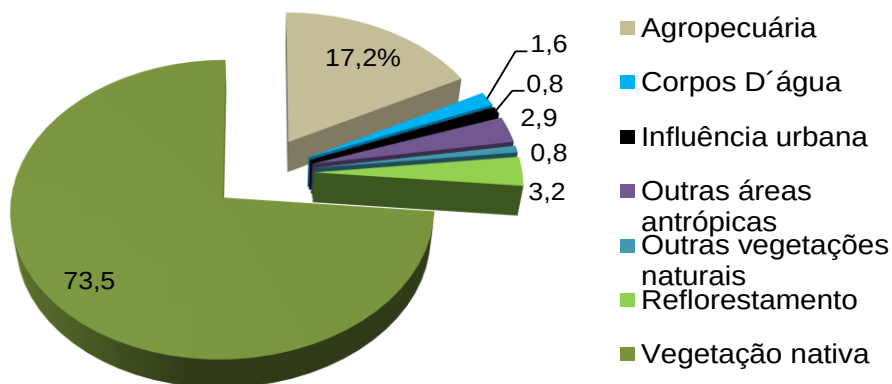


Biomass for Ceará State (IFN-CE)



DBH Classes	Variable	Average	CV%	LE %
DBH≥10cm	Volume (m ³ /ha)	13,37± 1,44	6,51	10,74
	Biomass (t/ha)	13,67 ± 1,81	8,04	13,27
	Carbon (t/ha)	6,70± 0,89	8,04	13,27
5cm ≤ DBH < 10cm	Volume (m ³ /ha)	10,13 ± 0,79	4,71	7,77
	Biomass (t/ha)	11,46 ± 0,95	5,02	8,28
	Carbono (t/ha)	5,61 ± 0,47	5,02	8,28
Total	Volume (m ³ /ha)	23,5 ± 2,23	5,75	9,49
	Biomass (t/ha)	25,13 ± 2,76	6,66	10,98
	Carbon (t/ha)	12,31 ± 1,35	6,65	10,97

Classes de Uso da Terra - Ceará (%)



Estoques médios de volume, necromassa e carbono de árvores mortas no estado do Ceará.

Classes de DAP	Variável	Média	CV%	LE %
DAP≥10cm	Volume (m ³ /ha)	1,18 ± 0,22	11,04	18,22
	Biomassa (t/ha)	0,94 ± 0,16	10,48	17,29
	Carbono (t/ha)	0,46 ± 0,08	10,48	17,29

*CV%= Coeficiente de variação; LE% = Limite de erro da amostragem (α = 0,1).

Biomassa e Carbono – IFN-DF (Federal District)

Compartimento		Biomassa (1.000 t)	Carbono
	5 cm=DAP< 10 cm	DAP=10 cm	
Biomassa	Acima do solo	491,15	3.947,3
	Abaixo do solo	537,85	2.339,8
	Total na biomassa	1.029,00	6.287,1
Necromassa	Árvores mortas em pé	102,03	976,1
	Madeira caída no solo	-	-
	Total na necromassa	-	-
TOTAL			

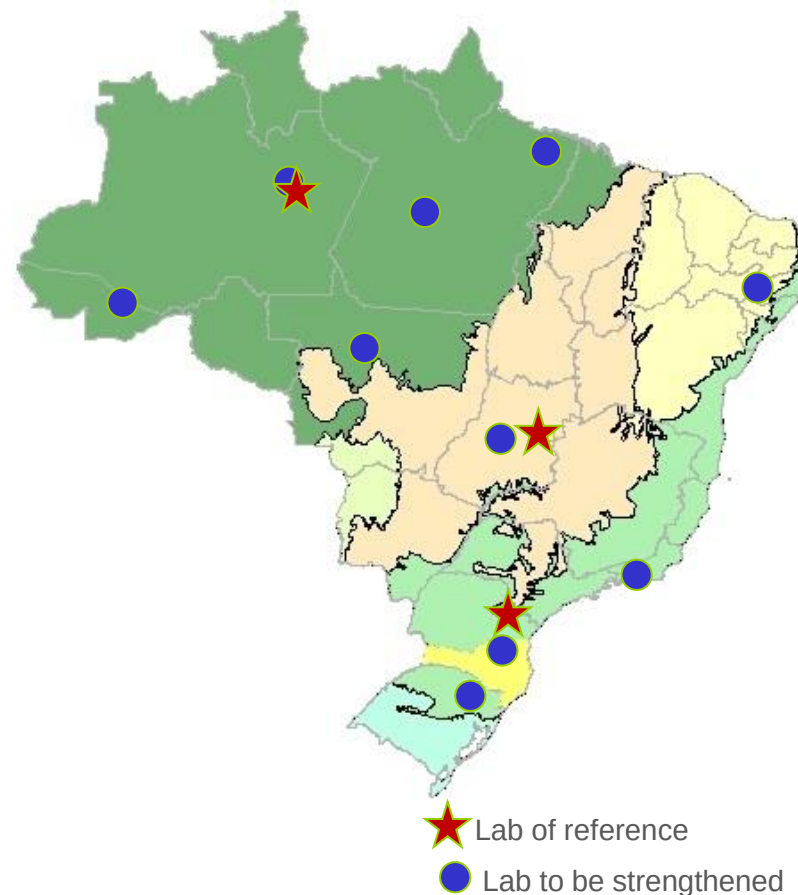
- **9** million m³ of **timber** stocked in DF's forests
 - Cerrado e Matas de Galeria
- **4,4** million t of **biomass** above ground
- **2,2** million t of **carbon** stored in above ground in natural forests of DF



NFI Allometry Initiative



1. To increase the number of allometric equations for NFI data processing
2. To organize information on available equations (FRA process)
3. To strengthen research groups and Labs of Forest Mensuration
4. Supporting field data collection in selected sites
5. Strategy for site selection (gaps)
6. Guidelines and training on data collection and processing
7. Groups produce equations per site, on IPCC pools
8. National repository for data collected
9. Groups can participate in NFI data processing (States' reports)
10. Data used for education and additional research



Criteria for selecting sites for data collection for developing new allometric equations for NFI in natural forests (adapted from Gibbs *et al.*, 2007)

3-Mesoregion	2-Forest condition →					
1-Forest Types ↓	Mature forest	Managed forest	Secondary forest (medium stage)	Secondary forest (young stage)	Special life forms	Other Land Use Classes
	...					

Data sets per site

•Above ground

- Trees DBH $\geq$ 5 cm (trees)
- Trees DBH<5cm (10m x10m)
- Trees DBH>10 cm
- Dead wood (10m x 10m)
- Litter (10 m x 10 m)

•Below ground

- Roots (10 m x 10 m sub sampling 1 m³)
- Soil content (as NFI)

Data sets from more than one site

- National database of trees (equations)
- New equations, improved equations...etc

Components of NFI Allometry

1. Data collection in field (biomass)
2. Lab processing (Dry weighth, carbon stock..)
3. Data processing (regression analysis)
4. NFI data processing (with the equations!)

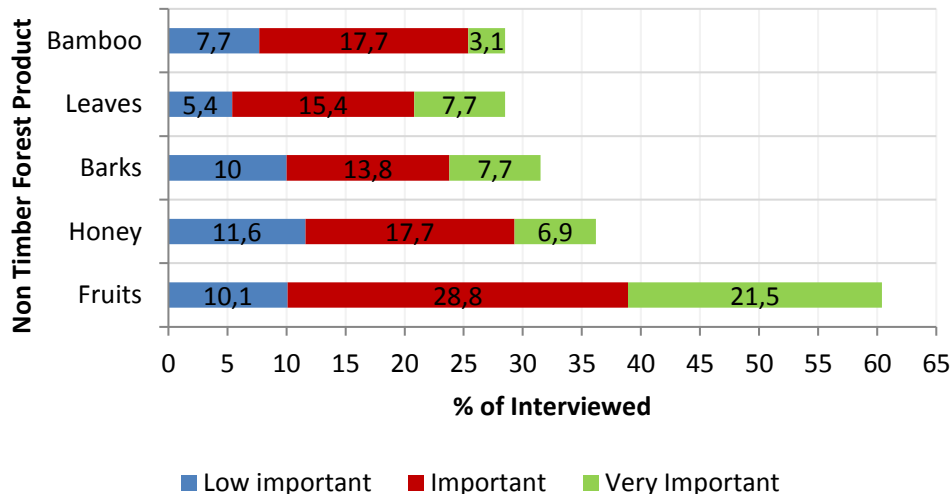


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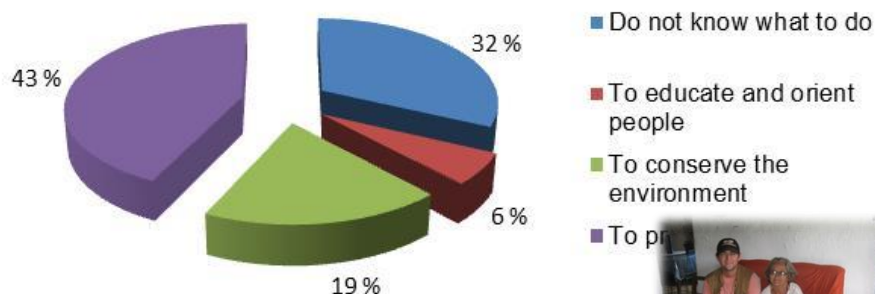
What do people think about their forests? (IFN-DF)

- The forest environmental service more cited was **spring protection** (41%)
- 70% of interviewed consider that **climate change** is affecting their lives
- 43% **believe** that in order to mitigate climate changes is necessary **to protect their forests**
- 20% of interviewed **participate in some group working to protect forests** (pro-forest groups)
- 65% do not know **the environmental laws**

NTEP - Relative importance for domestic use (N=132)



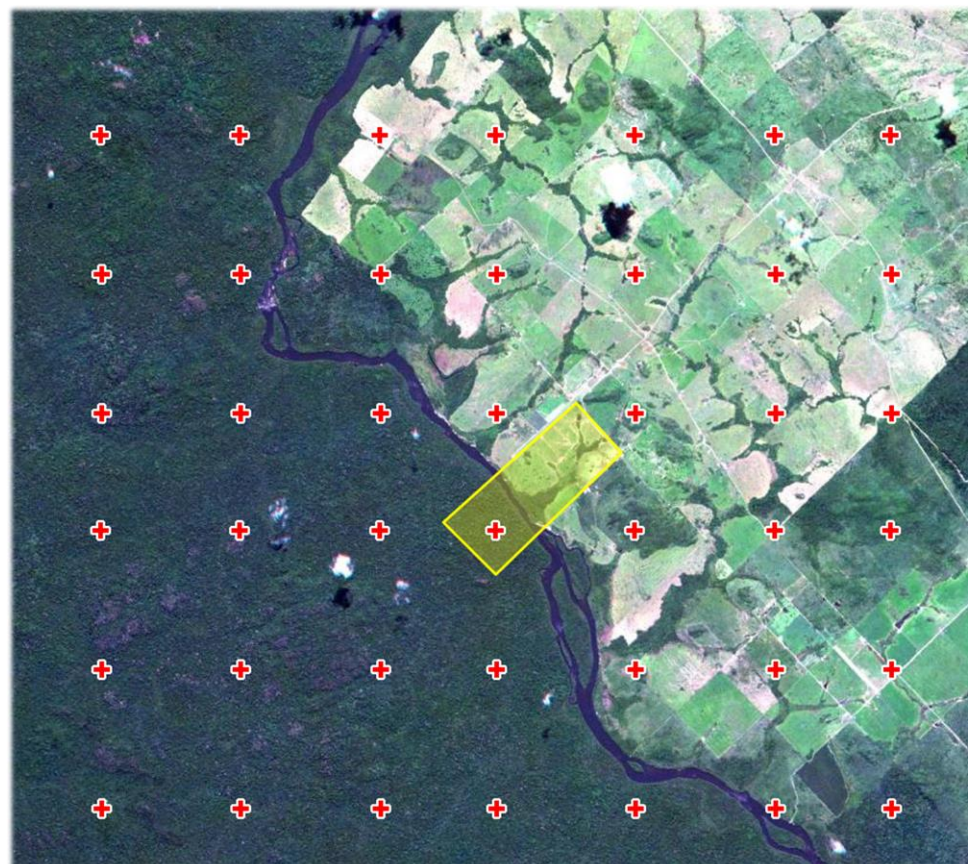
Attitudes for mitigating climate changes
(N=55)



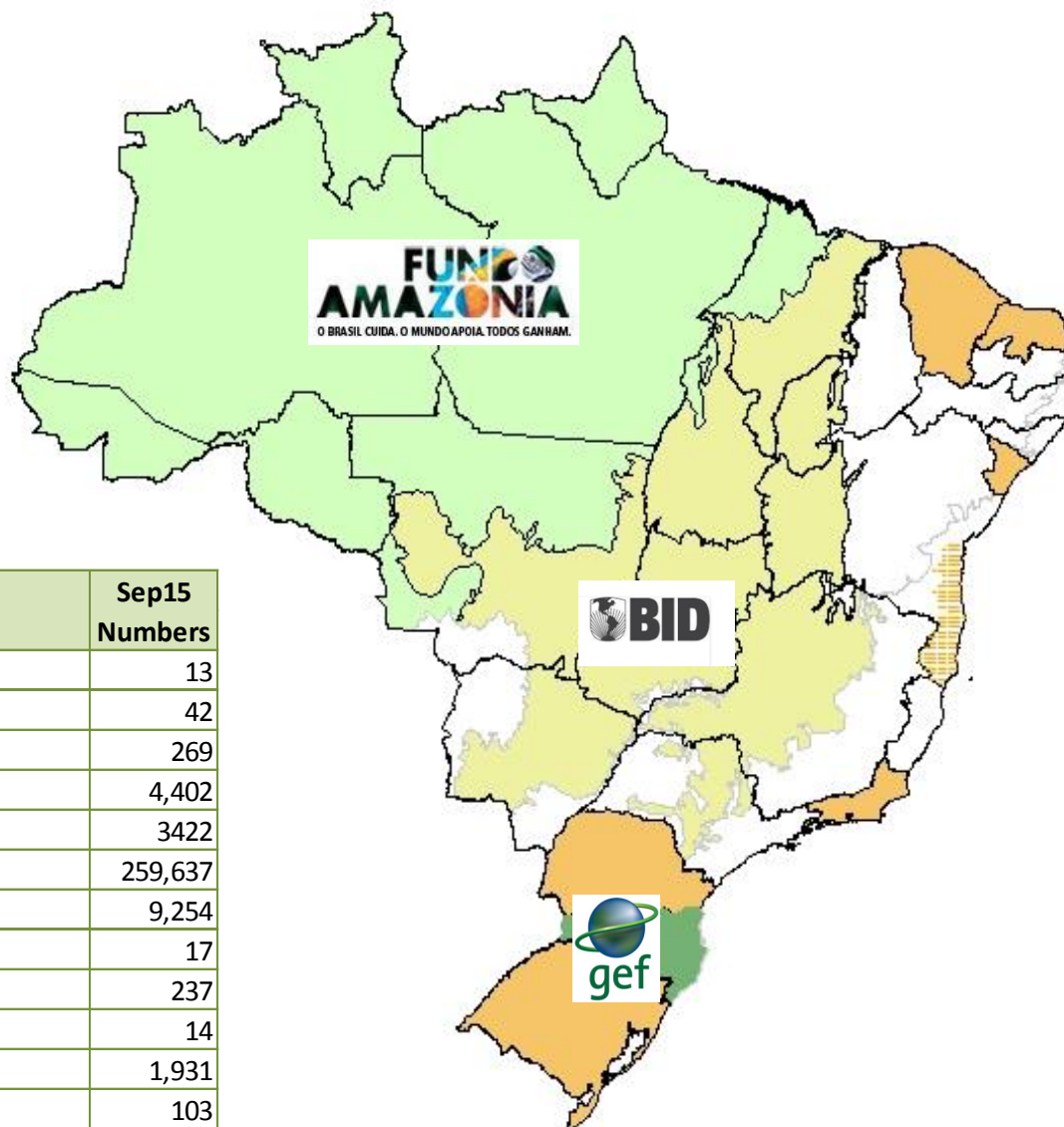
4

Integrating and supporting other projects and programs

- NFI and CAR:
 - Quality and condition of forests within **private properties**
 - **How much carbon private forests store** and contribute to this environmental service?
- NFI and forest restoration programs
- NFI and Remote Sensing carbon estimates
- Data available for the society



Implementing status

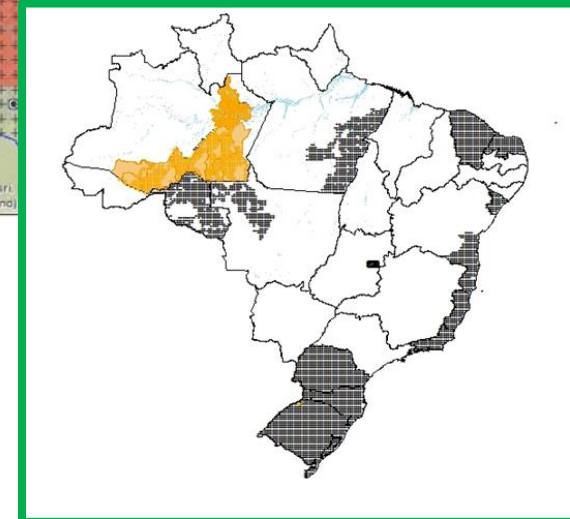
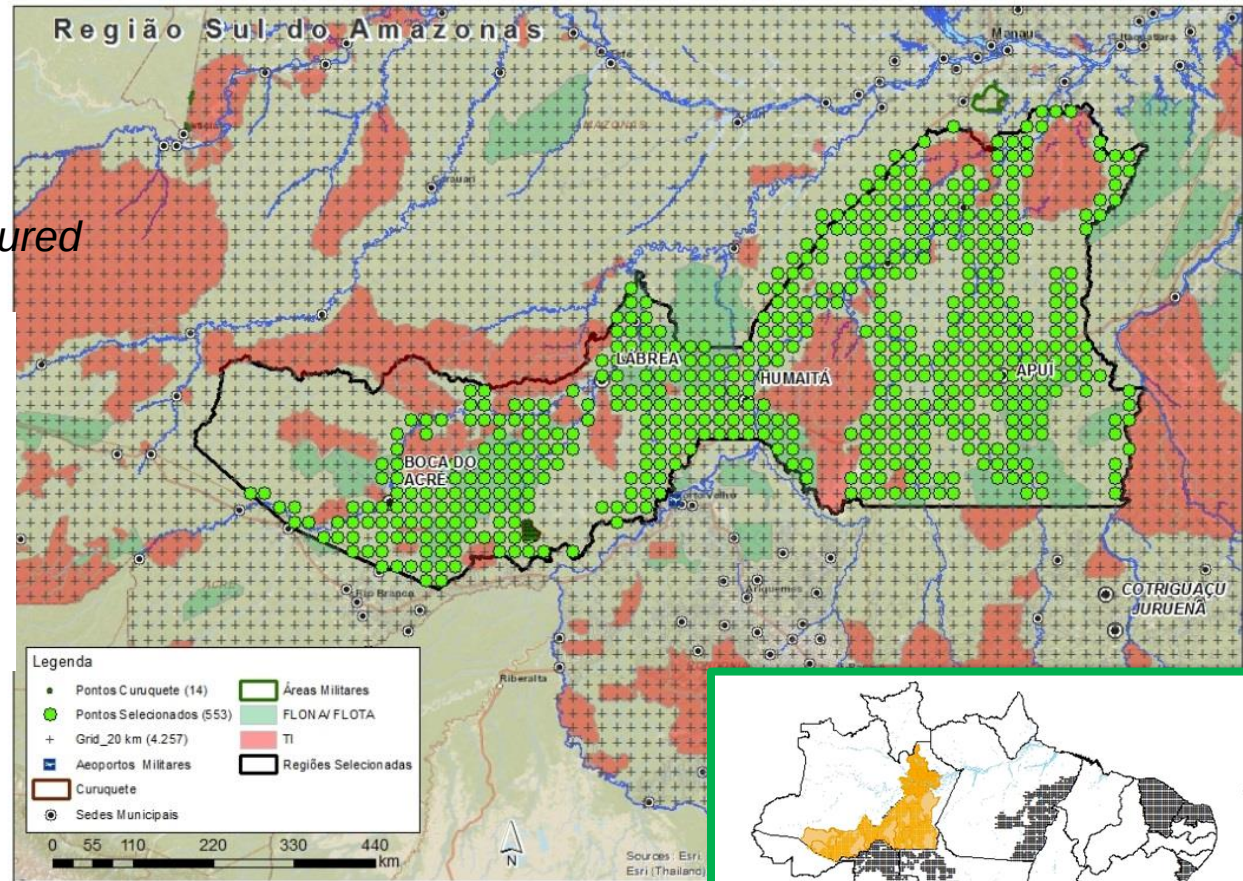
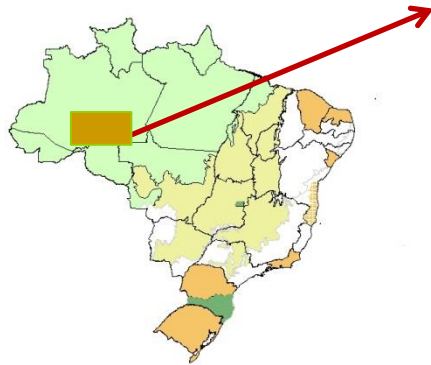


Indicator	Sep15 Numbers
States under data collection	13
Institutions working with NFI	42
People working with NFI	269
Contracted cluters	4,402
Measured clusters	3422
Measured trees	259,637
People interviewed	9,254
Number of training sessions	17
Trained people	237
Number of Herbaria with NFI	14
NFI species (7 stares)	1,931
Samples area (Million ha)	103

80-100%

Challenge: Data collection in Amazon region

- ✓ Access conditions;
- ✓ Costs;
- ✓ Forest characteristics;
- ✓ ~7,000 clusters planned
- ✓ So far ~1,500 clusters measured



Final remarks

- NFI will become an additional reference on forest information at national and subnational level;
- To value the forests is the first step to find the way achieve sustainable use and reducing deforestation;
- The biomass and carbon stocks of Amazon region estimates will be improved with NFI ground data;
- Other Amazon Fund projects can benefit from the NFI data and results (CAR, state projects, etc);
- More scientific and well informed decision-making about forests is the way forward!
- We have to move from isolated initiatives to multi-source monitoring systems: Amazon region is half of the country



Thank You!

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