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AGROFORESTRY NEWSLETTER

AGROFORESTRY IN INDIAN CONTEXT

Agroforestry has now earned a distinct identity of its own and hardly needs further elucidation. Number of definitions have been given by different authors starting from Bene et al (1977) and King & Chandler (1978). Dr.King, the first Director General of ICRAF who has also modified and improved his earlier definition in 1979 in an Agroforestry Seminar held at Imphal in India. Dr.Lundgren (1982), the present DG, ICRAF has also given a simple definition. In India also number of authors including Dwivedi (1980) defined agroforestry. With the advancement in Agroforestry technologies the term Agroforestry is becoming dynamic and it is very difficult to confine it within a limited definition. Agroforestry land use has two principal objectives viz., sustainability, a term so common in forestry, and productivity, a common word in agriculture. Meaning of agroforestry would be different for developing and developed countries. It is a must for the former where sustainability is very important and gets preference over productivity whereas it is a luxury for the latter where productivity gets preference over sustainability. We, the developing countries of the world, have to get a balance between the two depending on the edapho-climatic situations. An attempt has been made here to define agroforestry as a sustainable integrated land management system and technologies which increases the overall productivity of the land in which woody perennials including trees and shrubs (including fruit trees/shrubs), palms, vines, bamboos etc. are deliberately grown or kept on the same unit of land in association with herbaceous vegetation including crops and/or animals simultaneously or sequentially.

In India agroforestry as a traditional farming system has played and is still playing in some part of the country a very important role in meeting the multiple needs of the farmers besides sustaining the soil fertility. But with the fast increasing and present human and livestock population of over 800 and 474 million respectively and thrust given on green revolution with the introduction of high yielding varieties with high input technology for increased crop production, India has solved its foodgrain problem. But as a result of this thrust more and more of the marginal and submarginal and other degraded land not suitable for agriculture have been put to arable farming by eliminating woody perennials which is doing more harm than good to the farmers by way of heavy soil, water and mineral loss resulting in the siltation of the dams and waterways causing flood and loss of human and animal life in wet zones and desertification in dry zones. Perpetual mismanagement and over exploitation of our natural resources over the last about 50-60 years resulted in reducing our forest area from 165 m ha to only about 50 m ha and having at present more than 45% of our total land as wasted land and heavy deficit in fuelwood, fodder and timber production.

By the end of this century we have to meet the production target

of more than 250 m.t. of foodgrain and 2085 m.t. of green and dry fodder in addition to 350 m.t. of fuelwood and 60 m M^3 of timber besides amelioration of our highly polluted environment which is only possible through integrated agroforestry systems. As such there is urgent need today to achieve a balance between forest and agricultural land and avoid diversification between forestry and agriculture. The issue is how best forestry which is the foster mother of agriculture could be utilized for the improvement of agriculture.

Now let us discuss some of the typical problems of our country which may be also applicable to other developing countries. In India we know at least 80-90 m.t. of dried cowdung cakes is burnt annually representing 400-500 m.t. wet dung to meet the fuelwood shortage. We also know that out of 143 m.ha of cropped land, 104 m.ha (about 70%) is confined in arid and semi-arid regions most of which is deficient in organic matter and nutrients and more than 65% of the livestock is also confined in these region. By simply applying cowdung of these zone to the agricultural field instead of burning we can easily increase foodgrain production by 15-20 m.t. only from these zones. Similarly by introducing multipurpose nitrogen fixing trees and shrubs (MPTS) like Prosopis cineraria, Acacia nilotica, A.cuprissiformis, A.albida and other Acacias, Leucaena leucocephala, Casuarina equisitifolia, Sesbania spp., Glyricida, Alnus species etc. and other MPTS species under various agroforestry systems we can substantially increase agriculture production.

Similarly MPTS under these system will also contribute nutritious fodder and will significantly increase the livestock productivity since more than 65% of the total livestock of the country is also confined in arid and semi-arid region which has high potentiality for increasing livestock products like meat, milk, wool etc. which will help in reducing the grain consumption. There would be lot of employment generation and agroforestry being labour intensive farmers would be occupied throughout the year.

As such we have to give more thrust on agroforestry research and development including animal-agroforestry especially so in arid, semi-arid and hilly region in order to solve some of our pressing problems. In this context research on MPTS including nitrogen fixing trees and shrubs (NFTS) in agroforestry system needs special emphasis.

NRCAF AND AICRPAF

National Research Centre for Agroforestry (NRCAF), Jhansi started functioning from May 1988 with the joining of Dr.R.Deb Roy as its first Director. The Centre initiated working on three projects one each on three important agroforestry systems viz., Agri-Silviculture, Agri-Horticulture and Silvipasture. During March 1989 scientists from IGFRI & NRCAF (ICAR) and two Senior Scientists from ICRAF conducted diagnosis and design exercise in three villages of Lakara-Karari-Rund Karari watershed near Jhansi which was continued by the visit of Dr.R.Deb Roy, Director, NRCAF and Dr.S.Chinnamani, Asstt.Director General (AF) & Coordinator, AICRPAF to ICRAF Nairobi during July 24 to August 6, 1989 and prepared the Agroforestry Research Project Proposal for the watershed area after discussion with ICRAF's scientists especially Dr.M.Avila. The project would be implemented by ICAR in collaboration with ICRAF with the financial assistance from IDRC, Canada. In addition to Director, three scientists including two principal scientists joined the centre during 1989 and seven more scientists are expected to join the centre during 1990. It has the following mandate:
(i) Survey, evaluation and improvement

of MPTS suitable for agroforestry systems, (ii) Research related to basic and applied aspects including development of appropriate methodologies for agroforestry systems, (iii) Development of agroforestry informatic centre, (iv) Training on the methodology and scientific management of agroforestry systems, (v) Collaboration with national and international organisations.

Agroforestry research in the country is also being continued by 31 Co-ordinated Project centres located in different agroclimatic regions, closely coordinated by ADG-cum-Coordinator Dr.S.Chinnamani on three core projects viz., (i) Diagnostic and Design exercise, (ii) Collection and evaluation of promising MPTS and (iii) Studies on management practices of agroforestry systems.

SIGNIFICANT FINDINGS

In order to study the effect of boundary planting of Eucalyptus tereticornis and Leucaena leucocephala (Subabul) in the Tobacco-Bajra cropping system in Mahi ravines at Vasad under irrigated conditions, nursery raised seedlings in polybags were planted in single row at 2 m spacing in July 1984. Tobacco (Anand 190) transplanting were done during the last week of August and summer Bajra (var. BK 560) in the last week of February. Yield data of Tobacco and summer Bajra were recorded at 6 variable distance from tree lines separately for 5 years. Eucalyptus trees attained a height of 14.8 m and Dbh of 15 cm at the end of 5th year compared to 5.9 m and 6.4 cm with Leucaena leucocephala. The height and diameter of Subabul was badly effected due to grazing by wildlife animals. There was practically no reduction in yield during the first year in case of Eucalyptus, 1st and 2nd year in case of Leucaena. Reduction in yield is very high in Eucalyptus as compared to Leucaena and reduction increased as the tree grow older. At the 5th year, there was 58% reduction in the yield of Tobacco and 36% in summer Bajra grain and 17.5% in Bajra straw as compared to control. In case of Leucaena yield reduction of Tobacco, summer Bajra grain and Bajra straw was 37 13.8 and 9.4% respectively.

Economics of this type of agroforestry system revealed that growing of Eucalyptus under prevailing conditions appears to be more remunerative but looking to the fodder value of Leucaena and maintaining the fertility status of the soil this multipurpose trees would be more remunerative in the long run.

(K.T.N.Nambiar,
CSWCR&TI Res.Farm, Vasad)

Success of agroforestry systems in the semi-arid tropics depends on minimising the competition for soil moisture between trees and crops by using appropriate tree density or prunning design. However, study of interaction for moisture is notoriously difficult because method of transpiration measurements are laborious and technically difficult. Two sap flow techniques were evaluated at ICRISAT, Hyderabad which were found to be suitable for large or small trees. The first is called Custom Heat Pulse system which was developed in New Zealand and it require no calibration (Cost US$ 3500 each). A heat balance technique was developed at ICRISAT in conjunction with University of Washington State which allows measurement of tree seedlings with stems of less than 6 cm. For more information contact Dr.C.K.Ong, ICRISAT, P.O. Patencheru - 502324 (A.P.), India.

Custom Heat Pulse Recorder.

In a hedge-row management, alley cropping of Sorghum and Pearl millet in Leucaena alleys spaced 7.8 m apart increased the grain and fodder yield by 9 and 24% in Sorghum and 16 and 24% in Pearl millet respectively. Grain production of Sorghum (pure crop) was 26.8 q compared to 29.1 q/ha when mulched with Leucaena and fodder production was 20.6 and 25.5 q/ha respectively. Leucaena alleys was grown as paired rows at 60 cm and managed as low growing hedge by cutting at 15 cm height at monthly interval during cropping season. Cuttings from Leucaena were mulched to the arable crops during cropping season. Apart from increasing the grain and fodder yield of both Sorghum and Pearl millet Leucaena alleys yielded 1.5 tons each of fodder and fuelwood from the off season's growth.

(R.P.Singh
CRIDA, Hyderabad)

Agri-Silvicultural studies conducted at NRCAF Farm, Jhansi continued during 2nd year with 12 MPTS at 3 spacings and 4 crop combinations revealed that Eucalyptus tereticornis recorded maximum height and diameter of 4.37 m and 6.93 cm respectively followed by Acacia cuprissiformis (3.48 m and 5.68 cm). L.leucocephala recorded a diameter growth of 4.55 cm. Its height was significantly effected due to top dying in the past year during first year summer. The growth attributes of the MPTS was much better in association with crops than under control (without crops). Grain production recorded from Sorghum and Pigeonpea during Kharif '89 revealed that maximum Sorghum grain yield of 30.6 q/ha in association with Dalbergia sissoo followed by control (29.5 q/ha) and 26.3 q/ha in association with Leucaena leucocephala. The minimum

Eucalyptus in association with
Sorghum and Pigeonpea.

At the Indian Grassland and Fodder Research Institute, Jhansi, the IDRC Sponsored Silvipasture Operational Research Project for Bundelkhand Region has completed its first phase (1982-1989) and entered the IInd phase on July 1, 1989.. In the first phase integrated silvipastoral farming systems were tested at three sites viz., undulating terrain, eroded plains and ravines with salt affected soils for soil moisture conservation, contour bunding, trenching and furrowing. The second phase will focus on system evaluation through animals, carrying capacity and lopping management. The successful technologies of phase I will now be further extended and tested on a larger scale for standardization of the animal feed and firewood production.

(P.S.Pathak, IGFRI, Jhansi)

Information collected from common agroforestry practices adopted in mid tropical hill and plain zone of Meghalaya revealed that system comprising of pineapple, black pepper and arecanut gave the highest net return of Rs. 42,500/ha/year after 6 years of plantation of tree component while arecanut with black pepper alone could give Rs. 31,500/ha/year. In the temperate sub-alpine zone plum with potato/cole crops gave a net return of Rs. 19,700/ha/year. In the sub-tropical hill and plain zone, the combinations of Sehima with large cardamom could give a net return of Rs. 10,000/ha/year.

(D.S.Chauhan, AICRPAF
ICAR Research Complex, Shillong)

Agri-Silvicultural studies were conducted during 1984 with 4 trees (Teak, Semal, Safeda and Poplar) in combination with wheat and paddy. Trees were planted at the densities of 500 plants/ha. Data recorded during 1988 on plant growth showed the maximum height (11.91 m) and girth (45.1 cm) in Poplar followed by Eucalyptus (height 10.51 m and girth 38.87 cm). While the highest production of paddy was obtained in combination with Semal (39.0 q/ha) followed by Teak (37.0 q/ha). In case of wheat, the maximum production was recorded in combination with Teak (31.0 q/ha) followed by Semal (29.0 q/ha). Thus, the results indicated the highest tree growth with lower crop yield.

(AICRPAF,G.B.P.U.A.T.,
Pantnagar)

SYMPOSIA/SEMINARS/CONFERENCES

One month National Training on Agroforestry, Forage Production and Animal Nutrition is being held at IGFRI Jhansi from 26th Dec.89 to 26th Jan.90. Contact Dr.Panjab Singh, Director, IGFRI, Jhansi (U.P.) 284003, India.

Biennial Agroforestry Workshop and Symposium is being held at GAU, Navsari from 8-11 Jan.1990. Contact Dr.S.Chinnamani, ADG, ICAR, New Delhi-110001, India.

A National Workshop on Multipurpose Trees (MPTS) for Agroforestry System is being held at IGFRI Campus, Jhansi from 1-3 Feb.1990. Contact Dr.R.Deb Roy, Organising Secretary and Director, NRCAF, Jhansi-284003, India.

International Symposium on Natural Resource Management for a Sustainable Agriculture is being held at New Delhi from 6-10 Feb.90. Contact Dr. R.P.Singh, Org.Secretary and Director, CRIDA, Hyderabad-500659 (A.P.), India.

A two week National Workshop on Agroforestry Modelling is being held at IGFRI Campus, Jhansi during April, 90. Contact Dr.S.Chinnamani, ADG, ICAR, New Delhi or Dr.R.Deb Roy, Director, NRCAF, Jhansi-284003, India.

National Workshop on Nutrient Cycling is being held during March at CAZRI, Jodhpur. Contact Dr.S.Chinnamani, ADG, ICAR, New Delhi-110001.

National Seminar on Silviculture Approach for Wasteland Development is being held at IGFRI, Jhansi from 12-14 March, 1990. Contact Dr.Panjab Singh, Director, IGFRI, Jhansi-284003 (U.P.).

AGROFORESTRY ABROAD

A Seminar on Research Policy for Community Forestry is being held at Bangkok, Thailand from 8-12 January, 1990. Contact Mervin Stevens, RECOFTC, C/o Faculty of Forestry, Kesetsart University, Bangkok 10903, Thailand.

International Casuarina Workshop is being held at Cairo, Egypt from 15-19 January 1990. Contact Hosny El Lakany, Desert Development Centre, The American University in Cairo, P.O. Box 2511, 113 Sharia Kasr El Aini, Cairo, Egypt.

International Rangeland Symposia is being held at Reno/Sparks, Nevada during 12-16 February, 1990. Contact Jaims A Tiedeman, Forestry and Range Management, Washington State University, Pullman Washington 99164 USA or Chuck Gay, Department of Range Sciences, Utah State University, Logan, Utah 84322 USA.

The Annual meeting of the Nitrogen Fixing Tree Association is being held from 18-22 February 1990 in Waimanalo, Hawaii, USA. Contact Nitrogen Fixing Tree Association, P.O.Box 680, Waimanalo, Hawaii 96795, USA.

A three week Short Course on Forest Tree Improvement is being held at Raleigh, North Carolina from 12-30 March 1990. Contact Robert C.Kallison, Director, International Programs, College of Forest Resources, P.O. Box 8007, North Carolina State University, Raleigh, North Carolina 27695, USA.

ICRAF's next Training Course on Agroforestry Research for Development is being held in Nairobi from 7-25 May, 1990. Contact Mr.James Wahome, ICRAF, Nairobi.

Eight Week Short Course on Trees of Arid and Semi-arid Australia is being held at Canberra, Australia from June 25 to Aug. 17, 1990. Contact Australian Tree Short Course, Anutech Pty.Ltd., G.P.O.Box 4, Canberra ACT 2601, Australia.

A three month course on Management Development is being held at Mhlume Swaziland during May to July. Contact Management Agriculture, Management Centre, P.O.Box 20, Mhlume, Swaziland.

A three week course on Agroforestry : Sustainable Land use for the Humid Tropics is being held from July 23 to August 11, 1990 at Escazu, Costarica. Contact Dr.Gerardo Budowshies, Director, Natural Resources, University for Peace Apartado 199-1250 Escazu, Sanjose, Costarica.

A short course on Tropical Agroforestry is being held at Edinburg during June to September 1990. Contact TROPAG Courses, School of Agriculture, West Mains Road, Edinburg EH93JG, Scotland, U.K.

African Association for Biological Nitrogen Fixation will hold a conference on Biological Nitrogen Fixation and Sustainability of Tropical Agriculture from 25-29 September in Ibadon Nigeria. Contact International Institute of Tropical Agriculture, Oyo Road, PMB 5320 Ibadon, Nigeria.

Fifth International Congress on Ecology will be held at Yokohama, Japan from 23-30 August 1990. Contact A Miyawaki, Institute of Environmental Science and Technology, Yokohama National University, 156 Tokiwadai, Hodogaya Ku Yokohama 240 Japan.

IFURO's IX World Congress will be held at Montreal, Canada from 5-11 August 1990. Contact Congress Secretariat, IUFRO, Montreal 1990 INC P.O.Box 1990 Placed Armes Montreal with Quebed, Canada.

Fifth International Symposium on Nitrogen Fixation in Non-Legumes will be held at Florence, Italy from 10-14 September 1990. Contact Organising Secretariat Studio EGA, Via deiBrunelleschi 250100, Firenze, Italy.

A seven week International Course on Fodder Tree Legumes - Multipurpose Species for Agriculture will be held at Queensland, Australia during November-December 1990. Contact Fodder Tree Legumes Course Secretariat, UniQuest Limited, University of Queensland, St.Lucia, Queensland, Australia 4-67.

Fourth International Rangeland Congress will be held at Montpellier, France from 22-26 April, 1991. Contact H.N.Le Houerou, Chairman of the Organizing Committee of the IV International Rangeland Congress, CNEARC, B.P. 5098, F 340 33, Montpellier Cedex, France.

An Interdisciplinary graduate programme in Agroforestry leading to M.Sc. and Ph.D. is being conducted at the University of Florida. Contact Dr.P.K.R. Nair, Professor of Agroforestry, Dept. of Forestry, University of Florida 32611 - 0301, USA.

Homestead Agroforestry system with Guava and Papaya intercropped with Turmeric and vegetables.

The Agroforestry Newsletter aimed at providing important highlights on research, development, education and training in India published quarterly by the National Research Centre for Agroforestry (ICAR), Jhansi. Contributions, letters, comments, queries etc. on any aspects of Agroforestry may be sent to Dr.R.Deb Roy, Director, NRCAF, Jhansi.

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Agroforestry to stop burning of store energy and nutrients

Agroforestry is the cultivation of trees in association with crops. In our anxiety to increase food production, we have increased the area under cultivation by diverting most of our shrub jungles and other wasted land. Even forests have been indiscriminately felled, with the result that the effective area under forest trees has been reduced to a mere 13% of our total land area, as against the desirable 33%.

In villages firewood sometimes contributes 80% of the energy consumed. As fuelwood becomes scarce, dried cowdung is burn to keep the pot boiling. An estimated 100 million metric tonnes of dried cowdung cakes, represting 500 million tonnes of freshly collected dung is burnt away every year which is a shear waste of valuable organic fertilizer.

Even if 400 of the 500 million tonnes cowdung burnt every year is diverted to manuring, we will produce 15-20 million tonnes of additional foodgrains every year.

By the turn of this century we have to increase our food production by 75 million tonnes and fuel production by 140 million tonnes. Also fodder and pastures form an important component of our current strategy on agroforesty in which multipurpose trees and other woody perennials that yeild fruits, fibre and fuelwood are combined on the same land management unit with crops, in some form of space or time sequence.

An effective agroforestry strategy should provide sustainable productivity, economic viability, ecological suitability and social acceptability to farmers.

In the open arid and semi-arid lands of the north-western zone, hot swift winds blow away millions of tonnes of precious top-soil, which nature has taken hundred of years to build. If trees are planted as shelter-belts, they divert the wind up to a distance of about 20 times the height of the trees.

In the arid areas of Rajasthan and Gujarat, Khejri *(Prosopis cineraria)* was found to be the best tree for growing with crops like pearlmillet, clusterbean, mungbean and mothbean. Another useful shrub is bordi or jhadiaber *(Zizyphus nummularia)*.

'Seb' variety of ber or jujube *(Zizyphus mauritiana)*, is an ideal fruit-tree suited to semi-arid regions.

A good pasture could be raised in between the trees of *Prosopis cineraria* and *Acacia tortilis* (Israeli-babul) planted at a density as high as 400 plants per hectare. The leaves can be used as an animal feed as well as mulch, which improves the soil structure, reduces evaporation, increases the moisture-holding capacity and enriches the organic carbon and nutrient content of the soil.

In one form or another agroforestry has been traditionally practised for a long time by our farmers. Trees are raised to protect shade-loving spices, condiments, medicinal and plantation crops in humid and sub-humid areas. They are often grown on field boundaries, and as shelter-belts and windbreaks in arid and semi-arid areas.

Even if we miraculously stop the clearing of forests and shrub jungles today, we have still to plant millions of trees and shrubs on waste lands, roadsides, farm-steads and around houses to meet our future firewood needs, upgrade our soils, and stabilize our water resources. While reforestation and large scale planting of trees will need huge investments from the government and social organizations, agroforestry imparts practical knowledge to farmers and enlists their support and energy in meeting the future food, fodder and fuel needs.

RESEARCH HIGHLIGHTS

Agroforestry studies under rainfed condition for central Maharashtra

In closer alley width (5 m) the reduction in grain production was more compared to the wider alley (7.5 and 10 m) of all the tree species and the reduction increased with the advancement in age of tree species. Among the four different tree species Subabul *(Leucaena leucocephala)* being the fast growing species had a maximum shade effect (maximum height 11.83 m and girth of 33.6 cm) which intercepted the light to the extent of 61.53 to 83.43% and also more number of lateral roots and spread in the sub-soil reduced the grain yeild to the extent of 90 to 99, 72 to 100 and 95 to