# Forest Resource Assessment in Nepal


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# FOREST RESOURCES ASSESSSMENT IN NEPAL

- Forest Resources Survey Office (1960-70's): First Assessment)
- Land Resources Mapping Project (LRMP)
- Nepal Remote Sensing Centre
- Master Plan for Forestry Sector (MPFS)
- National Forest Inventory ( 1990's): Second Assessment)
- Topographic Maps (Department of Survey)
- JAFTA (2000-01)
- Forest Resources Assessment (FRA 2010's): Third Assessment)
- Re-measurements of FRA 2010's Plots (starting from 2016)

# FORST COVER BY DIFFERENT ASSESSMENTS (%)

| Category | NFI 1960–70's | LRMP 1978/79 | NRSC 1984 | MPFS 1985-86 | NFI 1990's | DoS 1995 | JAFTA 2000/01 | FRA 2010–2014 |
|---|---|---|---|---|---|---|---|---|
| Forest | 46.3 | 38.0 | 35.9 | 37.4 | 29.0 | 38.3 | 37.3 | 40.36 |
| Shrub/ OWL | - | 4.7 | - | 4.8 | 10.6 | - | 9.3 | 4.38 |
| Total | 46.3 | 42.7 | 35.9 | 42.2 | 39.6 | 38.3 | 46.6 | 44.74 |

# COMPARISON OF THREE ASSESSMENTS

| Assessments | Period | Purpose | Material | Area Estimation (Method) | Basic Unit |
|---|---|---|---|---|---|
| 1st Assessment | 1962-73 | Forest Area & commercial timber volume | Aerial Photo (66.5 %) not covered whole area | Map | Management Regime |
| 2nd Assessment | 1987-98 | Forest Area & stem volume, Biomass | Aerial Photo (91.5 %) Satellite Image(8.5 %) | Grid (72.1%) Map (27.9 %) | Development Region |
| 3rd Assessment | 2010-14 | Forest Area<br>Stem Volume<br>Carbon<br>Forest Biodiversity | Satellite Image | Map ( 1st Phase Grid) | Physiographic Region |

# Comparison of three Assessments

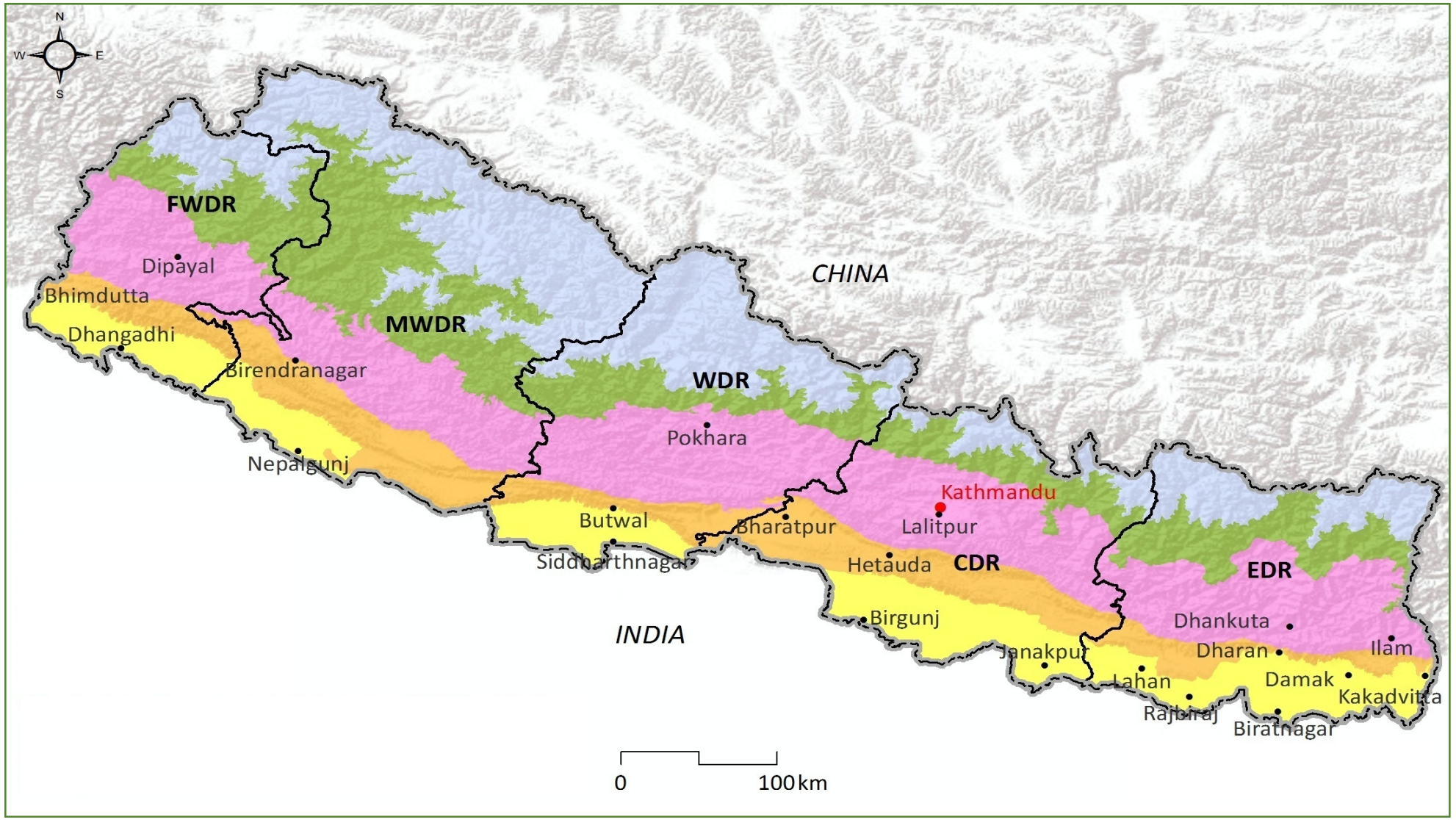
| Assessments | Land Cover Classification | Sample Plot Distribution & Shape and Size | Permanency of Sample Plots | Number of stems/ha (> 10cm dbh) |
|---|---|---|---|---|
| 1ST Assessment | Forest,<br>Cropland,<br>Grass,<br>Urban,<br>Water,<br>Badly Eroded Barren | Commercial Forest<br>Rectangular<br>810 sq. meter | Marked in aerial photos & maps | Dbh class No.<br>10-20 159<br>20-50 141<br>> 50 13<br>313 |
| 2nd Assessment | Forest,<br>Shrub,<br>Others | Forest reachable (except protected area & slope >100%)<br>Square<br>900 sq. meter | Marked in aerial photos & maps | Dbh class No.<br>10-20 244<br>20-50 143<br>> 50 21<br>408 |
| 3rd Assessment | Forest,<br>OWL,<br>Other Land | Forest, OWL, Others ( Slope < 100 %)<br>Circular<br>1257 sq. meter | Geo-referenced | Dbh class No.<br>10-20 287<br>20-50 125<br>> 50 18<br>430 |

# FOREST RESOURCES ASSESSMENT (FRA 2010-2014: THIRD ASSESSMENT)

# Methods

1. Stratification (Physiographic-5)
2. Visual Interpretation (1st phase)
3. Sample Cluster Selection (2nd Phase)
4. Data collection
5. Image Analysis (wall to wall map)
6. Reporting

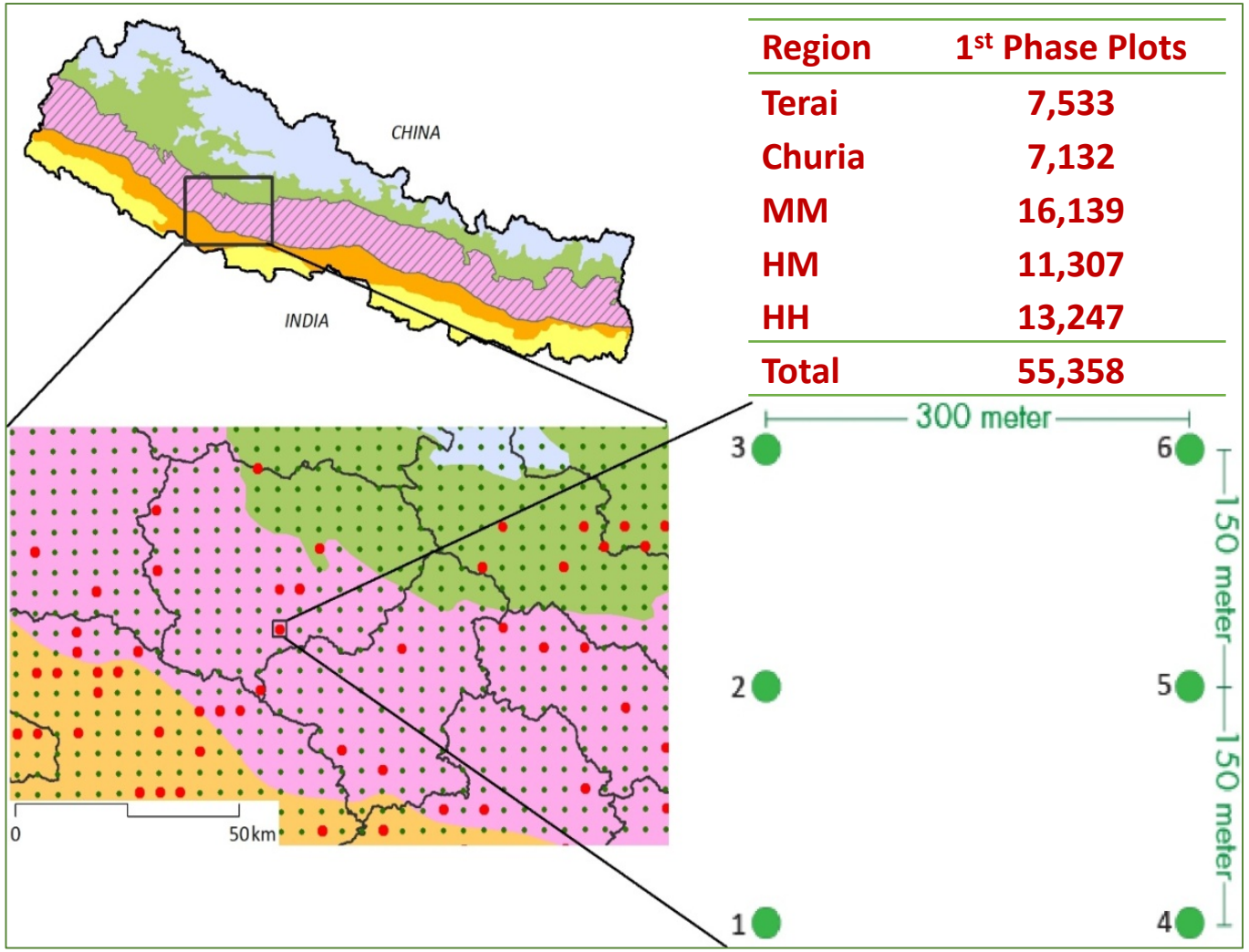
# PHYSIOGRAPHIC REGIONS OF NEPAL




| Area | (%) |
|---|---|
| HH | 23.9 |
| HM | 20.4 |
| MM | 29.2 |
| C | 12.8 |
| T | 13.7 |

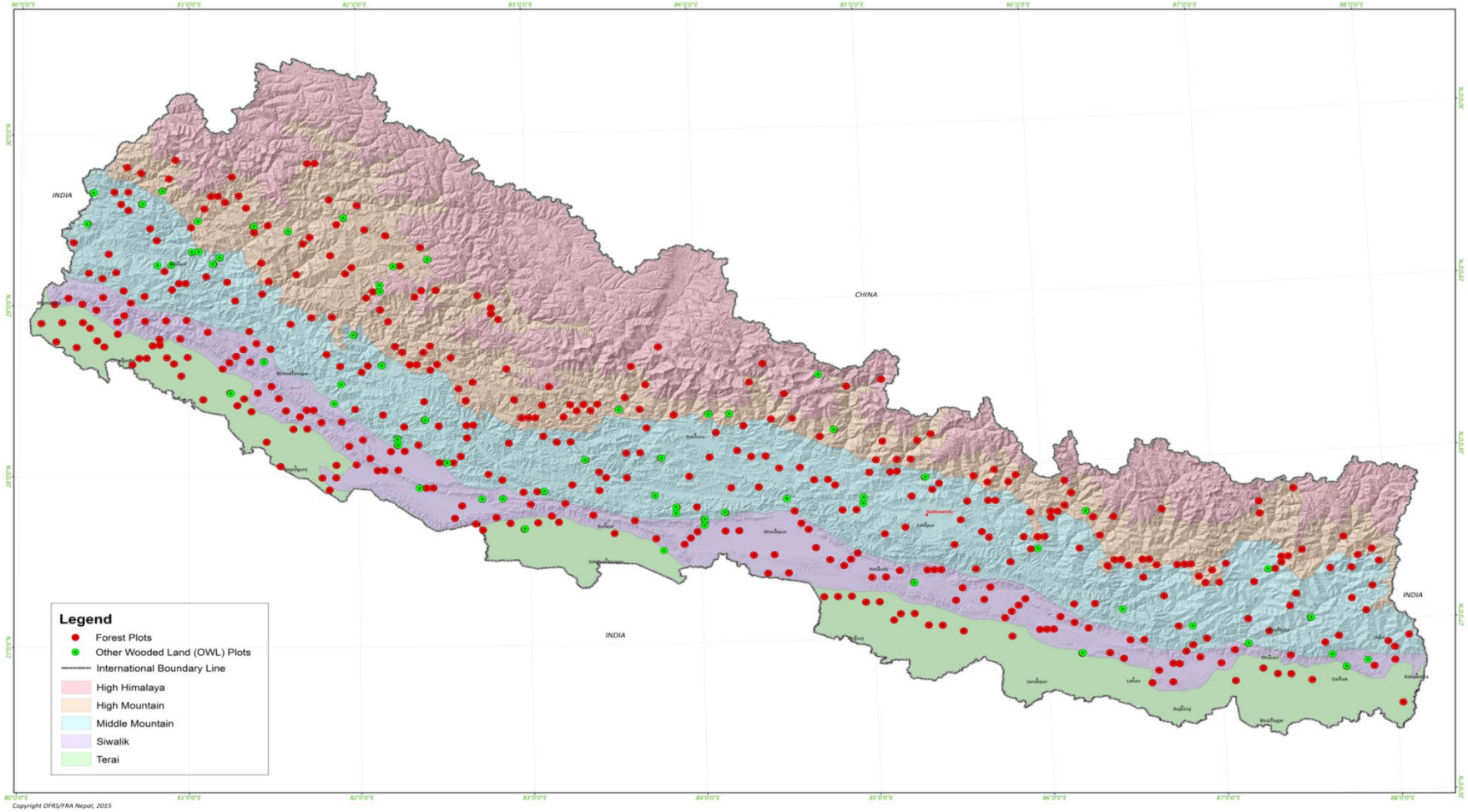
# VISUAL INTERPRETATION (1st PHASE)

- 4 km x 4 km grid placed across Nepal
- 9,230 sampling clusters laid out
- 55,358 plots (6 plots/cluster) interpreted
- Rapid Eye, Google Earth & Topo Sheet used




| Region | 1st Phase Plots |
|---|---|
| Terai | 7,533 |
| Churia | 7,132 |
| MM | 16,139 |
| HM | 11,307 |
| HH | 13,247 |
| Total | 55,358 |

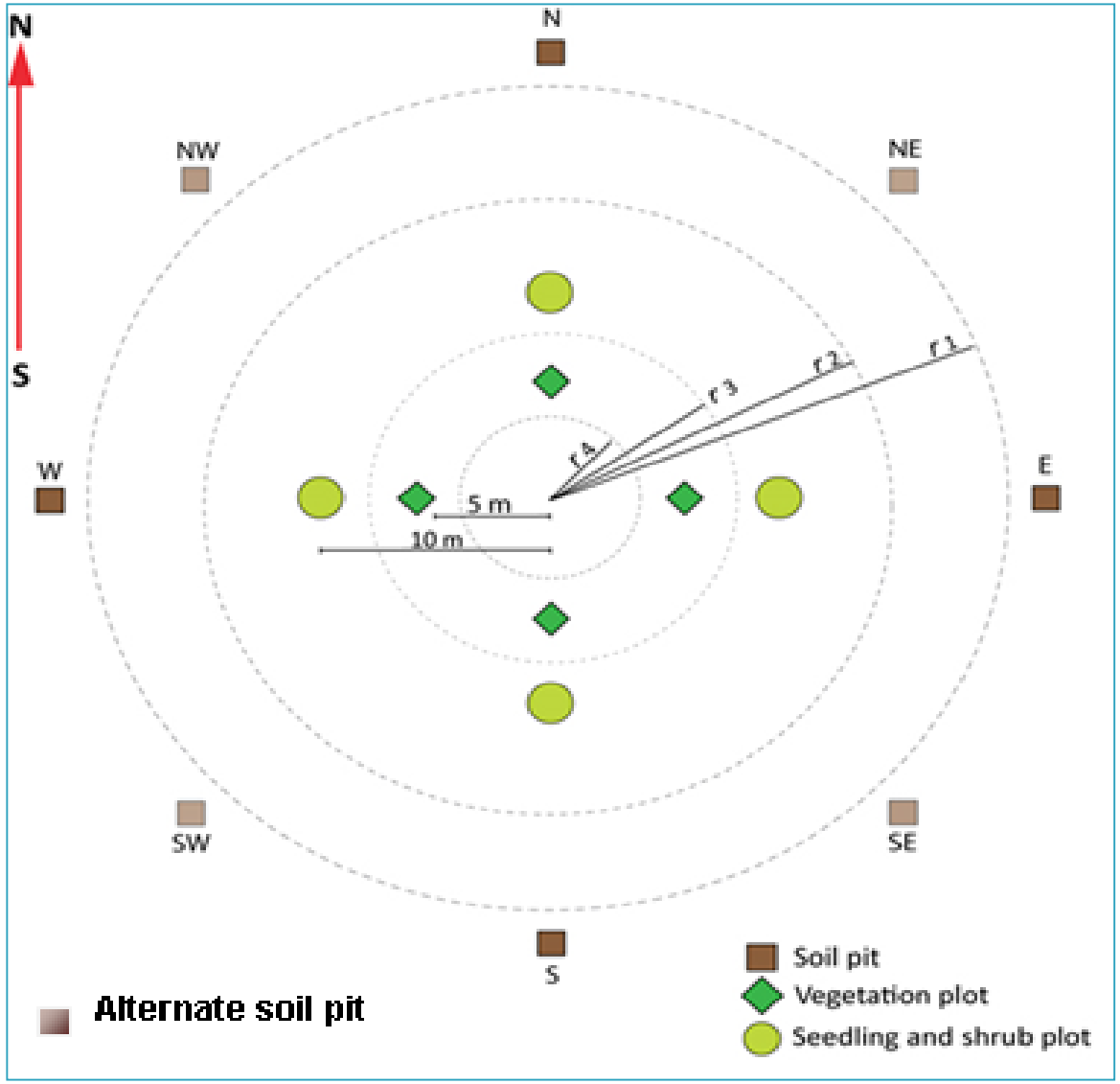
# DISTRIBUTION OF SAMPLE PLOTS (2nd PHASE)




**No. of measured sample plots**

| Region | Forest | OWL | OL | Total |
|---|---|---|---|---|
| Terai | 175 | 5 | 160 | 340 |
| Churia | 477 | 11 | 219 | 707 |
| MM | 433 | 63 | 377 | 873 |
| HM | 421 | 21 | 115 | 557 |
| HH | 47 | 5 | 15 | 67 |
| ***Total*** | ***1553*** | ***105*** | ***886*** | ***2544*** |

# PLOT DESIGN AND MEASUREMENTS




## Sub-plots

4 CCSP = Trees

4 x 1 $m^2$ = Herb

4 x 12.56 $m^2$ = Shrub

4 X 12.56 $m^2$ = Seedlings

4 x 12.56 $m^2$ = Saplings

4 x 1 $m^2$ = Litter and debris

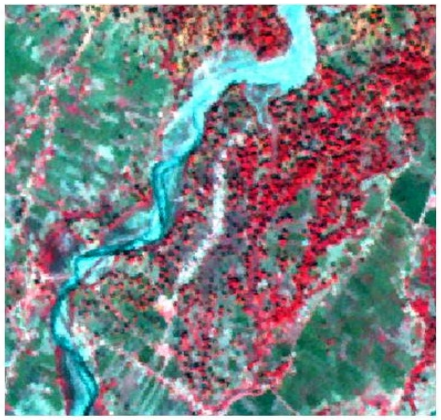
1 x 314.16 $m^2$ = Deadwood

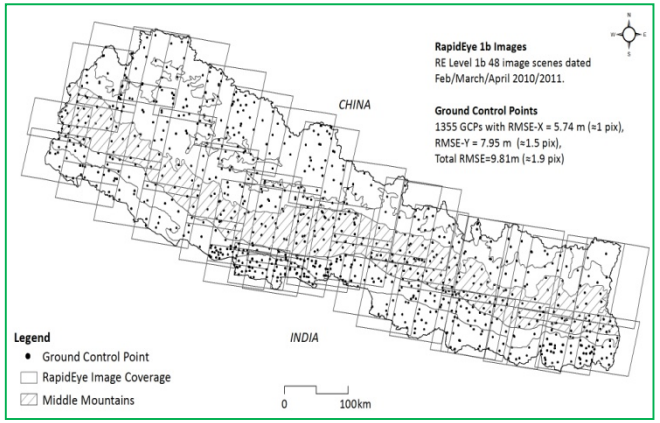
4 x 30 cm deep = Soil samples

1 x 1256.63 $m^2$ = Disturbance

# METHODS: LAND COVER MAPPING

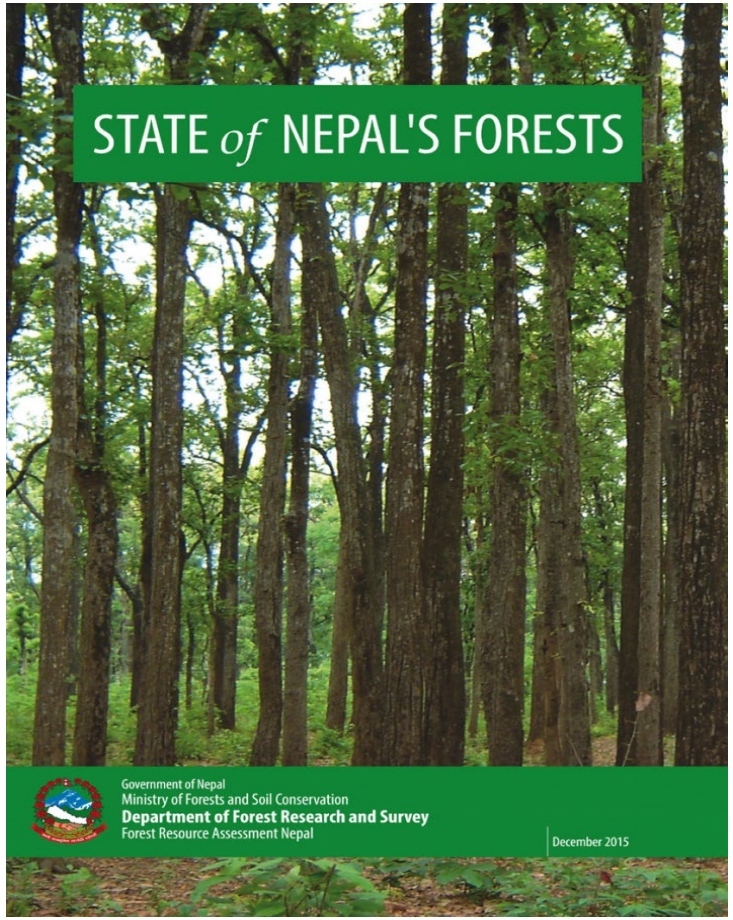
- Use of high resolution satellite image (Rapideye 5m spatial resolution)
- Image segmentation and regression tree (CART) classifier
- Wall-to-wall mapping
- Training and test data set from field
- Hybrid approach (classification aided by extensive visual interpretation)





# RESULTS

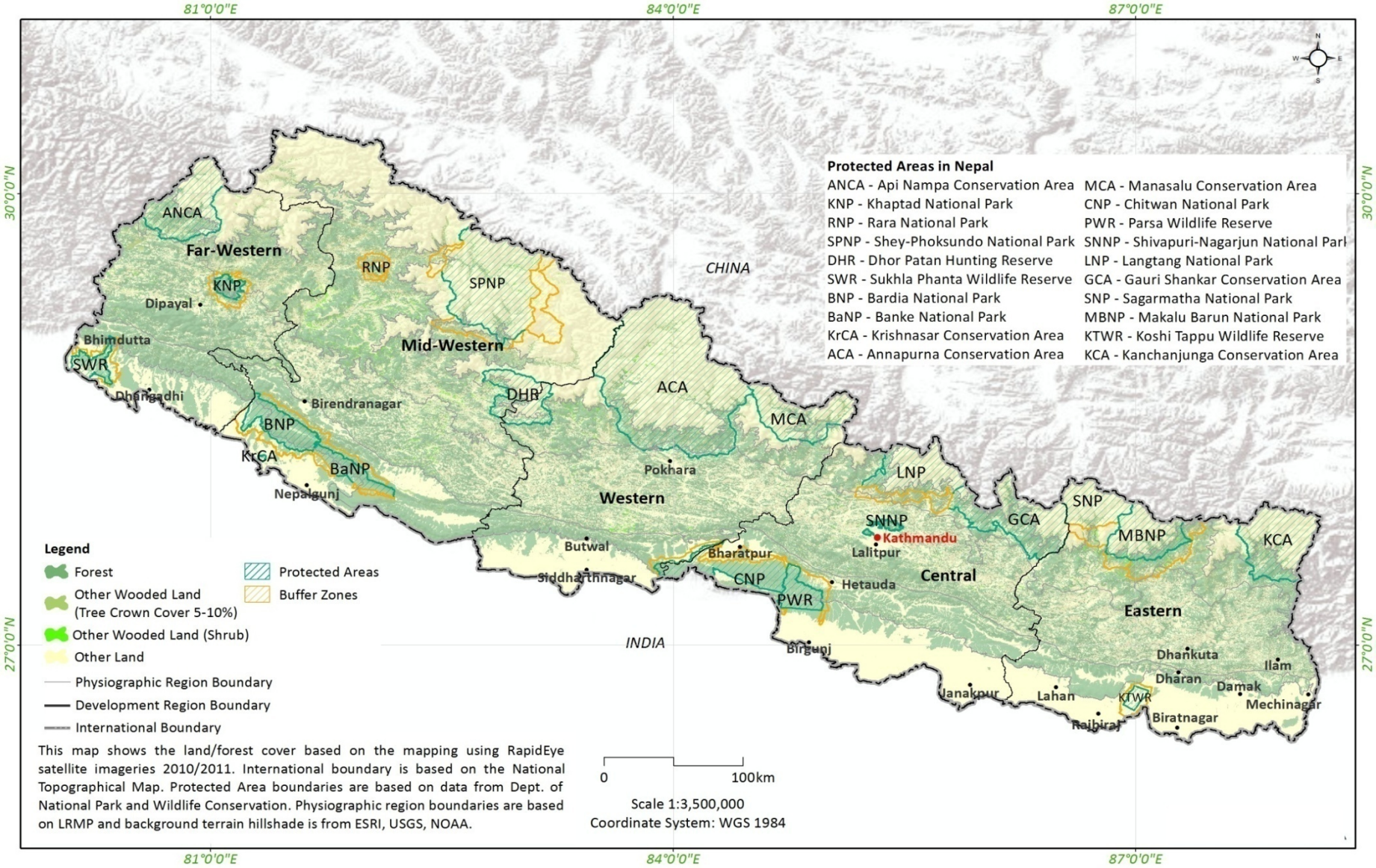
- Land Cover Area
- Forest Stocking

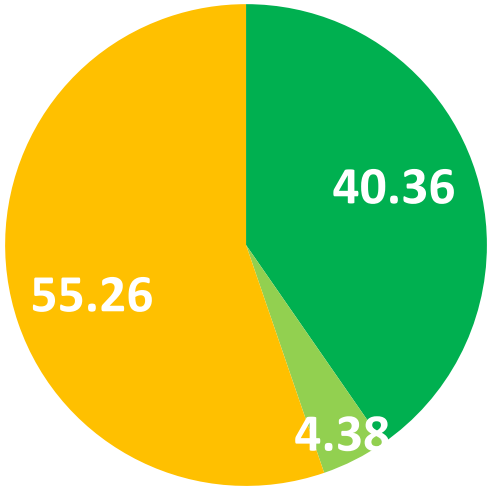


# LAND COVER AREA BY PHYSIOGRAPHIC REGION (ha)

| Physiographic Regions | Forest | OWL | OL | % of Forest |
|---|---|---|---|---|
| Terai | 411580 | 9502 | 1595916 | **20.4** |
| Churia/Siwalik | 1373743 | 22672 | 501848 | **72.4** |
| Middle Mountains | 2253807 | 62287 | 1993302 | **52.3** |
| High Mountains and High Himal | 1922909 | 553431 | 4072426 | **29.4** |
| **National** | 5,962,038 | 647,892 | 8,163,492 | **40.4** |

# LAND COVER MAP OF NEPAL



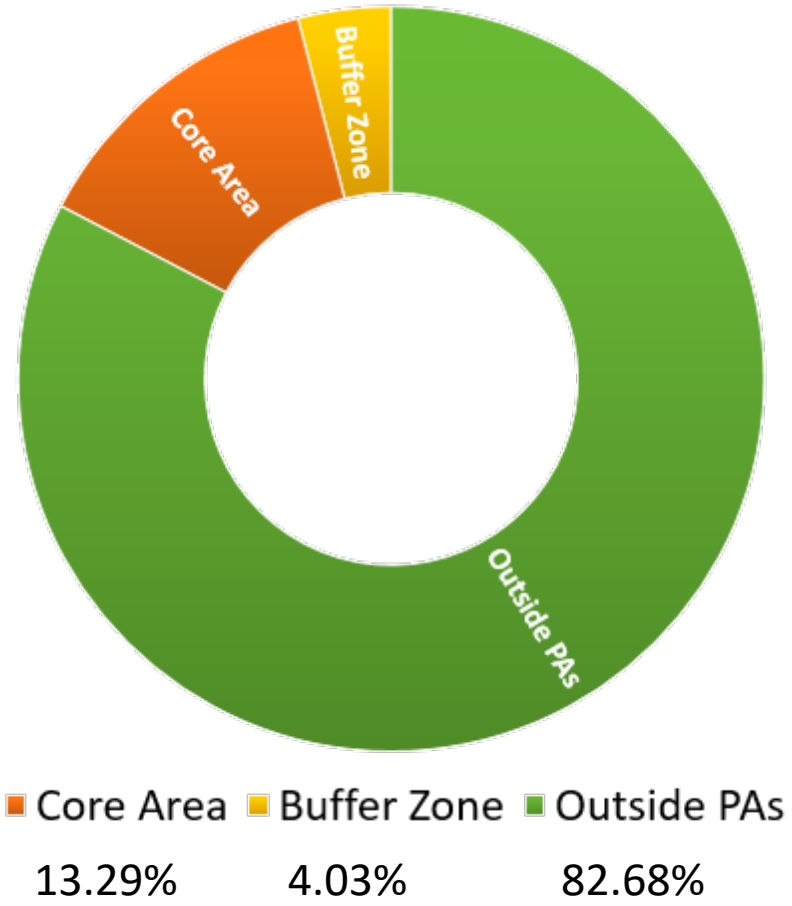




Forest OWL OL

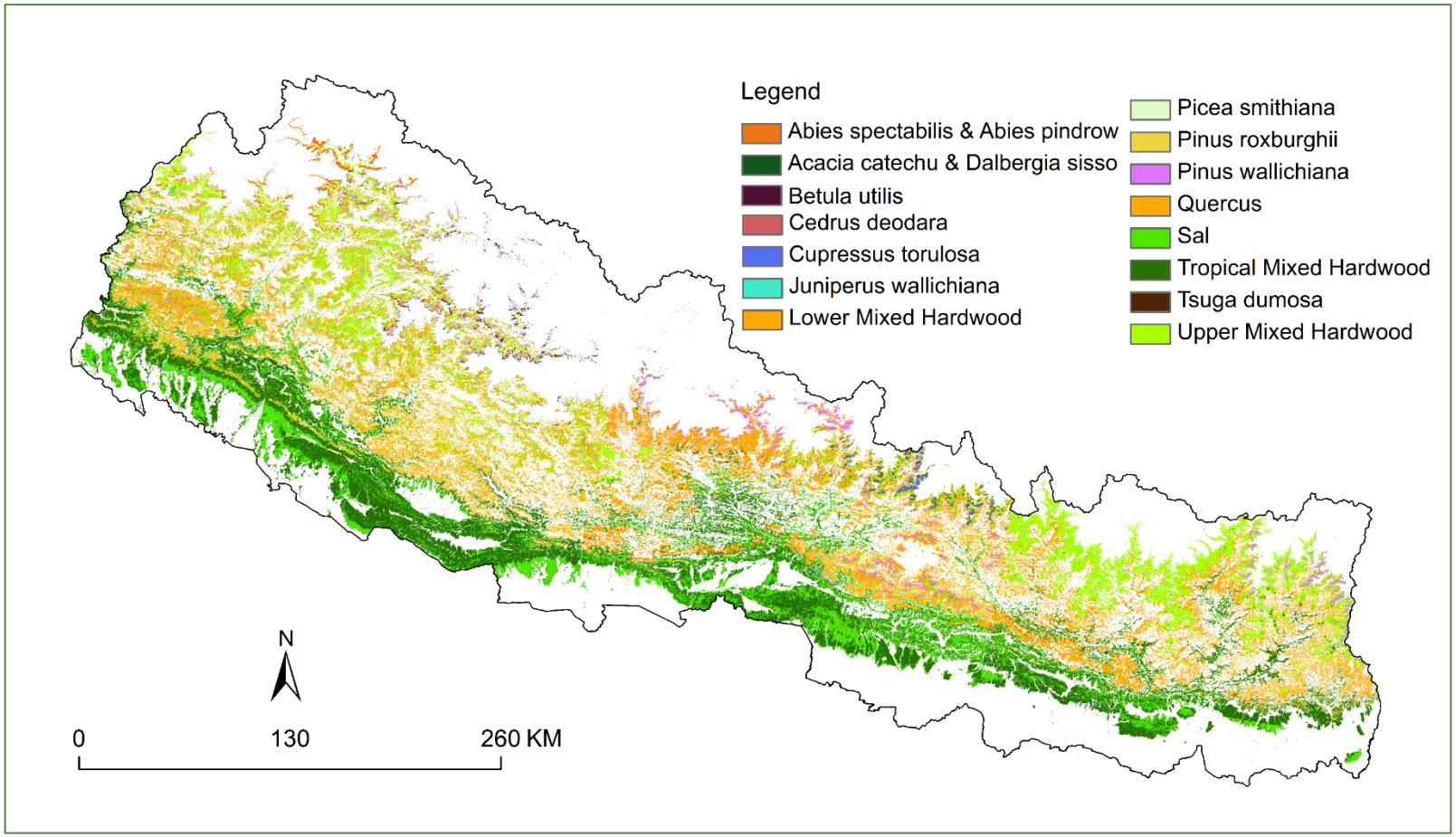
Overall accuracy = 85.16%

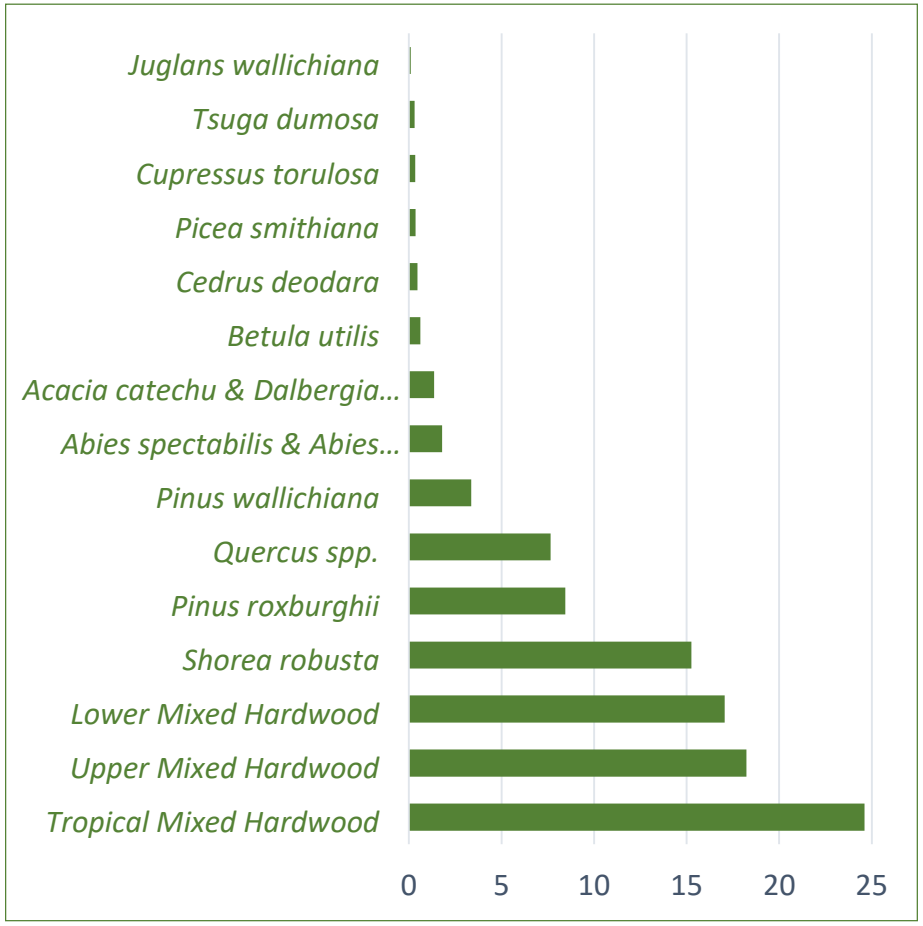
# FOREST INSIDE PROTECTED AREA

| Physiographic region | % of forest inside PAs |
|---|---|
| Terai | 23.55 |
| Churia | 24.06 |
| Middle Mountains | 1.22 |
| High Mountains & High Himal | 30.04 |
| **National** | **17.32** |



# FOREST TYPES MAP OF NEPAL



# NUMBER OF STEMS (≥10 CM DBH) IN NEPAL

| Physiographic Regions | Forest | OWL | OL |
|---|---|---|---|
| | Stems/ha | Stems/ha | Stems/ha |
| Terai | 274.19 | 50.31 | 25.14 |
| Churia | 342.46 | 35.49 | 65.72 |
| Middle Mountains | 429.29 | 52.34 | 187.42 |
| High Mountains and High Himal | 526.51 | 26.74 | 70.87 |
| **National Average** | 429.93 | 30.22 | 100.51 |

# STEM VOLUME ($m^3$/ha ≥10 CM DBH) IN NEPAL

| Regions | FOREST | Other Wooded Land | Other Land |
|---|---|---|---|
| Terai | 161.66 | 30.59 | 5.41 |
| Churia | 147.49 | 15.05 | 9.32 |
| Middle Mountains | 124.26 | 11.04 | 23.72 |
| HM & HH | 225.24 | 6.73 | 13.41 |
| **National average** | **164.76** | **7.91** | **14.69** |

# ABOVE GROUND BIOMASS (t/ha-airdry) IN FOREST

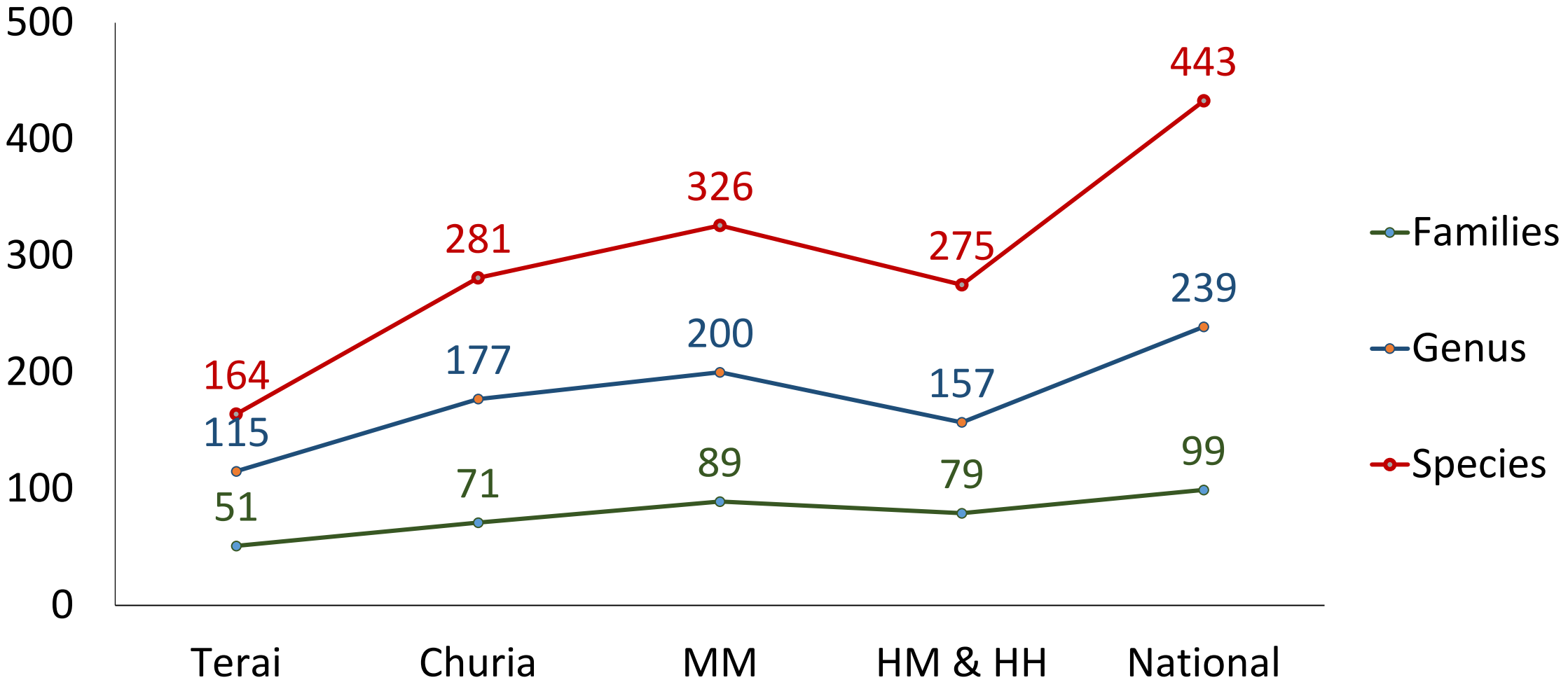
| Physiographic Regions | Stem biomass | Branch biomass | Foliage biomass | Total above ground air-dried biomass |
|---|---|---|---|---|
| Terai | 134.49 | 47.55 | 7.98 | 190.02 |
| Churia | 122.24 | 42.59 | 7.38 | 172.21 |
| MM | 89.21 | 44.37 | 9.68 | 143.26 |
| HM & HH | 145.62 | 102.57 | 23.27 | 271.46 |
| **National** | **118.14** | **62.95** | **13.42** | **194.51** |
| **%** | **60.7** | **32.4** | **6.9** | **100.0** |

# CARBON STOCK IN FOREST

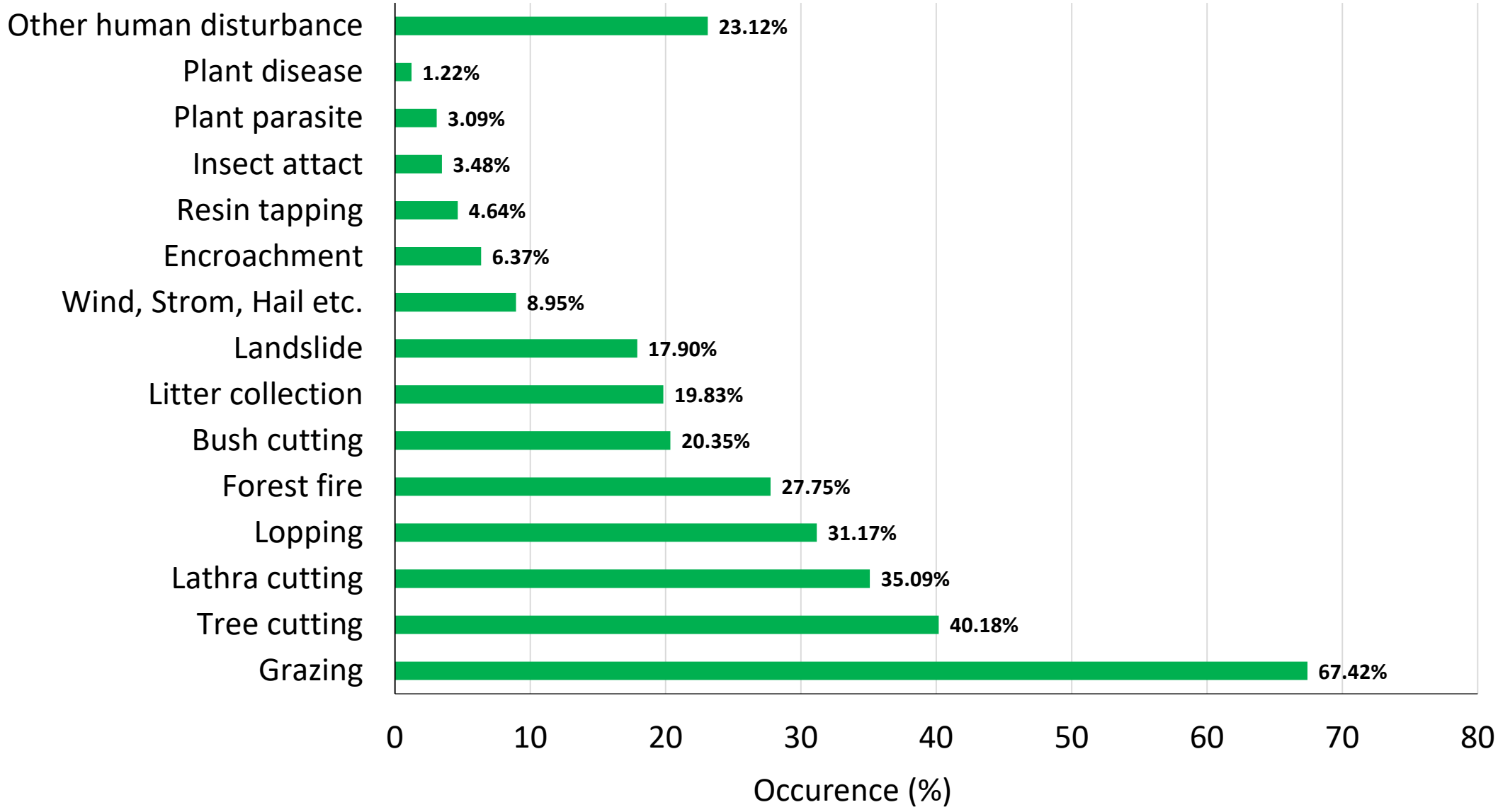
| Physiographic region | Carbon by components (t/ha) | | | |
|---|---|---|---|---|
| | Tree* | SOC | Litter & Debris | Total |
| Terai | 104.47 | 33.66 | 0.28 | 138.41 |
| Churia | 97.69 | 31.44 | 0.32 | 129.45 |
| MM | 79.42 | 54.33 | 1.65 | 135.40 |
| HM & HH | 152.36 | 114.03 | 1.44 | 267.83 |
| **National** | 108.88 | 66.88 | 1.18 | 176.95 |
| **%** | 61.53 | 37.80 | 0.67 | 100.00 |

* Live tree, dead tree, deadwood, below ground biomass

# FOREST BIODIVERSITY (TREE)



# FOREST DISTURBANCES



# Forest Resource Assessment (2016-2020....)

- Terai (Forest cover map , re-measurement and established additional-196 plots)-2016&2018
- Siwalik (Forest cover map and re-measurement) - 2017&2018
- Middle Mountain ( re-measured 84 plots)- 2018

# Forest Resource Assessment (2016-2020...)

- Middle Mountain (349 plots- 2018/2019)
- High Mountain and High Himal( 468 plots)- 2018/2019
- Additional plots (MM,HM,HH- 2019)
- Forest cover maps (MM,HM,HH- 2019)

# THANK YOU

## FOR FURTHER QUERIES

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