

# National Forestry Resources Monitoring and Assessment of Tanzania (NAFORMA)

How it is done in Tanzania

By

R. E. MALIMBWI

National Forest Inventory Consultant

email:remalimbwi@yahoo.com

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Tanzania

# - NAFORMA OBJECTIVES

- **Develop a broad consensus to NAFORMA process and approach incl. methodology**
- **Strengthen capacity of FBD in inventory and monitoring of forests and TOF**
- **Develop a national database on Forests and TOF**
- **Prepare national maps of forests and other land uses**
- **Define long term monitoring program – design and formulate specific management oriented inventories**
- **To develop Tools and methods for integration of REDD+ and MRV to NFI**

# Stakeholders' Needs

- Extent of forest resources in Tanzania by categories of: vegetation types
- ownership (e.g size of reserved forests and forests in general land)
- stocking levels including carbon estimates at national and subnational (district) levels
- use status (productive/protective e.g catchment & wetlands areas)
- Biodiversity status
- Tree outside the Forest area (TOF)
- NTFP

# NAFORMA SAMPLING DESIGN

- The framework of the sampling design is Double sampling for stratification
- The first phase - dense grid of clusters over Tanzania, 5 km x 5 km
- The second phase is a subsample of phase 1 measured during the actual inventory
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# SAMPLING DESIGN CONT

From the dense grid of clusters, the optimal sampling ratio was calculated for each stratum considering the following variables:

- wood volume estimates based on satellite images calibrated with field data from past inventories
- measurement time;
- slope

# Description of the 18 NAFORMA strata

Strata No.	Time (minutes)	Mean volume on land (m <sup>3</sup> /ha)	Slope (%)	Sampling ratio
1.	0-480	0-27	0<=10	12
2.	0-480	27<=61	0<=10	10
3.	0-480	61<=118	0<=10	8
4.	0-480	118<-	0<=10	2
5.	480-960	0-27	0<=10	13
6.	480-960	27<=61	0<=10	12
7.	480-960	61<118	0<=10	9
8.	480-960	118<-	0<=10	4
9.	>960	0-27	0<=10	20
10.	>960	27<-61	0<=10	17
11.	>960	61<-118	0<=10	13
12.	>960	118<-	0<=10	5
13.	0-960	0-61	10<=20	7
14.	0-960	61<-	10<=20	4
15.	>960	0-61	10<=20	3
16.	>960	61<-	10<=20	5
17.	0-	0-118	20<=slope	6
18.	0-	118<-	20<=slope	4

# The cluster sizes and the rough land estimates

<b>Strata</b>	<b>Plots per cluster</b>	<b>Land area estimates (mill. ha)</b>
1-12	10	83
13-16	8	4.6
17-18	6	0.5
<b>Total</b>		<b>88.1</b>

# The cluster

- An L shaped arrangement of plots
- The distance between clusters and number of plots in cluster vary according to the strata
- The distance between plots in a strata is 250 m
- Total number of clusters = 3419
- Total number of plots = 32 660

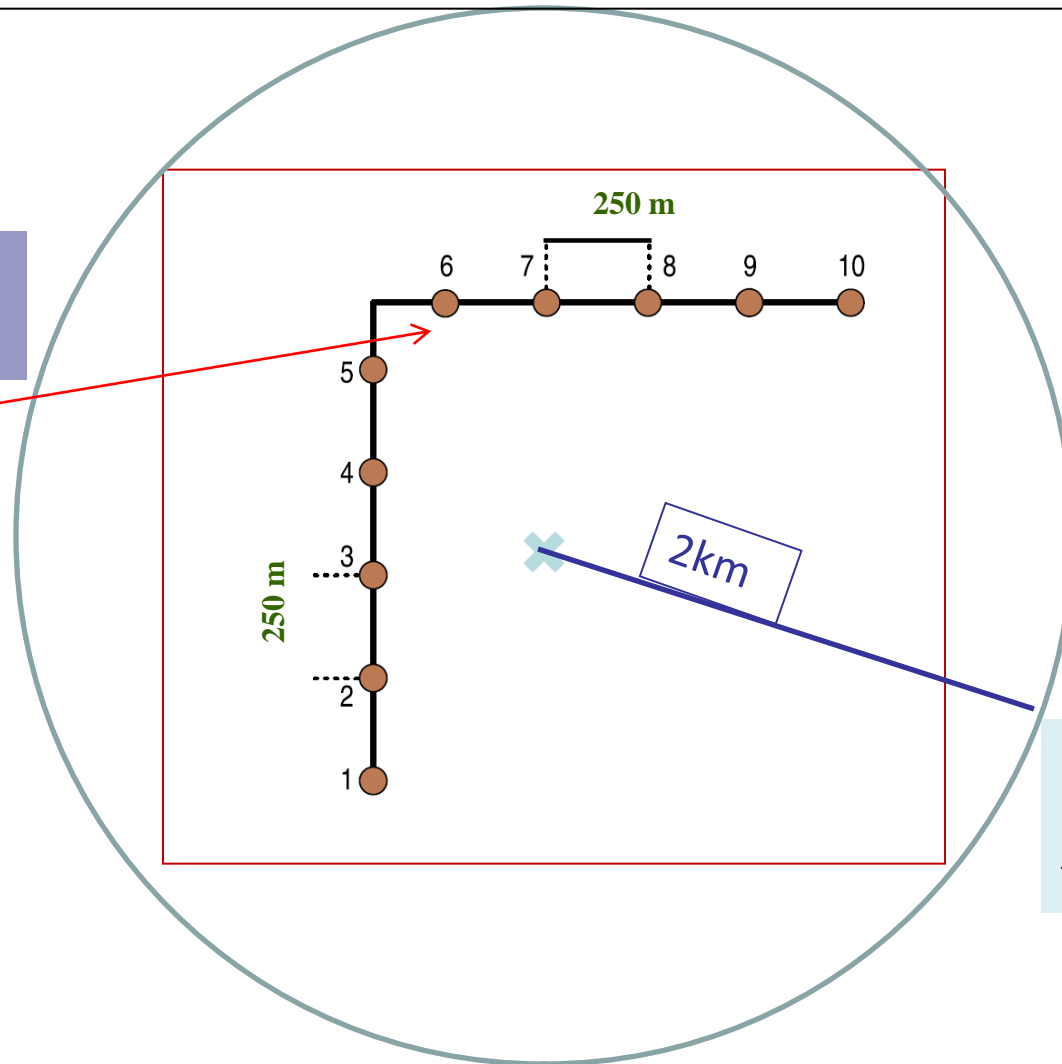


# The cluster cont

- Every 4<sup>th</sup> cluster is permanent
- There are 856 permanent sample clusters
- Soil samples for soil carbon measurement taken in PSPs
- Social Economic survey taken in half of the clusters including PSPs

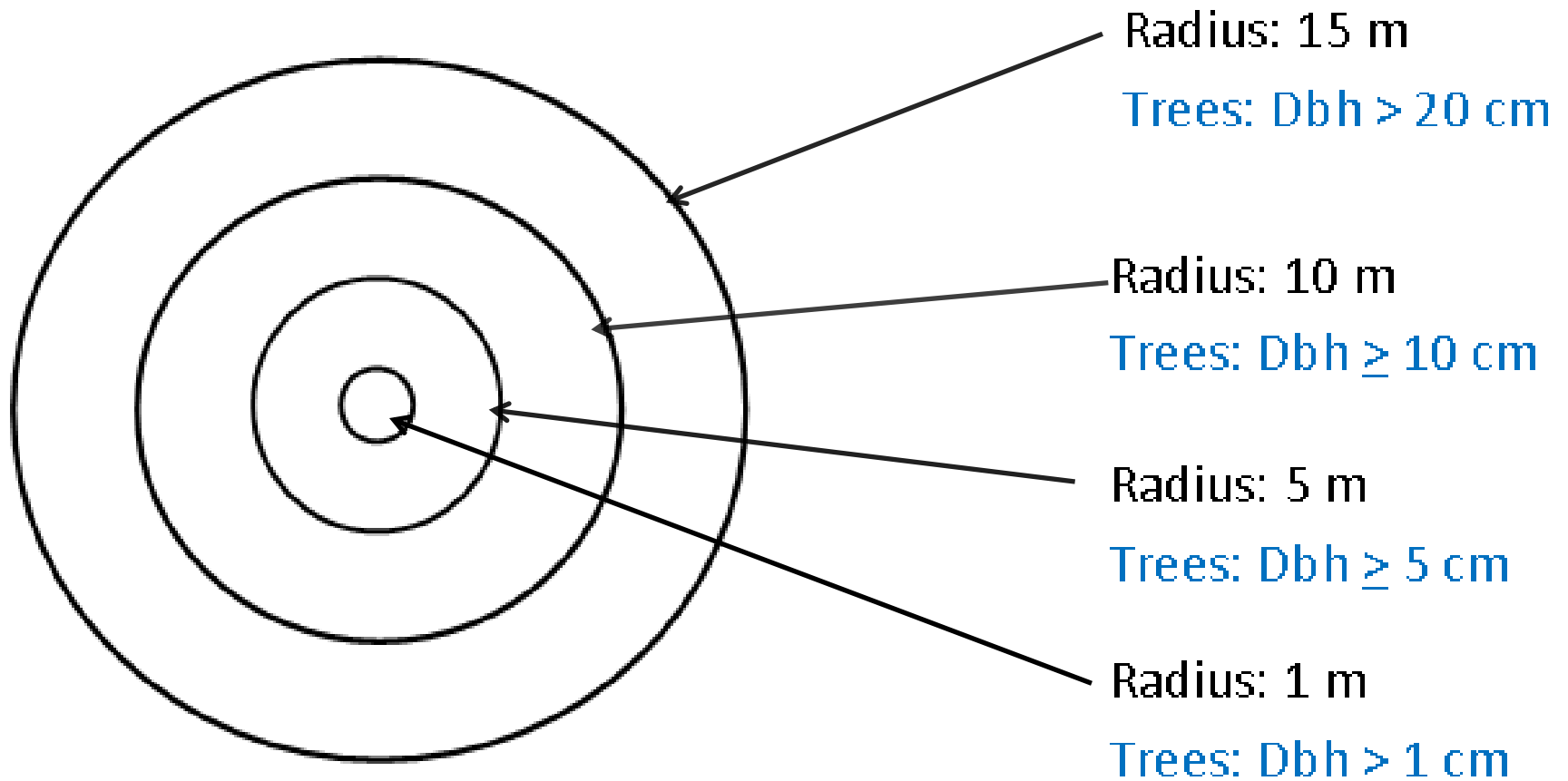
# The NAFORMA cluster

Biophysical  
sample plot

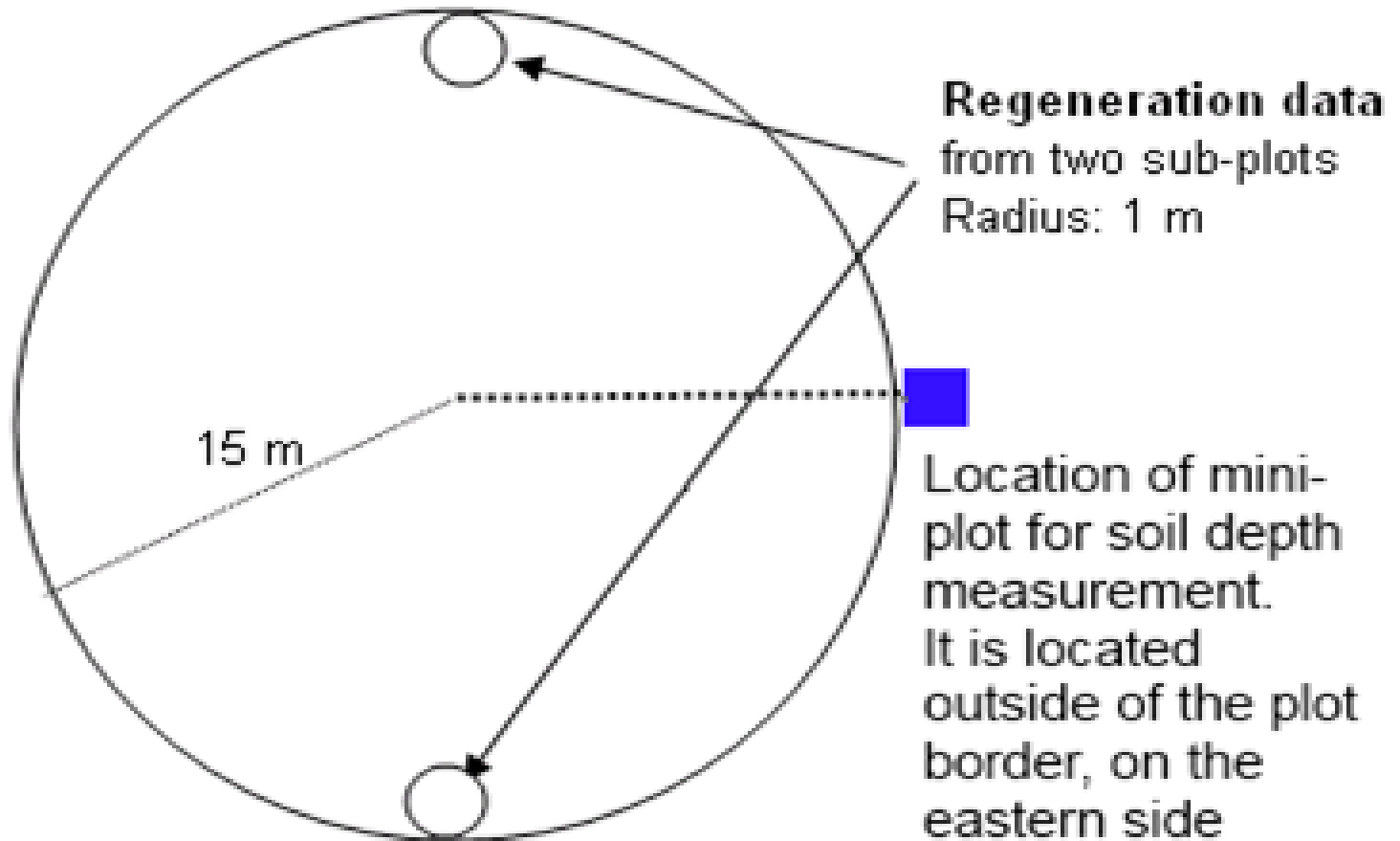


Center of  
sampling unit  
for interviews

# THE PLOT



# Location of regeneration sub-plots and soil sampling in the plot



# NAFORMA BIO-PHYSICAL VARIABLES (FORMS)

## 1. Cluster

- Number
- Region
- District
- Crew No
- Accessibility
- Time study
- Starting GPS position
- Distance and direction to 1<sup>st</sup> plot
- Who recorded
- Who checked
- Who entered data
- Who validated/cleaned data

# NAFORMA BIO-PHYSICAL VARIABLES

- 2. Plot
  - Position (UTM coordinates)
  - Photo
  - Land use
  - Vegetation
  - Ownership
  - Human impact
  - Canopy coverage
  - NWFP
  - Soil





# NAFORMA BIO-PHYSICAL VARIABLES

## Tree variables

- Species code,
- Dbh,
- Sample tree (5<sup>th</sup> tree)
  - Total ht
  - Bole ht
  - Stump ht
  - Stump diam



# OTHER BIO-PHYSICAL VARIABLES

- Regeneration
- Stumps
- Dead wood
- Crown cover



# Land uses

- Production forest
- Protection forest
- Wildlife reserve
- Shifting cultivation
- Agriculture
- Grazing land
- Built-up areas
- Water body or swamp
- Other land

# The vegetation types

## Hunting Technical Services Map (1995)

- Forest
- Woodland
- Bushland
- Grassland land
- Cultivated
- Open
- Water
- Other

# OWNERSHIP CATEGORIES

- Central government
- Local government
- Community owned
- Private: companies
- Private: individuals and families
- Private: others
- General land
- Not known

# Socio-economic data

- Collected in 4 house holds within a radius of 2 km from the cluster center
- The area must be in inhabited
- Concentration of bio-physical clusters is in forests => **less populated**

# Options for identifying dwellings

- High Resolution images
- Search for dwellings while in the cluster

# FIELD EQUIPMENT







# MORE FIELD EQUIPMENT




# DISTRIBUTION OF FORESTRY SAMPLE POINTS

N



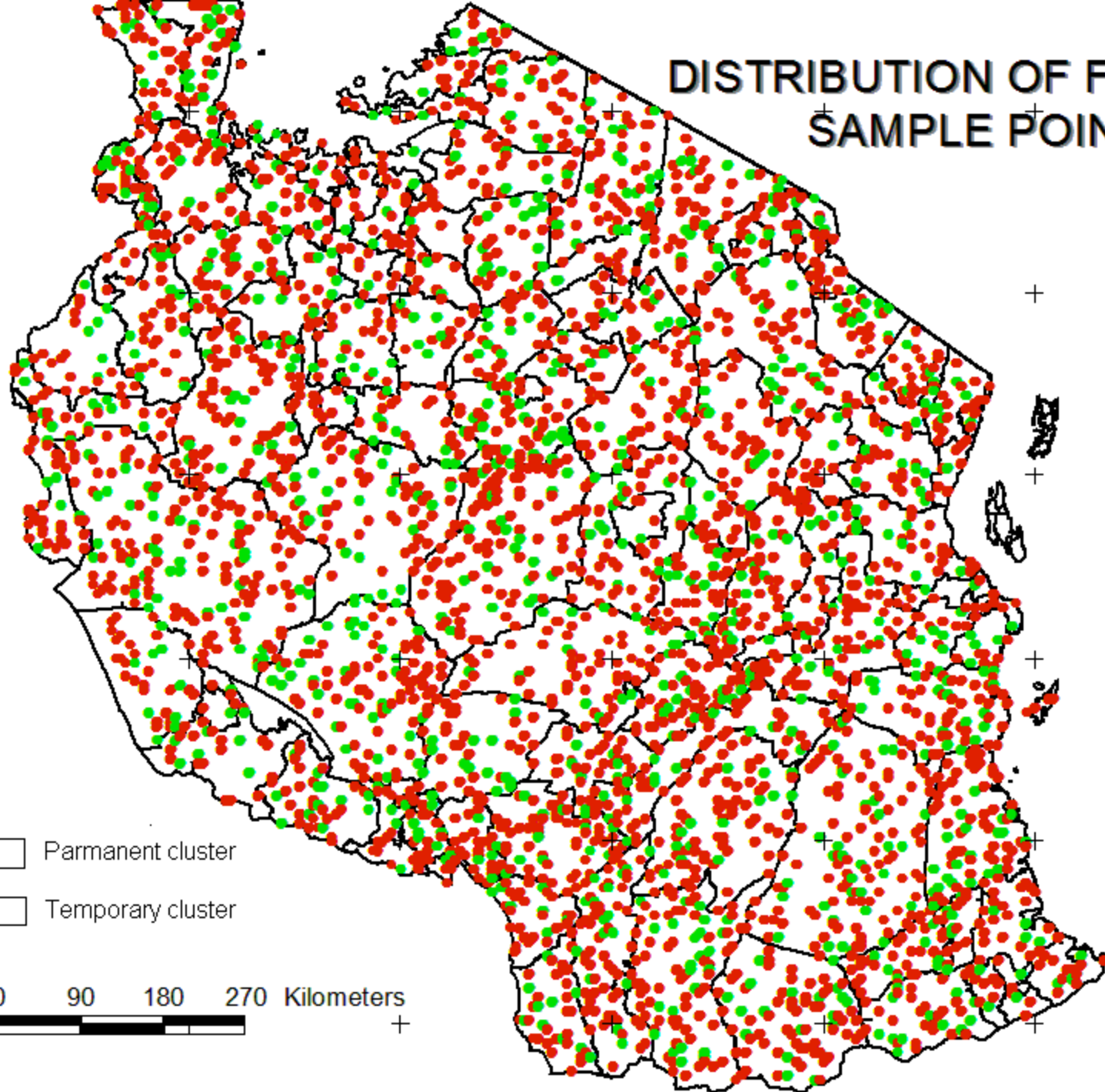
-  Permanent cluster
-  Temporary cluster

90 0 90 180 270 Kilometers

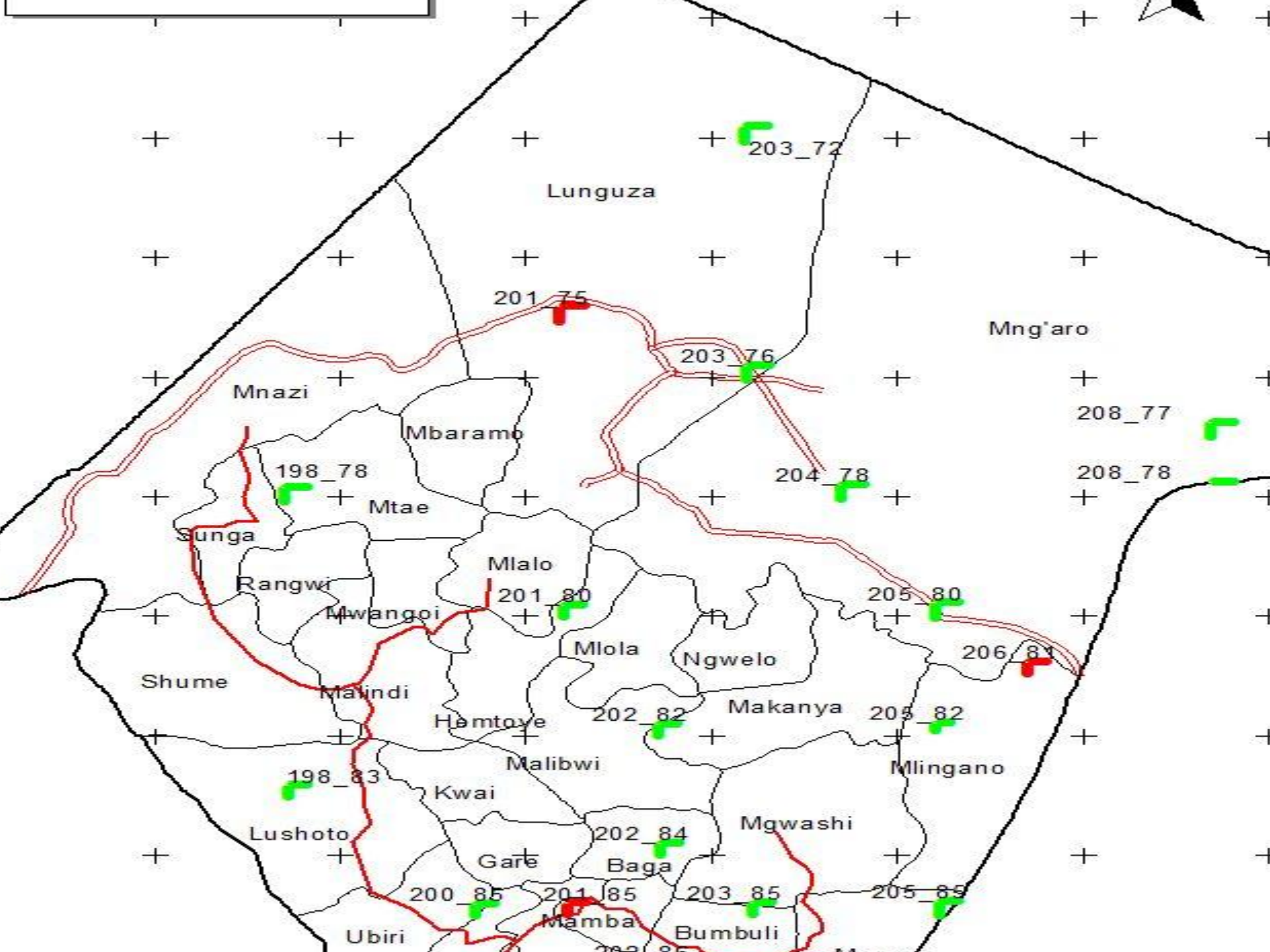


## NOTES:

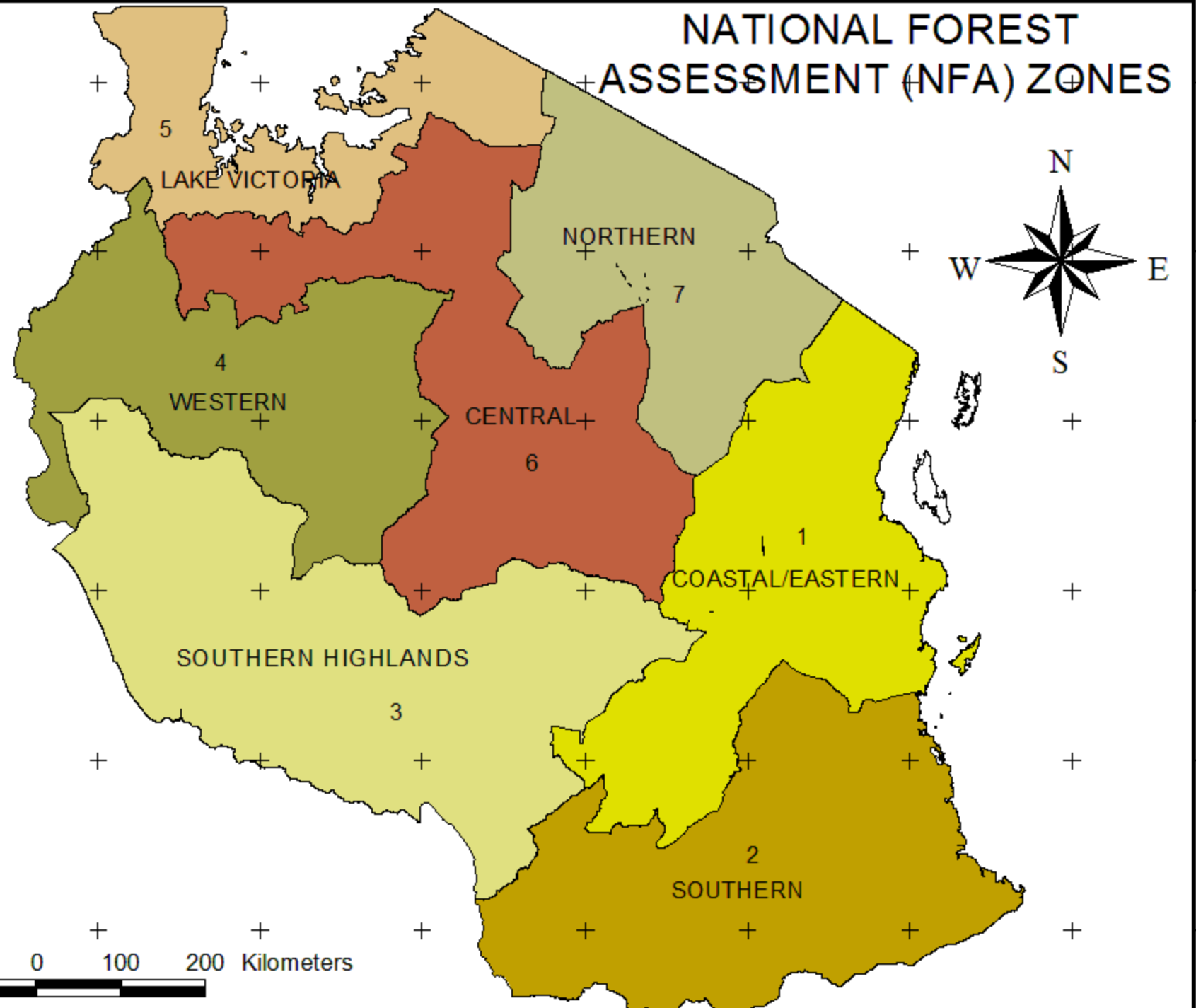
A cluster contains  
10 points (Max)  
spaced at 250 m







# NATIONAL FOREST ASSESSMENT (NFA) ZONES



# TRAINING OF FIELD CREWS

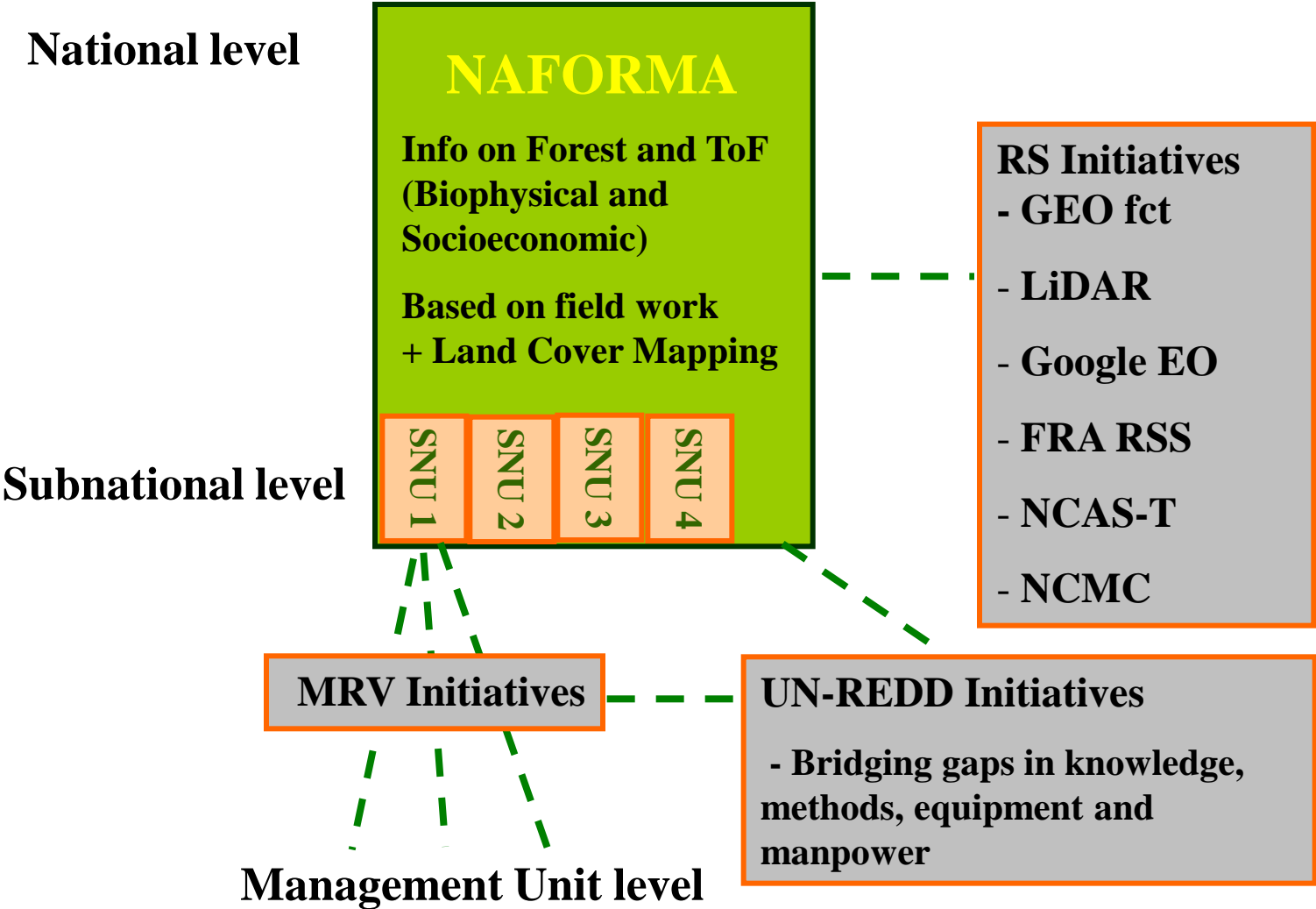
- BIOPHYSICAL VARIABLES Dec 2009
- SOCIO-ECONOMIC VARIABLES JAN 2010
- COMBINED March 2010
- Started Fieldwork May 2010
- Use of Radios, review of manual Nov 20Jan 2011

# Mobilization of field teams

- 7 persons per team
  - 1 socio-ec., 1 soil, 3 biophys (TL), game scout, driver
- In the field

Period	Teams in Field
May-Oct	5 + 1 QA
Nov- Dec	10 + 1 QA
Jan 2011-to date	16 + 2 QA

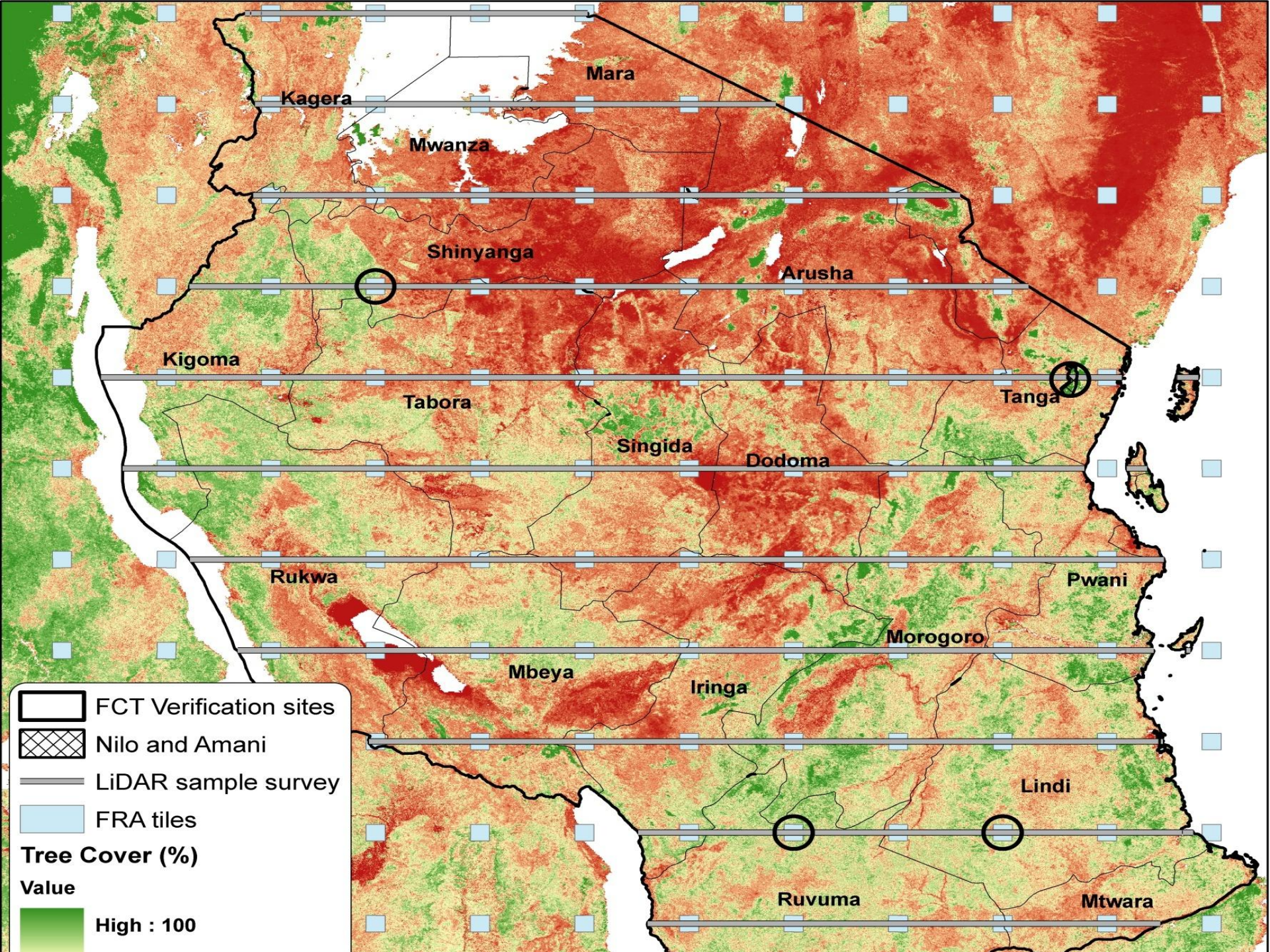
# NAFORMA COLLABORANTS



# Collaborators cont

- Mjumita sent a technician to work with NAFORMA crew as on ground training for 2 weeks
- Jane Goodall forest inventory adopted NAFORMA cluster and plot design
- WWF assessing biomass in sights lacking NAFORMA plots
- This training: Nigeria, Peru, Vietnam, Kenya, Zambia, Sudan and Finland and Norway as development partners





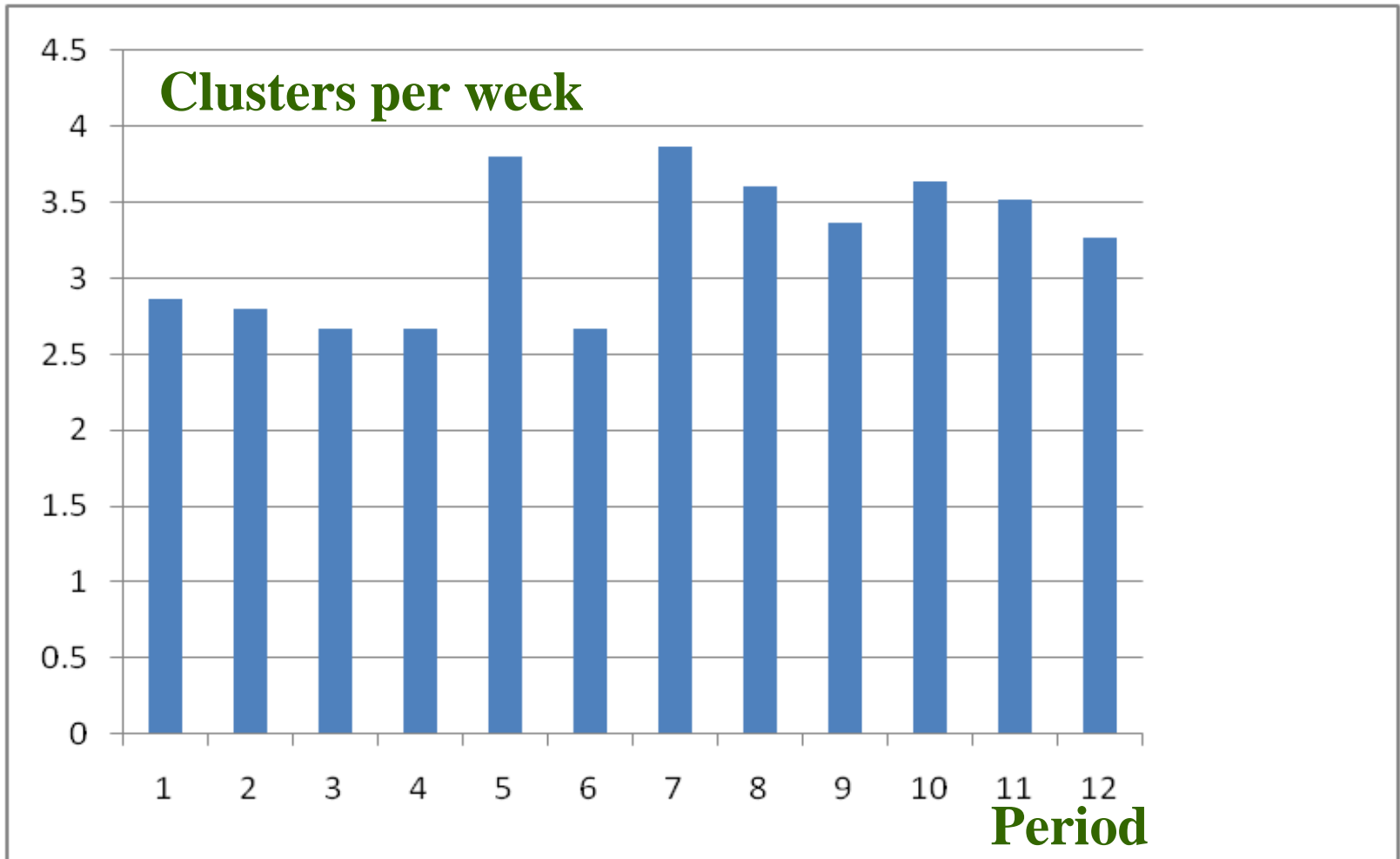


# PROGRESS MADE TO DATE

- Currently, in Southern High Lands Zone
- By June 2011, 1200 clusters (>30% of total of 3419 clusters) have been measured
- 450 socio-economic collected
- >50% entered into data base



# Performance



# Some preliminary results from NAFORMA bio-physical measurements

	Forest Type	Number of plots	Stoking (N) (stems/ha)	Basal area (G) m <sup>2</sup> /ha	Volume (V) m <sup>3</sup> /ha	Biomass (t/ha)
1	Humid Montane	73	500.2	6.28	68.28	34.14
2	Lowland Forest	82	348.42	6.69	58.35	29.17
3	Closed Woodland (>40%)	376	417.72	4.7	34.9	17.45
4	Open Woodland (10- 40%)	615	308.79	2.64	19.63	9.82
5	Scattered Woodland	10	254.07	4.03	31.16	15.58

# FOREST INVENTORY FIELD WORK PLAN

			Year 2010								Year 2011										Year 2012					
			5 teams, 1 QA				10 teams, 2 QA				15 teams, 2 QA						18 teams, 2 QA teams				9 teams in each zone, 2 QA teams					
Zone	Region	Cluster	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	TOTAL
Eastern	Dar es Salaam	10						10																		
Eastern	Morogoro	292	60		160	72																				
Eastern	Pwani	125							125																	
Eastern	Tanga	114						114																		
	<b>Total</b>	<b>541</b>																								
Southern	Lindi	271								240	31															
Southern	Mtwara	69									69															
Southern	Ruvuma	271										271														
	<b>Total</b>	<b>611</b>																								
Southern highland	Iringa	275													275											
Southern highland	Mbeya	228														228										
Southern highland	Rukwa	223															223									
	<b>Total</b>	<b>726</b>																								
Western	Kigoma	136																	52	84						
Western	Tabora	236																144	92							
	<b>Total</b>	<b>372</b>																								
Northern	Arusha	137																137								
Northern	Kilimanjaro	62																			62					
Northern	Manyara	143																	143							
	<b>Total</b>	<b>342</b>																								
Lake	Kagera	130																					130			
Lake	Mara	65																						65		
Lake	Mwanza	54																						54		
Lake	Shinyanga	157																						13	144	
	<b>Total</b>	<b>406</b>																								
Central	Dodoma	156																								
Central	Singida	195																					144	12		
	<b>Total</b>	<b>351</b>																						132	63	
<b>Total Clusters</b>		<b>3,349</b>		60	0	160	72	124	125		240	100	271			275	228	223	281	287	146		274	276	207	3349

# QUALITY ASSURANCE

- proper use of inventory equipment : HP-GPS, hypsometers, densiometer etc
- adherence to mensuration protocols
  - plot locations
  - tree measurements using proper instruments
  - proper recording of tree/spp codes
  - Use of 1.3m stick to determine uniform point of dbh measurement
  - Use of slope correction tables
  - Use of Diameter tape in permanent plots

# QUALITY ASSURANCE

- Avoid errors at all stages
  - Errors in taking measurements and reading
  - Errors in recording in the field
  - Errors Data entry into computer
- Crew Leaders to re-check data thoroughly before submission
- Maintain quality assurance team
  - remeasures quarter of all clusters
  - reports discrepancies to respective teams immediately
- Data entry team to play QA  
i.e to inform Coordination team or query field crews immediately abnormality is detected

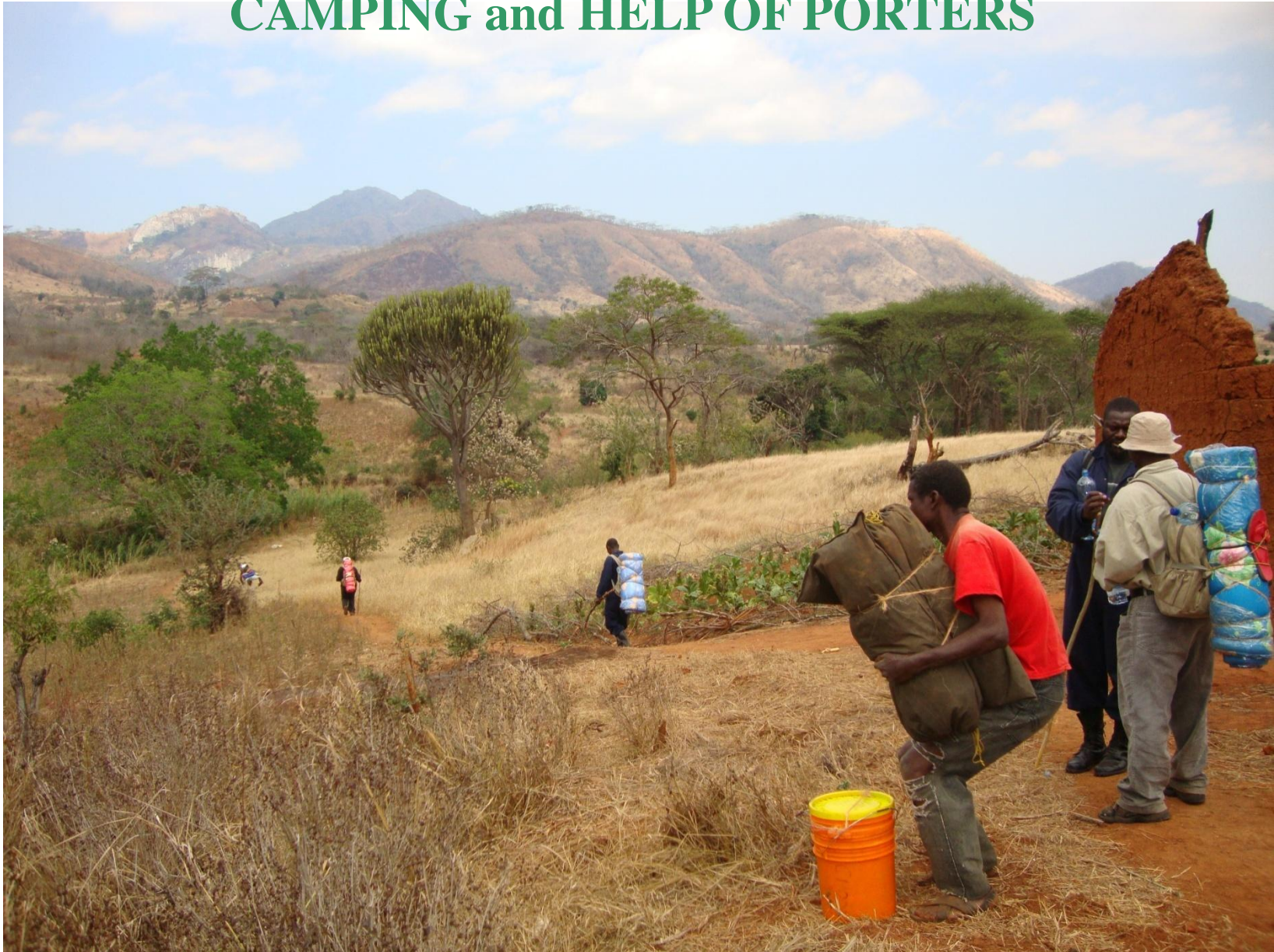
# CHALLENGES

- **Maintaining team effort, motivation and performance**
  - Field contact essential
  - Proper planning and mobilization of field crews
  - Performance based pay
- **Maintaining quality**
  - Proper supervision
  - Dedication
- **Public awareness about NAFORMA**

# CHALLENGES

- Shortage of game scouts at the districts level
- Difficult terrain, inaccessibility due to floods and thick vegetation in some regions slowed speed of field work
- Delayed procurement process
- Malfunctioning of some HP GPS
- Delayed permission to work in military areas and private farms
- Delay in DSA payments now improved by LoA to districts

# CLUSTER IS IN THE FAR MOUNTAINS, NEED CAMPING and HELP OF PORTERS





# ACCESSING THE CLUSTER





# END OF THE ROAD..TRACKING WITH GARMIN





# Photo of a plot, helps future re-identification





# Plot centre in swamp





# Dbh measurement, buttressed tree. Not a picnic!!





# Two lions in the middle of the road





# The lions decide to give way



# Way forward



- Finished Southern Zone
- Proceeding with Southern highlands Zone
- Break in August
- Resume in Sept to SH Zone, Western....



*End,*

*Ahsanteni*

