



DỰ ÁN “HỖ TRỢ CHƯƠNG TRÌNH ĐÁNH GIÁ VÀ THEO DÕI LÂU DÀI
TÀI NGUYÊN RỪNG VÀ CÂY PHÂN TÁN TOÀN QUỐC TẠI VIỆT NAM”

PROJECT “ SUPPORT TO NATIONAL ASSESSMENT AND LONG TERM
MONITORING OF THE FOREST AND TREE RESOURCES IN VIETNAM (NFA)”



NFA Project Status Update for STWR-MRV

Tani Höyhtyä, 31 Aug 2012

NATIONAL FOREST ASSESSMENT (NFA) PROJECT

- NFA project is designing improved national forest inventory system to be implemented in Vietnam during the next national forest inventory round between 2016 and 2020.
- Current NFA project is not carrying out any large scale national forest inventory excluding some pilot tests
- NFA project is developing tools for next NFI round
 - Data collection, input, verification, calculation, analyses and dissemination tools
 - Hardware and software solutions
 - Strengthening of institutional and human resources through training of all personnel involved
 - NFA has very important role in developing methods and tools within the FAO Finland Forestry Programme to serve FAO to be used in other member countries.

TYPICAL INFORMATION CONTENT OF NFI

- Area of land
 - by land use classes and forest categories (e.g. forestry, agriculture...)
 - by land cover classes (forest, other wooded land, other land)
- Area of forest land
 - by forest types, by tree species dominance and by age classes
- Volume of growing stock
 - by tree species, by forest types
- Growth by tree species or tree species groups (permanent sample plots)
- Volume of the total drain (=harvest plus natural losses) (permanent plots)
- Carbon pool and carbon pool changes of the five pools given in IPCC GPG LULUCF 2007 (above ground biomass, below ground biomass, dead wood, litter, soil)
- The areas of accomplished and needed operations on forest land
- Quality: damages and disturbances
- Biodiversity elements
- Changes

ROAD MAP FOR THE IMPROVED NFIMAP SAMPLING DESIGN

- A. Plot size evaluation with NFI-4 data
- B. Correlogram / Semivariogram analyses with NFI-4 data to compare efficiency of different designs
- C. Accessibility analysis; tests with Google Earth
- D. Bac Kan pilot inventory
- E. Land cover and forest type mapping trials in Bac Kan and Ha Tinh using eCognition software
- F. Next steps

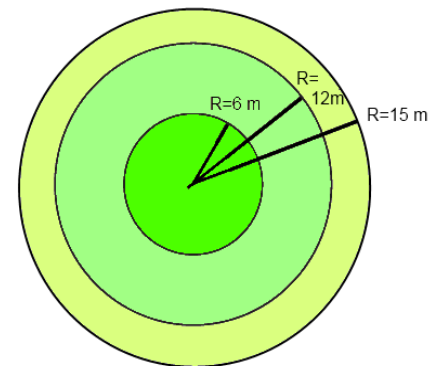
A. PLOT SIZE EVALUATION WITH NFI CYCLE 4 DATA

PLOT SIZE EVALUATION

- Usually there are more small trees than big trees
- For efficiency, the plot should be larger for big trees than for small trees
- The same volume estimates by DBH classes can be get through reducing the number of measured trees for smaller DBH classes

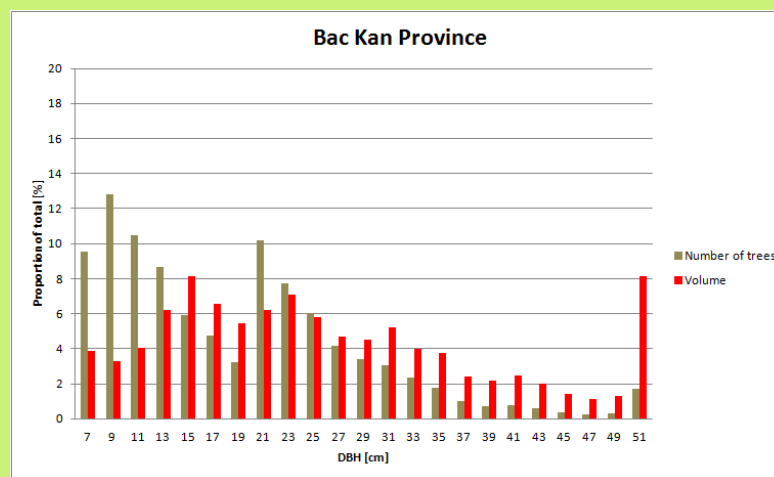
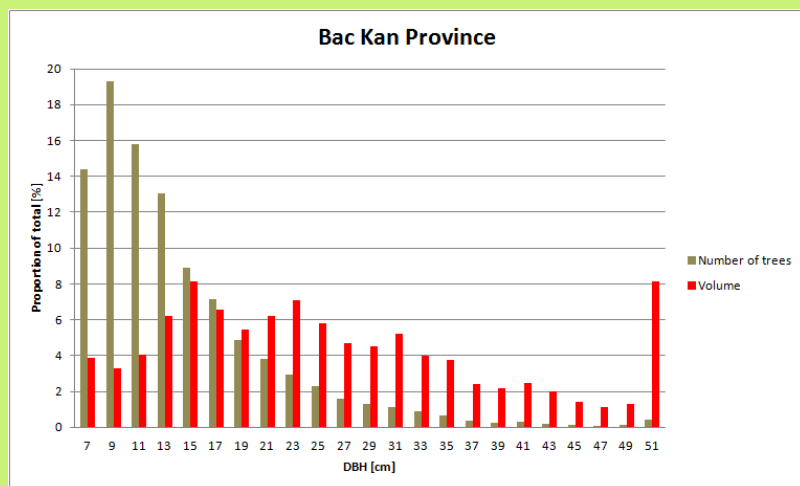
→ Nested circular plot
= different radius
according to DBH

Radius: 15 m
Trees: DBH \geq 40 cm
Radius: 12 m
Trees: DBH \geq 20 cm
Shrubs, Bamboo, Dead wood
Radius: 6 m
Trees: DBH \geq 6 cm



PLOT SIZE ADJUSTMENT

HOW CAN WE DO THIS?



Rectangular plot

Subplot size: 20 m x 25 m

Nested circular plot

Diameter, cm

Plot radius, m

Tree expansion

6.0 – 19.9

6

6.25

20.0 – 49.9

12

1.5625

50.0 –

15

1

22 481 trees (NFI-4 data)



7 654 trees

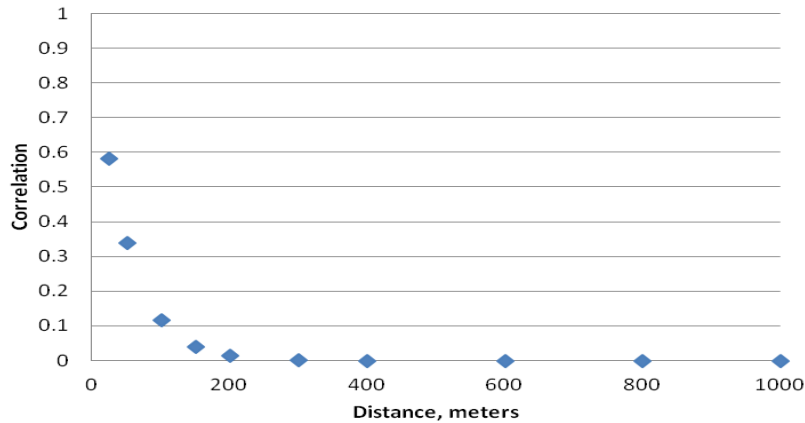
**B. CORRELOGRAM / SEMIVARIOGRAM
ANALYSES WITH NFI-4 DATA TO COMPARE
EFFICIENCY OF DESIGNS**

CORRELOGRAM / SEMIVARIOGRAMS

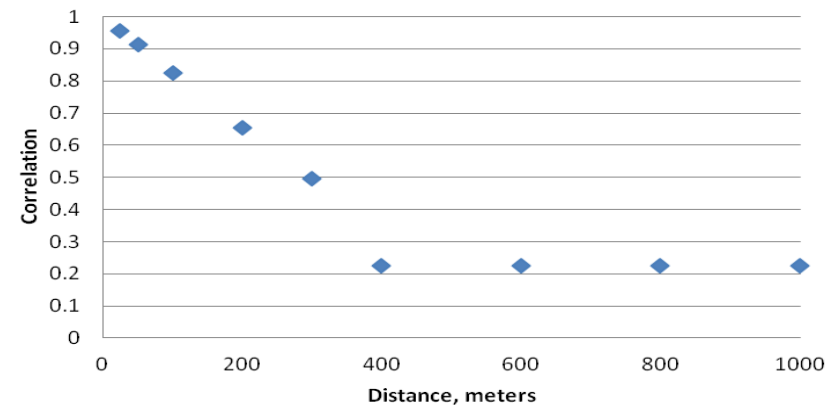
- General challenges in planning inventory sampling design
 - Avoiding unnecessary walking by locating plots near to each other => clustering
 - Plots close to each other are highly correlated (same forest type, almost same volume etc.)
- => Balance between unnecessary walking between plots and high correlation between plots must be found
- => Correlogram analyses with existing data

CORRELOGRAMS FOR BAC KAN AND HA TINH PROVINCES

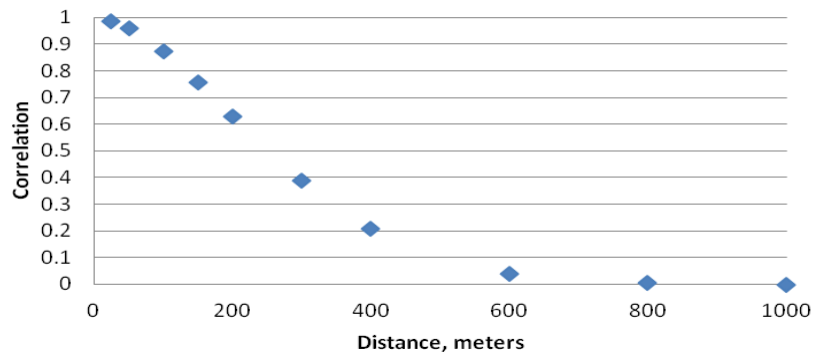
Bac Kan, volume



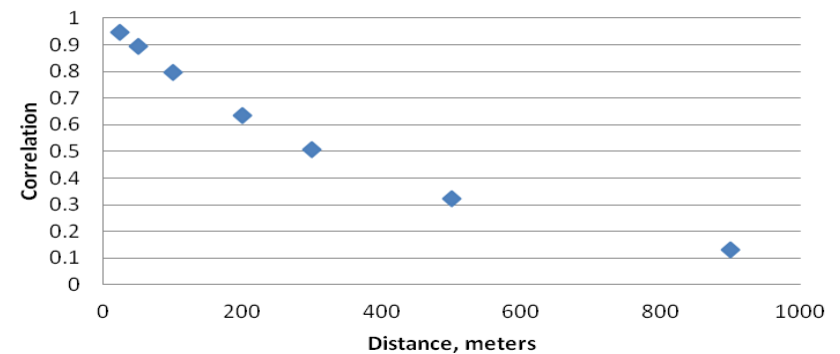
Bac Kan, forest/non-forest



Ha Tinh, volume



Ha Tinh, forest/non-forest



USE OF CORRELOGRAMS: ESTIMATE SAMPLING VARIANCES OF DIFFERENT CLUSTER DESIGNS

- estimator of sampling error in random sampling:

$$\bar{s}_k^2 = \frac{\sum_{i=1}^n (Y_{ik} - \bar{Y}_k)^2}{n_k(n_k - 1)} = \frac{s_k^2}{n_k}$$

- not valid for cluster sampling because plots in a cluster are correlated, estimator:

$$\sigma_{CL}^2 = \frac{\sigma^2}{n} + \frac{1}{n^2} \sum_{i \neq j} cov(v_i, v_j) = \frac{\sigma^2}{n} + \frac{\sigma^2}{n^2} \sum_{i \neq j} corr(v_i, v_j)$$

$$\sigma^2 = \frac{\sigma_{CL}^2}{m}$$

- where n = number of plots in a cluster, m=number of clusters

RESULTS FOR DIFFERENT CLUSTER TYPES IN BAC KAN

| Plots in a cluster | Cluster type | Distance between plots | Number of clusters | Sampling error mean volume, (m ³ /ha) | Sampling error forest area (%) |
|--------------------|--------------|------------------------|--------------------|--|--------------------------------|
| 4 | square | 100 meters | 100 | 5.4 | 9.6 |
| | | 150 meters | 100 | 5.0 | 8.8 |
| | | 200 meters | 100 | 4.8 | 8.2 |
| 3 | triangle | 173 (d=100) | 100 | 5.6 | 9.3 |
| | | 260 (d=150) | 100 | 5.5 | 8.8 |
| | | 346 (d=200) | 100 | 5.5 | 8.2 |

D. BAC KAN PILOT INVENTORY

ACCESSIBILITY ANALYSIS – GOOGLE EARTH

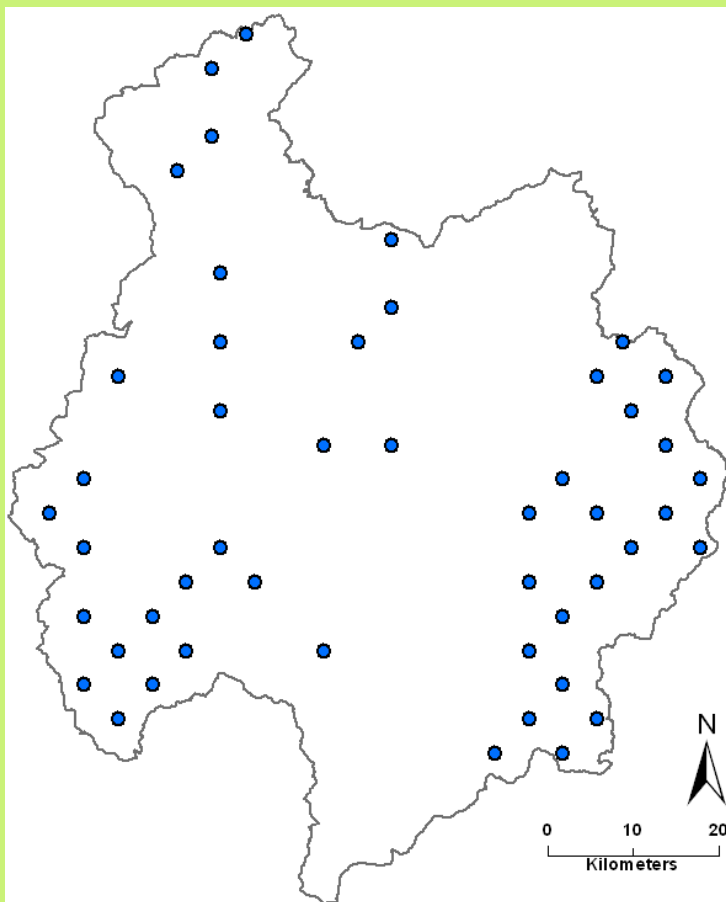
Questionnaire for analysis of accessibility of clusters and plot

| Google Earth testing, Bac Kan Province | | | | | | | | | | | | |
|---|---|-------------|-------------|----------------|--------------------------|---------------------|-------|------------------------|---------------------|---|------------------|-----------------------------------|
| Goal of the exercise: test time consumption of cluster sampling. | | | | | | | | | | Forest types: Forest, Shrub, Open, Other with trees, Other no trees | | |
| Note: 1) see comment above in cell; 2) if daily time exceeds 10 hours, field crew stays over night in the forest and continues next day | | | | | | | | | | Accessibility: Yes=Accessible; NoL=No due to lime stone; NoM=No due to other mountain; NoW= No due to water courses; NoO= No due to other reason | | |
| Variables to assess | | | | | | | | | | | | |
| Cluster | Travel time from base camp to cluster by car/motor bike | Plot Number | Forest Type | Accessi bility | Walking time to the plot | Plot measuring time | Lunch | Walk to car/motor bike | Travel to base camp | Total: Days | Total: Hours:Min | Image quality: Good, Medium, Poor |
| Example | 120 | 2 | Forest | Yes | 120 | 60 | | | | | | |
| Example | | 3 | Shrub | Yes | 30 | 30 | | | | | | |
| Example | | 4 | Forest | NoL | 0 | 0 | | | | | | |
| Example | | 1 | Forest | Yes | 60 | 60 | 60 | 120 | 120 | 1 | 02:00:00 | Good |
| 1 | 0 | 4 | Forest | | 60 | 60 | | | | | | |
| 1 | | 1 | Forest | | 30 | 60 | | | | | | |
| 1 | | 2 | Forest | | 20 | 60 | | | | | | |
| 1 | | 3 | Srub | | 20 | 30 | 60 | 50 | | | | |
| | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | |

NFI-4 INVENTORY DESIGN AND BAC KAN PILOT INVENTORY DESIGN

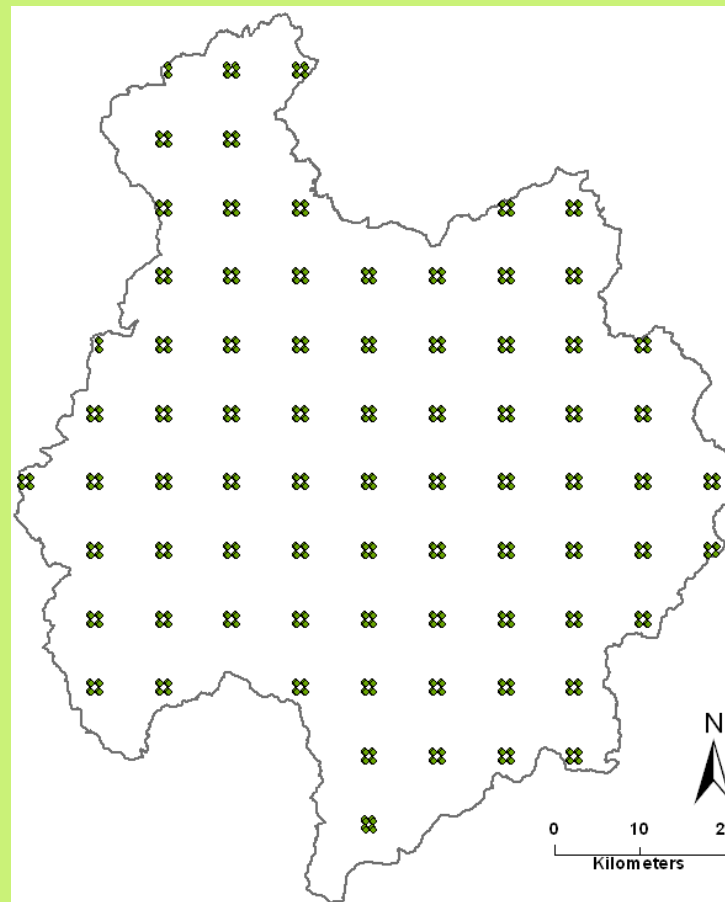
NFI-4 inventory design

- 48 plots, 1920 sub-plots

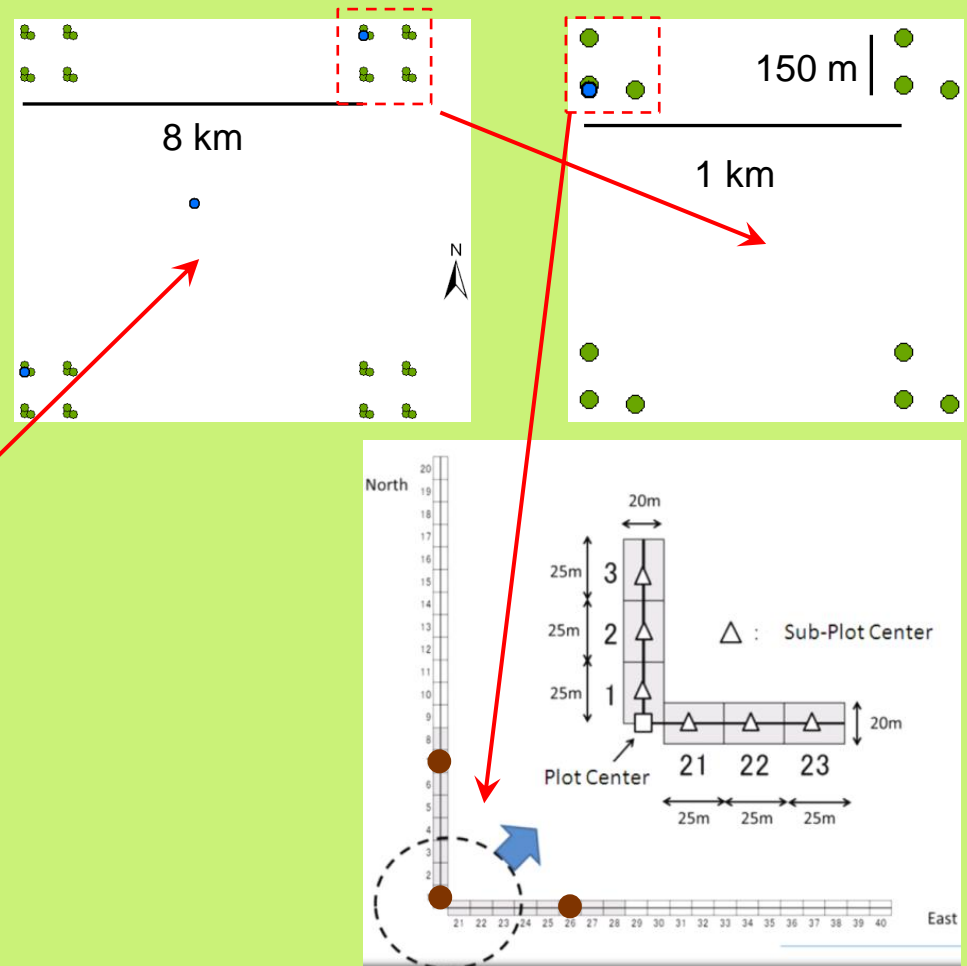
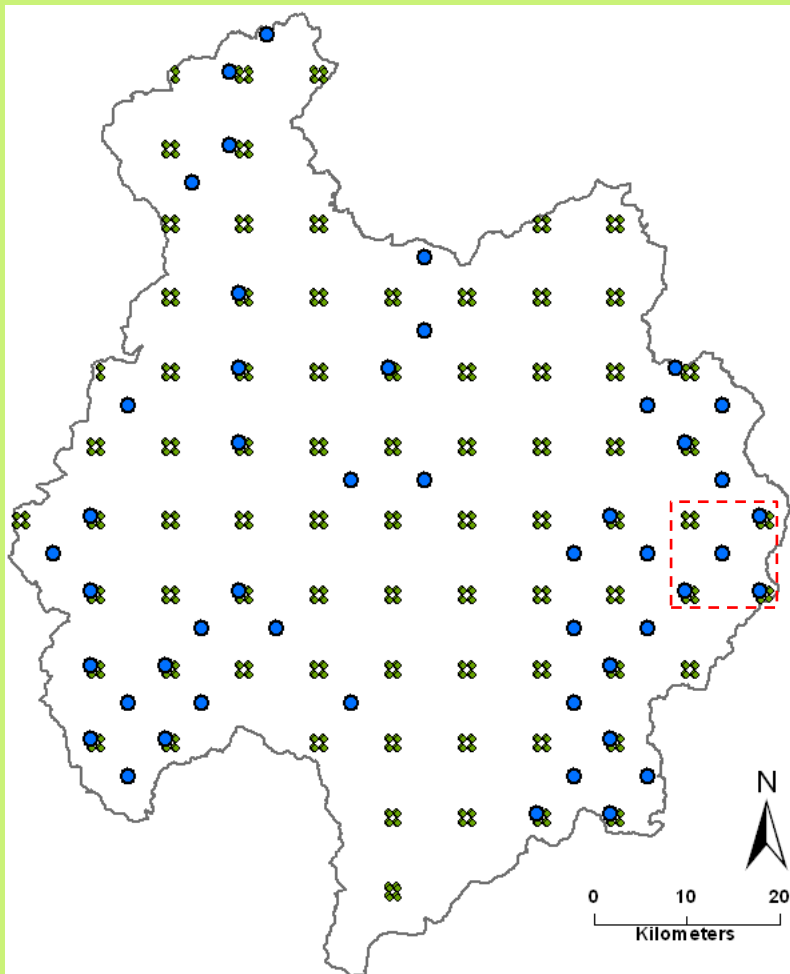


Bac Kan pilot inventory design

- 77 plots (clusters), 907 sub-plots of which 720 are accessible according to GoogleEarth study



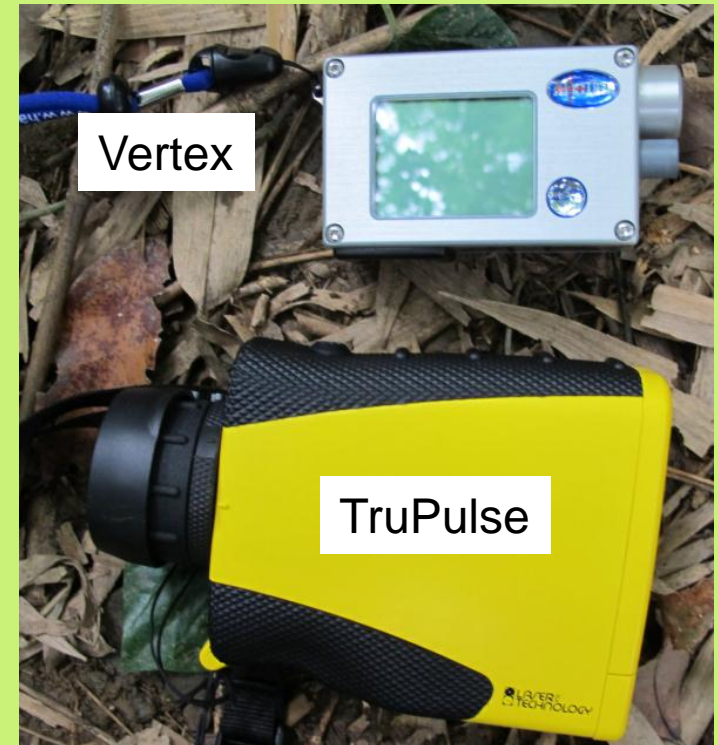
BAC KAN PILOT INVENTORY CLUSTERS



Some plots overlay with NFI-4 plots

NEW EQUIPMENT TO BE TESTED

- Simple to use, quicker and easier measurements
- More accurate and reliable measurements



NEW EQUIPMENT TO BE TESTED



TruPulse, laser rangefinder measure:

- distance
- height
- inclination
- calculate horizontal and vertical distances



Vertex + transponder (ultrasound).

- distance
- height
- slope
- horizontal and vertical distances
- *some problems have been reported with environmental sounds (e.g. crickets in Tasmania) interfering with the sonic pulses.*

Aim and shoot!

CHALLENGES

- Field manuals and instructions must be clear and simple, no room for (mis)interpretation



DBH measurement?

Optimum plot size?

Stump diameter?



Bamboo's?



MAIN DIFFERENCES BETWEEN NFI-4 AND IMPROVED NFI SAMPLING DESIGN

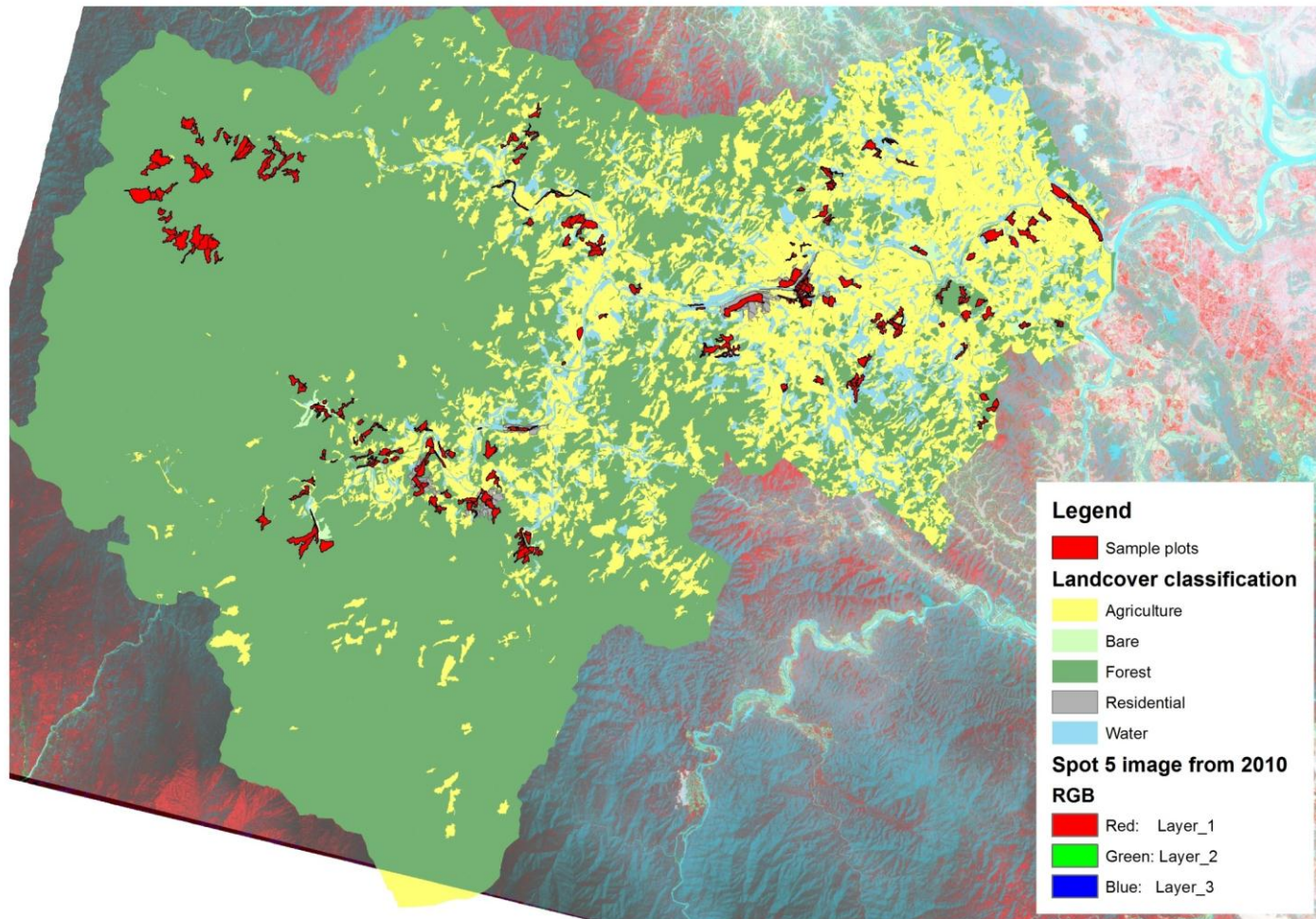
| Item | NFI-4 | Improved NFI |
|--|---|--|
| Coverage of sample | Forested area only | All land uses |
| Plot (cluster) | 40 sub-plots in L-shape | Camp unit design, 4 plots and 12 sub-plots in a cluster |
| Plot shape | Rectangular 20 x 25 m | Nested circular with 6,12,15 meter radiuses |
| Distance between plots | 0 (zero) meters | 150 meters |
| Correlation between plots | High | Low |
| Ratio of trees measured | 100 % | 34 % |
| Sub-plot demarcation in the field | Concrete pole and GPS-coordinates for L-shape corner only | GPS coordinates for each sub-plot |
| PSP (Permanent Sample Plot) demarcation in the field | Concrete pole and GPS-coordinates for L-shape corner only | Metal stick inside ground and 3 reference points for each PSP-plot |

MAIN DIFFERENCES BETWEEN NFI-4 AND IMPROVED NFI SAMPLING DESIGN

| Item | NFI-4 | Improved NFI |
|--|--|--|
| Trees outside forest measured? | No | Yes, based on systematic sampling over all land uses |
| Dead wood measurement carried out? | No | Yes |
| Carbon calculations exist? | No | Yes, using models (litter and soil excluded from current plan) |
| Data input, verification and validation | <ul style="list-style-type: none"> • Custom made VB 6 tools, standalone computers only • Data delivery by mail on CD-ROM | <ul style="list-style-type: none"> • OpenFORIS Collect tool • Remote access via Internet • Data storage directly on FIPI server |
| Result calculations for national and provincial levels | <ul style="list-style-type: none"> • Based on measured ground sample plots only • Manual calculations | <ul style="list-style-type: none"> • Based on combined use of ground sample plots and satellite image interpretation • OpenFORIS tools |
| Thematic mapping using satellite images | No | Yes |

**E. LAND COVER AND FOREST TYPE MAPPING
TRIALS IN BAC KAN AND HA TINH USING
ECOGNITION SOFTWARE**

LAND COVER MAPPING IN HA TINH

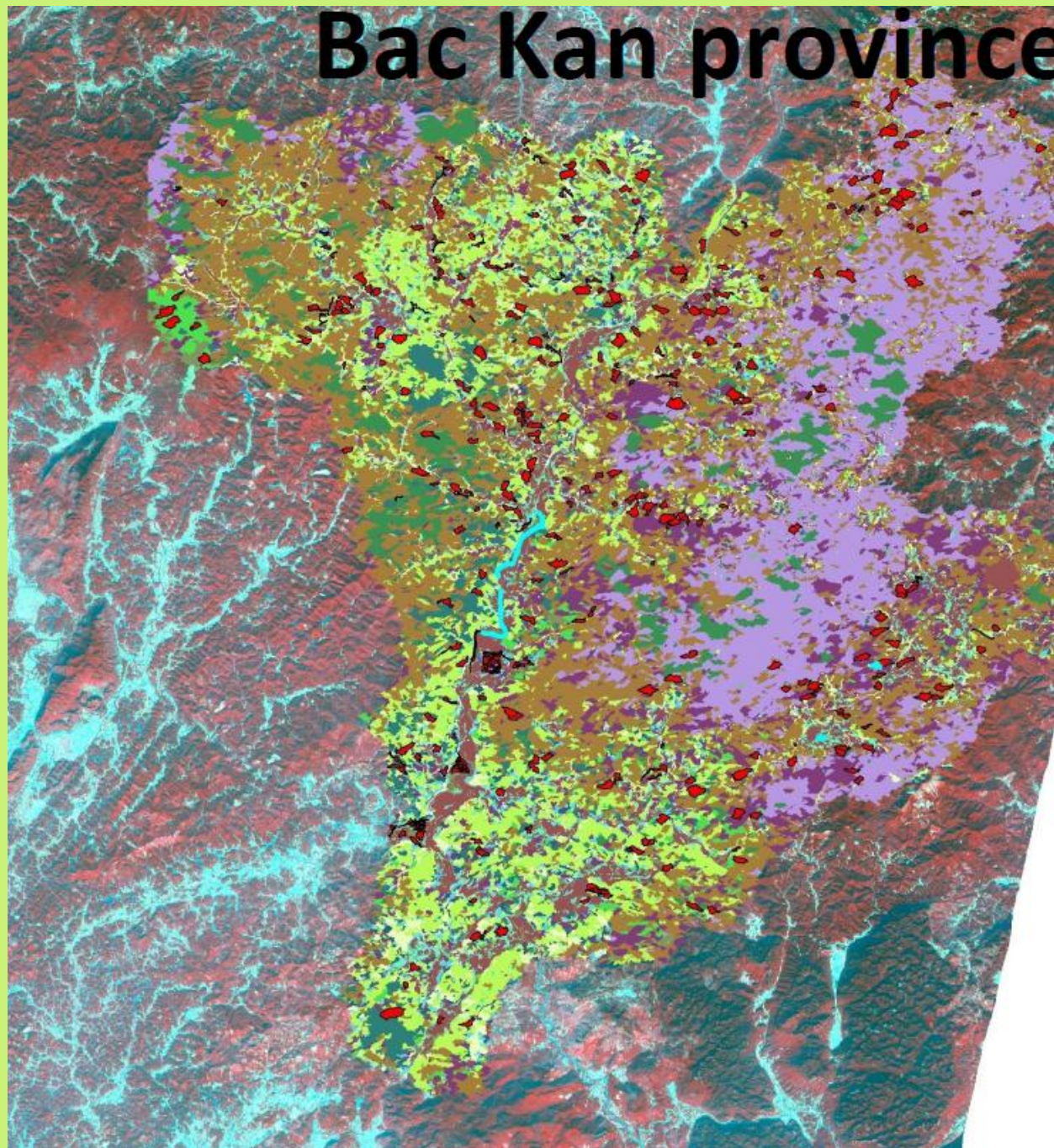


ACCURACY OF HA TINH LAND COVER

| User \ Reference Class | Forest | Agriculture | Water | Bare | Sum |
|-------------------------|-------------|-------------|----------|----------|--------|
| Forest | 126833 | 3267 | 0 | 0 | 130100 |
| Agriculture | 2944 | 15240 | 0 | 0 | 18184 |
| Water | 0 | 265 | 3638 | 0 | 3903 |
| Bare | 2414 | 0 | 0 | 15919 | 18333 |
| unclassified | 2491 | 0 | 0 | 0 | 2491 |
| Sum | 134682 | 18772 | 3638 | 15919 | |
| Producer | 0,94 | 0,81 | 1 | 1 | |
| User | 0,97 | 0,84 | 0,93 | 0,87 | |
| Hellden | 0,96 | 0,82 | 0,96 | 0,93 | |
| Short | 0,92 | 0,70 | 0,93 | 0,87 | |
| Overall Accuracy | 0,93 | | | | |

The accuracy of forest types mapping was 0,41 due to the absence of DEM and low number of plots (129 plots for 11 classes)

Bac Kan province



Legend


 Training set

Land cover/ Forest types

Class_name

 Agricultural land


 Bamboo forest

 Bare land


 Forest garden


 Fruit trees


 Industrial area


 Limestone without forest


 Mixed timber and bamboo


 Natural evergreen broadleaf forest (medi

 Natural evergreen broadleaf forest (poor

 Natural regrowth forest


 Natural regrowth forest on Limestone for

 Other land

 Palm trees

 Plantation

 Residential area


 Water body

Spot 5 image

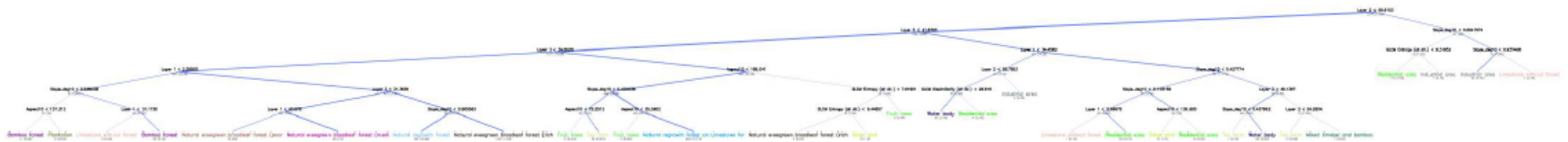
RGB

 Red: Layer_1

 Green: Layer_2

 Blue: Layer_3

REGRESSION TREE AND ACCURACY OF FOREST TYPE MAPPING IN BAC KAN

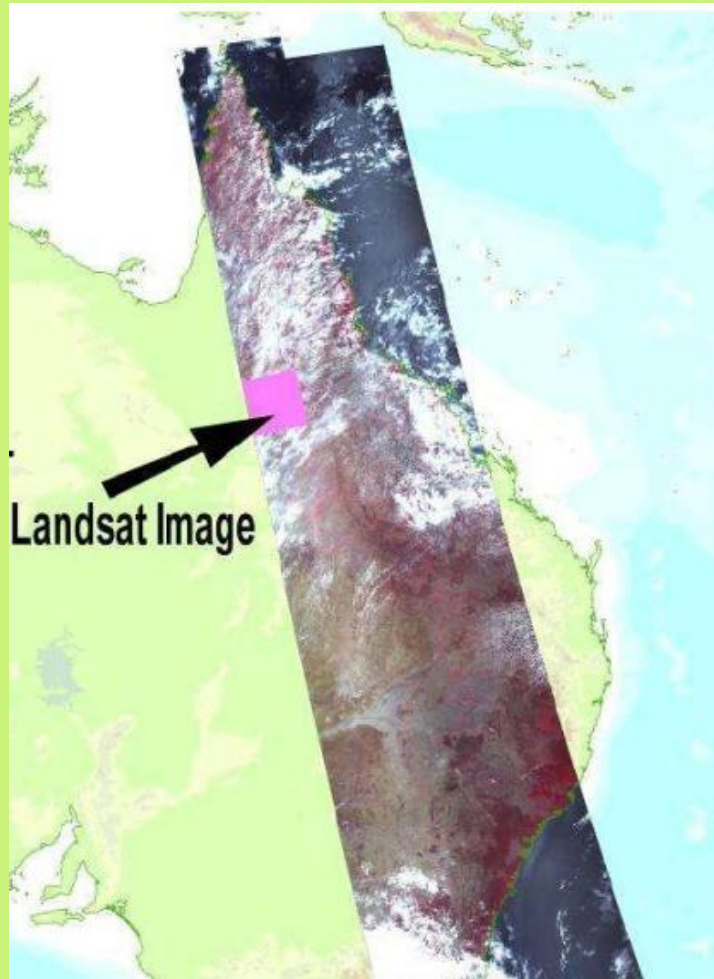


Class

Accuracy Per Class

| | |
|--|-------------|
| Natural regrowth forest | 0,73 |
| Natural evergreen broadleaf forest (poor | 0,84 |
| Plantation | 0,81 |
| Natural evergreen broadleaf forest (medi | 0,75 |
| Natural regrowth forest on Limestone for | 0,85 |
| Mixed timber and bamboo | 0,61 |
| Industrial area | 0,93 |
| Bamboo forest | 0,78 |
| Palm trees | 1,00 |
| Overall | 0,85 |

POTENTIAL SATELLITE IMAGERY DATA TO BE UTILIZED



1. Spot 5: Costs for the whole country?
2. DMCII: size 660km x 4,100km; €0.038 per km², i.e. roughly € 47695 for the whole country at 20 m resolution (scheduled) and € 12500 (3 month old data)
3. Landsat 5: free, small size, frequency?

F. NEXT STEPS

SUPPORTING CONSULTANCIES AT AUTUMN 2012

- National INA Expert (Information Needs Assessment) to be recruited
 - To study and analyze information needs of all identified stakeholders
 - To summarize, evaluate and prioritize information needs to be included for nationwide NFIMAP proposal by December 2012
- International SE Expert on board since mid-August, visit to Vietnam in October
- FGM: Concept notes for project proposal developed within NFA framework, no current activities
- Land use and forest type mapping trials continue with support from International RS Expert (Sep – Oct)

MAIN ACTIVITIES AT AUTUMN 2012

- National workshop on 11 September 2012
- Implementation of pilot inventory in Bac Kan province (Sep - Oct 2012)
- Collected data is utilized in further analysis and improvement of sampling design in co-operation with METLA (Oct – Nov 2012)
- Development of data input, validation and processing tools for the test data set using FAO and METLA Open Source Tools
- Final proposal for nationwide improved NFIMAP design by the end of 2012

THANK YOU!

Contact info: tani.hoyhtya@fao.org, tel. +84 (0)982428147

