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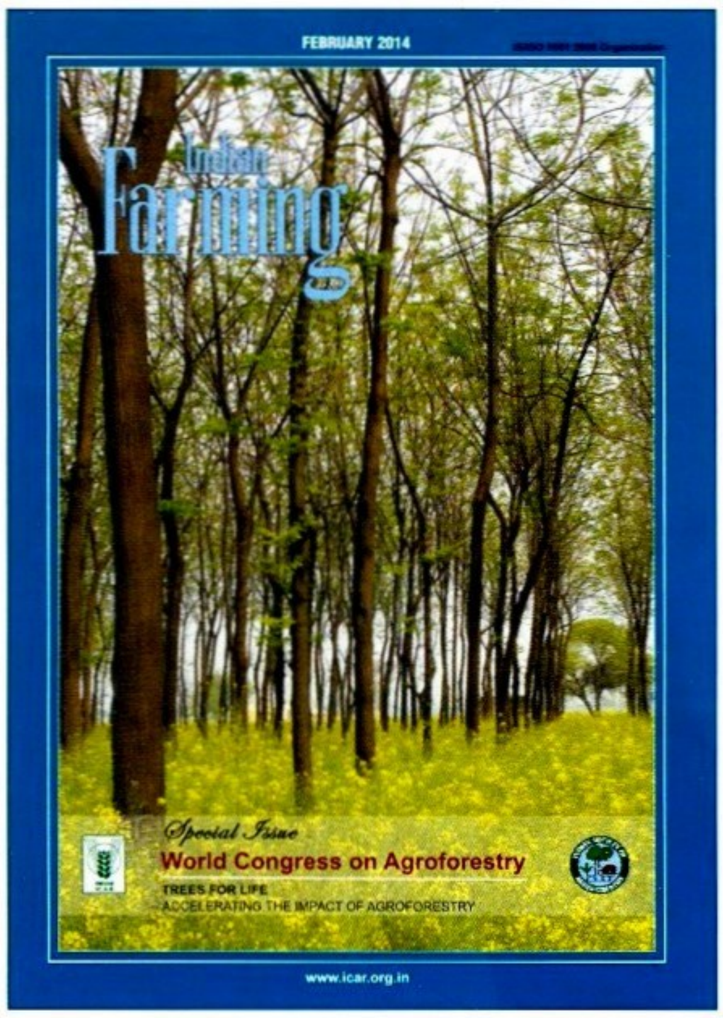

Cover I : Trees for Life – Accelerating the Impact of Agroforestry

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Indian Farming

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Mapping Agroforestry area in India

through remote sensing and preliminary estimates

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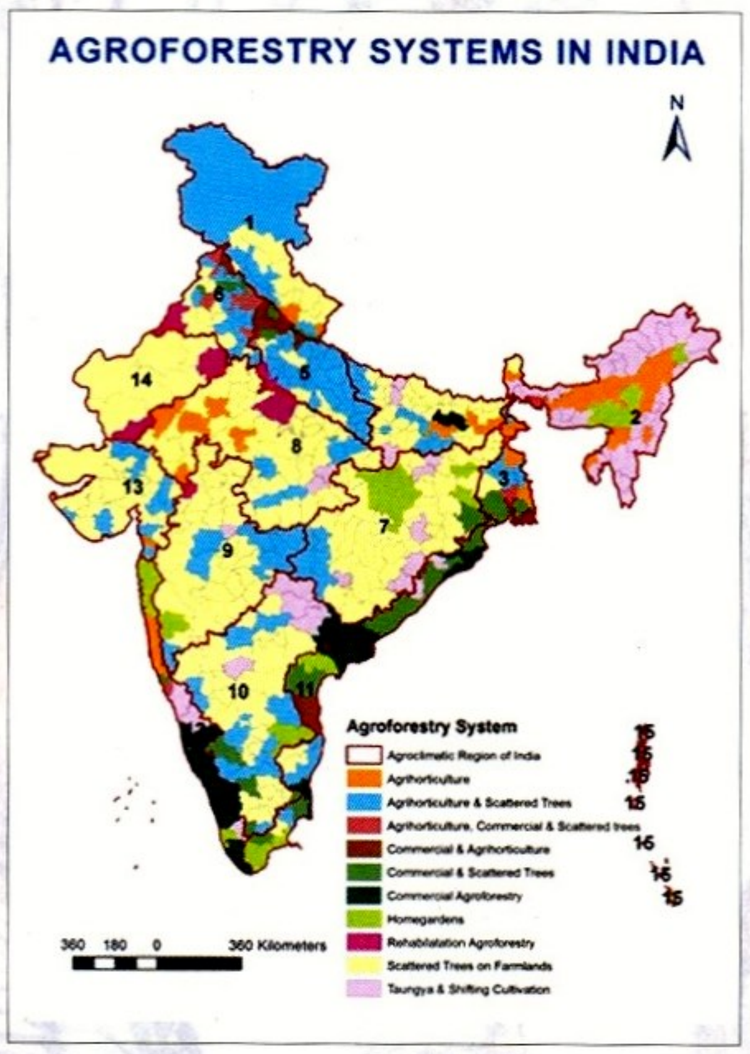
THE integrated use of spatial technologies like, Geographical Information System (GIS), Remote Sensing (RS) and Geographical Positioning System (GPS) have the potential of mapping the desired feature e.g. agroforestry (AF). GIS enables the storage, management and analysis of large quantities of spatially distributed data. Remote sensing is often the most cost effective source of information for updating a GIS and it is a valuable source of current land use/land cover data.

In India the diagnostic survey and appraisal of agroforestry practices in the country revealed that there are enumerable practices in different agro-ecological zones. These systems/ practices occupy sizeable areas, but this area is yet to be accurately estimated. Though few attempts have been made in this direction, however, these estimates are not the true reflection as they are not based on ground truthing. A major problem in estimating the area under agroforestry is lack of procedures for delineating the area influenced by trees in a mixed stand of trees and crops. In simultaneous systems the entire area occupied by multi-strata systems such as homegardens, shaded perennial systems and intensive tree-intercropping situations can be listed as agroforestry. The problem is more difficult in the case of practices such as windbreaks and boundary planting where although trees are planted at wide distance between rows (windbreak) or around agricultural fields (boundary planting) because the influence of trees extend over a larger than easily perceivable extent of areas.



Thematic map showing various agroforestry systems in India

At NRCAF, efforts are being made to estimate area under agroforestry in the country. Now, a country level preliminary estimate of agroforestry extent was attempted using Bhuvan LULC (2011-12) data. Methodology for mapping agroforestry in India using medium resolution remote sensing data has also been proposed.

Proposed Methodology for Mapping Agroforestry Area

For mapping and estimating area

Various forms of agroforestry systems are prevalent in different agro-climatic regions of India. These agroforestry systems occupy sizeable area in the country that is yet to be estimated accurately. Geospatial technologies have the potential for mapping and delineating agroforestry area for large geographical area whether state or country. Since agroforestry consist of both tree and crop components, so there are some problems in mapping agroforestry. Methodology for estimating agroforestry area in the country using medium resolution remote sensing data (LISS III) is also proposed. Moreover, preliminary estimates of extent of agroforestry area in India are attempted using Bhuvan LULC (2011-12). According to this, area under agroforestry is estimated to be 17.45 M ha in India. These preliminary estimates may be useful for state or country level planning.

Table 1. Preliminary estimates of area under agroforestry in India

(Figures in Lakh ha)

State/UT	Cropland	Fallow land	AF area (excluding fallow)	AF area (including fallow)
Andhra Pradesh	117.52	49.83	11.75	16.73
Arunachal Pradesh	1.76	0.06	0.18	0.18
Assam	25.90	0.81	2.59	2.67
Bihar	75.65	3.85	7.56	7.95
Chhattisgarh	60.07	9.90	6.01	6.99
Delhi	0.49	0.08	0.05	0.06
Goa	0.93	0.17	0.09	0.11
Gujarat	81.26	27.71	8.13	10.89
Haryana	33.59	1.58	3.36	3.52
Himachal Pradesh	3.27	—	0.33	—
J & K	8.83	0.53	0.88	0.94
Jharkhand	29.32	24.04	2.93	5.34
Karnataka	92.42	36.94	9.24	12.93
Kerala	8.60	0.83	0.86	0.94
Madhya Pradesh	117.24	17.27	11.72	13.45
Maharashtra	160.67	30.95	16.07	19.16
Meghalaya	2.19	—	0.22	—
Manipur	1.82	—	0.18	—
Mizoram	0.40	—	0.04	—
Nagaland	0.47	0.01	0.05	0.05
Orissa	56.49	23.91	5.65	8.04
Puducherry	0.12	0.05	0.01	0.02
Punjab	41.30	0.73	4.13	4.20
Rajasthan	155.11	50.01	15.51	20.51
Sikkim	0.68	0.11	0.07	0.08
Tripura	2.56	0.03	0.26	0.26
Tamil Nadu	64.99	3.82	6.50	6.88
Uttar Pradesh	186.41	10.71	18.64	19.71
Uttarakhand	7.06	0.39	0.71	0.74
West Bengal	36.00	4.56	3.60	4.05
All India	**1445.88**	**298.95**	**144.59**	**174.48**

under agroforestry using medium resolution remote sensing data, phased approach has to be adopted. First, spectral signatures of different agroforestry systems/ species have to be generated using high resolution remote sensing data (LISS IV). Then land use/ land cover classification on LISS III data will be done either by unsupervised or supervised method. Agricultural land including cropland and fallow land will be extracted from this classified image for masking equivalent area from False Colour Composite. Apply fuzzy or sub-pixel classifier on extracted agricultural area using the generated signatures. Final image will consist of pixels of five categories i) pixels covering trees plus cropland, ii) pixels covering fallow land plus trees, iii) pixels covering trees only, iv) pixels covering cropland only and v) pixels covering fallow land only. Pixels of first three categories represent agroforestry in real sense and hence their total area will give an estimate of area under agroforestry.

Estimates of Extent of Agroforestry Area

At global level area under agroforestry and Silvo-pastoral systems have been attempted by taking the FAO estimate of agricultural land multiplied by an estimate of 20% covered by agroforestry. But this value of 20% is not based on objectively measured data. Besides, the data source is taken at 1 km x 1 km resolution. The major limitation of this global spatial analysis is that results from an individual pixel (1 km x 1 km) cannot be close to reality. Though the estimates of Dhyani *et al.* (2013) wherein an average 14.19% of total cultivated land has agroforestry in one form or other seems to be closer to actual area. The author further stated that these estimates may be revised once the agroforestry mapping is completed using geospatial technologies in due course of time.

To give preliminary estimates for extent of agroforestry in India, Bhuvan Land Use/ Land Cover data of 2011-12 was used. The map service is on Land use/ Land cover map of India on 1:250000 scale and under Bhuvan–Thematic Services of NRSC, ISRO. The LULC maps are generated using multi-temporal satellite data of IRS AWiFS sensor for the year 2011-12. Cropland and fallow land areas were considered for estimation purpose and 10 per cent of these areas were calculated as agroforestry based on the available information. In this way, extent of agroforestry in India was estimated to be 14.46 M ha when fallow land was not included (Table 1). Potential area under agroforestry was estimated to be about 17.45 M ha, when fallow land was included. These figures are lower than 25.32 M ha as estimated by NRCAF in 2013.

Similarly the area under agroforestry in different states was also estimated. Uttar Pradesh, Maharashtra and Rajasthan ranked first, second and third in terms of area under agroforestry (1.86, 1.61 and 1.55 M ha, respectively). These preliminary estimates may be considered for state and country level planning. A thematic map showing various agroforestry systems in India is prepared, which depicts that scattered trees on farmlands is the most prevalent agroforestry systems in India followed by agrihorticulture system. Homegardens exist in some parts of Kerala, Tamil Nadu, Maharashtra, Chhattisgarh and north-eastern states.

SUMMARY

Agroforestry will play a major role in coming years, not only for

importance in food and livelihood security but also for its role in combating environmental challenges. In order to harness its potential, an accurate estimation of extent of area under agroforestry in the country is required. The accurate assessment of area under agroforestry systems in India can be done with the help of geospatial technologies. These preliminary estimates will have to be verified once proposed methodology for agroforestry mapping using geospatial technologies has been developed.

[1] Senior Scientist, [2] Director, [3] Principal Scientist, [4&5] Research Associates

World Congress on Agroforestry

10-14 February 2014, Delhi.

Pre congress activities

The meeting of Global Advisory Group for WCA 2014 held in New Delhi, on 16th January 2013 decided that there may be a need for pre-conference activities such as school tree planting programmes, policy and media briefs etc. As part of Pre-Conference activities events like national Agroforestry Day (May 8th), plantations in different parts of the country by school children, farmers and others, satellite seminars, brain storming session, consultation meet, programmes on television and radio were organized. A brief summary is placed below;

- **National Agroforestry Day** was celebrated on 8 May 2013 at National Research Centre for Agroforestry, Jhansi. On the eve a number of events including plantation programme were organized. Invited guests and experts and eminent scientists in the field, scientists of the Centre, representative from state departments, KVK, Heads from IGFRI and CSWCRTI Centre, farmers and NGO participated. An exhibition of agroforestry technologies through exhibits, posters and materials was also organized on the occasion.
- **Brain Storming Session on "Agroforestry Research and Development: The Way Forward"** was organized on 8.5.2013 at NRC for Agroforestry, Jhansi to review the research work conducted till now and to develop a road map for further strengthening the agroforestry research to overcome the emerging challenges. Invited guests and experts and eminent scientists in the field and NGOs participated in the session.
- **Organization of Satellite Seminar and Plantation Drive**

  Bhubaneshwer, Odisha – children participated in the plantation program organized by the AICRP for Agroforestry Centre.

  Dharwad, Karnataka –
  - Awareness Programmes cum Seminar on Agroforestry and Plantation drives were organized by AICRP on Agroforestry Centre, UAS, Dharwad at Gudageri, Kundagol Taluk, Veerapur and Surshettikoppa villages of Dharwad district on 16th, 19th, 27th July and 29th August 2013. About 140 farmers participated and saplings of different tree species (1800) were planted
  - An Exhibition stall on Agroforestry and Biofuels was a part of mega event "Krishimela-2013" of UAS Dharwad held from 21-24 September 2013. This stall attracted many farmers. More than 12 lakh farmers participated in *Krishimela*.
  - A "Biofuel rally" was organized at Veerappur village, Dharwad on 29.08.2013. School children also participated.

  Mined Areas of Megalahalli Village, Chitradurga District – A Training programme on 'Agroforestry' and Biofuels Tree Species was organized on 4 July 2013 as a curtain raiser event for 3rd World Agroforestry Congress. School childredn also participated in the plantation programme.

  SDAU, Sardarkrushinagar, Gujarat – Children participated in the plantation program organized by the AICRP for Agroforestry Centre.

  SKUAST, Srinagar, J&K – youth and children participated in the plantation program organized by the AICRP for Agroforestry Centre.

  Jhansi district, Uttar Pradesh – Farmers, youth and children participated in plantation program on 17.08.2013 organized by the NRC for Agroforestry.

- **National Consultation Meet on Agroforestry:** A one day National Consultation Meet on Agroforestry Research and Development in India was organized at New Delhi on 19th November, 2013. The meet was attended by the officials from Central Government Ministries, State Departments and organizations such as National Advisory Council (NAC), Planning Commission, National Rainfed Agriculture Authority, Ministry of Agriculture, Ministry of Environment and Forests, Ministry of Rural Development (Land Use and Planning), World Agroforestry Centre, BAIF, ICFRE, ICAR Institutes, representatives from WIMCO, ITC, NABARD, Tree Grower's Association and progressive farmers. The Meet was organized as precursor for showcasing Indian perspective for Agroforestry R & D and development at Global level during forthcoming WCA2014. The outcome of the meeting was identification of critical gaps and implementing constraints in Agroforestry Development and how to overcome them. This was a part of initiatives for evolving a framework for a National Agroforestry Policy.

- **Live Phone in program on Agroforestry:** Dr. S.K. Dhyani participated in Live phone in program on Agroforestry on National television on 17.10.2013. The program was very successful and pan India farmers/stakeholders asked questions on the topic.
- **Awareness Program for Farmers:** Group of experts participatedand answered questions in a radio program for farmers 'Janvani' on FM radio on 25.10.2013 at Pantnagar, Uttarakhand.
- **Awareness through Newspapers etc.:** The event is being covered through news items etc. in newspapers. Two items appeared in Business Standard, National edition [English] Business Standard, National edition [Hindi] on 17.12.2013.