**Introduction**

Agro forestry has potential for high productivity and simultaneously satisfying three important objectives viz., protecting and stabilizing the ecosystems; producing a high level of output of economic goods; and improving income and basic materials to rural population. Besides, agro forestry is capable to conserve natural resources through various systems under different agro climatic regions. The livelihood security through agro forestry and its potential in meeting basic needs viz., food, fuel, fodder, and employment generation are highlighted in this article.
Agro forestry is the intentional combination of agriculture and forestry technologies to create integrated, diverse, productive, profitable, and sustainable land-use systems. Agro forestry plantations already meet nearly 80% of round wood requirements of wood based paper and panel products industries and have the potential to lead us to self-sufficiency in timber simultaneously contributing immensely to employment generation, greening of India, carbon sequestration and environmental amelioration. The potential of agro forestry in meeting the deficit of demand and supply in timber, fodder supply, bio energy sector through tree biomass and meeting the food/fruit security has been enumerated. The direct benefits like employment generation and indirect ones like carbon sequestration and environment restoration have been emphasized in respect of various agro forestry systems.

An examination on the impact of agro forestry technology generation and adoption in different parts of the country highlights the major role of smallholders as agro forestry producers of the future. It is crucial that progressive legal and institutional policies are created to eschew the historical dichotomy between agriculture and forestry and encourage integrated land-use systems. Government policies hold the key to agro forestry adoption.

Introduction to SARA & WCMP:

SARA is a Non-governmental, Non-profitable organization registered under Karnataka Societies Registration Act 1960, in 2001 and supported by West Coast Paper Mills Limited, Dandeli and a leading paper manufacturing industry in India. SARA is a group of forestry, agricultural and financial experts and progressive farmers to help the West Coast Paper Mills Limited procure wood raw materials as part of the Controlled Wood Policy created in 2001. The policy ensures that West Coast Paper Mills Limited can procure its wood raw materials from known sources to meet the annual production of 3.2 Lac metric tons of paper and paper products. For this, Company is using wood and wood chips around 9.50 Lac MT annually as main raw materials for quality paper production. Company is also certified for FSC<sup>®</sup>-Chain of Custody and Controlled Wood. It declares that Company is committed through its Controlled Wood policy to procure wood from legal and known sources. Further company is also committed to conserve Natural resources and will not use any GM (Genetically Modified) crop as per FSC<sup>®</sup> policy. Company is supporting financially to SARA since the beginning to help out to meet its requirement for raising the plantations on farmer’s degraded land also company has given a written commitment to SARA to purchase entire wood of the farmer after harvesting.

Since 2006 to 2017, SARA has been implementing plantation activities under contract farming on farmer’s degraded land to raise plantation to make use of their unproductive land for income generation. To date, SARA has covered around 50,000 acres of degraded, waste and marginal lands in and around 1900 villages across the various districts of Karnataka, Maharashtra, Andhra Pradesh and Tamil Nadu States. It has also enjoined more than 8000 farmers to join SARA in the Captive Plantation Project to strengthen them through income generation and capacity building from plantations. The details of plantation area in various districts of Maharashtra, Karnataka and Andhra Pradesh, are as under in (Table 1).

Table 1 Details of plantation area covered 2006 to 2017 by SARA-WCMP in various states

| S. no. | Name of section | District & state       | Plantation area in hectare | Species undertaken               |
|-------|----------------|------------------------|----------------------------|----------------------------------|
| 1     | Ram Nagar      | Uttara Kannada-Karnataka | 1026                       | Eucalyptus, Acacia, Casuarina    |
| 2     | Kharapur       | Belgaum-Karnataka       | 5035                       | Eucalyptus, Acacia              |
| 3     | Chennamana Kittur | Dharwad-Karnataka       | 2600                       | Eucalyptus, Acacia              |
| 4     | Koppal         | Koppal-Karnataka        | 2424                       | Eucalyptus, Subabul             |
| 5     | Malgi          | Sarsi-Karnataka         | 1783                       | Eucalyptus, Acacia              |
| 6     | Chandgad       | Kolhapur-Maharashtra    | 2171                       | Eucalyptus, Acacia              |
| 7     | Radhanagri     | Kolhapur-Maharashtra    | 2528                       | Eucalyptus, Acacia              |
| 8     | Kulwali        | Dharwad-Karnataka       | 996                        | Eucalyptus, Acacia, Casuarina, Subabul |
| 9     | Nellore        | Gudur-Andhra Pradesh     | 2213                       | Eucalyptus                      |
| Total |                |                        | 20776                      |                                  |

Contract for farming scheme

Under the Contract for Farming scheme, pulpwod plantation were raised on farmer’s land with no expenditures from farmer’s side to give a support and helping hand to poor and marginal farmers for a period of 5years. After 5years on maturity of Crop Company will arranged harvesting contractors and further the same will be transported to company with proper arrangements by society. All the plantations raised by the SARA and WCMP on waste lands, barren and fallow lands of farmers with a clear intention to provide means of employment to farm communities for their livelihood and capacity building through income from Captive Plantations with the support of SARA. The wood are then sold to SARA after five years. Company makes the payment directly to farmers into his account on predetermined price at the time of execution of contract.

All plantations under the project are certified by SARA under the Forest Stewardship Council<sup>®</sup>-Forest Management by the Scientific Certification System since 2011 as Well-Managed Group Plantation. The Society ensures that all plantations comply with the certification objectives of promoting responsible management of forest; protecting and maintaining natural communities and high concentration of value forests; respecting the rights of communities and indigenous people; and building markets, adopting the best value and creating equal access to benefits.

Production of superior planting material

As part of contract farming, SARA is also actively engaged in producing quality superior clones of Eucalyptus, Acacia, Casuarina and Subabul. It has set up an advanced clonal nursery with an area of...
Major plantations on farmer’s degraded lands in Karnataka supports agro forestry promotion and development: Pioneer efforts of SARA-WCPM in India

3000 sq. m. and with five mist chambers. This clonal nursery produces 50-60 lacks of clonal saplings which are transplanted to the farmers’ fields (Figure 1).

Table 2 Section wise geographical data

| S.No. | Parameters       | Radhanagri | Chandgad | Khanapur | Chennamanna Kuttur & Kuwalli | Malgi | Koppal | Nellore/Andhra Pradesh |
|-------|------------------|------------|----------|----------|-------------------------------|-------|--------|------------------------|
| 1     | District/State   | Kolhapur/  | Kolhapur/ | Belgaum/ | Udupi/ Karnataka              | Udupi/ | Udupi/ | Nellore/Andhra Pradesh |
|       |                  | Maharashtra| Maharashtra| Karnataka|                              | Karnataka| Karnataka|                        |
| 2     | Mean Temperature | 20°C-30°C  | 20°C-3520°C | 25°C-35°C | 25°C-35°C                      | 20°C-30°C | 20°C-30°C | 35°C-40°C               |
| 3     | Latitude and Longitude | N 16° 24’ 33.48” E 73° 57’ 28.67” | N 15° 56’ 33.95” E 73° 59’ 27.09” | N 15° 42’ 58.39” E 74° 22’ 52.02” | N 15° 24’ 57.51” E 74° 29’ 52.02” | N 15° 35’ 29.90” E 74° 27’ 50.51” | N 14° 34’ 58.84” E 75° 00’ 39.65” | N 15° 35’ 07.08” E 76° 15’ 54.31” |
| 4     | Mean Annual Rainfall (mm) | 2500 | 2500-3000 | 2000-2500 | 2000-2500 | 1000-1250 | 1200-1500 | 500-750 | 750-1000 |
| 5     | Altitude         | 550-600m above MSL | 300-600m above MSL | 650-750m above MSL | 600-700m above MSL | 680-750m above MSL | 580-650m above MSL | 350-450m above MSL | 18-50 m above MSL |
| 6     | No. of Wet days  | 95 | 95 | 90 | 93 | 70 | 80 | 45 | 65 |
| 7     | Soil Type        | Red Lateritic Soil | Red Lateritic Soil | Red Lateritic Soil | Sandy loam + Red Lateritic Soil | Red + Black Cotton Soil | Partly Red Muram + Partly Black Cotton | Red Muram + Black Cotton | Red Muram + Black Cotton |
| 8     | Soil pH          | 7-8 | 7-8 | 7-8 | 6-7 | 6-7 | 7-8 | 7-8 | 7-8 |

Yield from the matured plantation on maturity

SARA also assists farmers in engaging expert contractors to harvest the trees that have completed the five-year harvesting cycle. The first rotation crop of 2006, 2007, 2008, 2009, 2010 and 2011 has been harvested and farmers were paid for their pulpwood. Further harvesting of 2012 plantation is in progress. The actual harvesting, however, is carried out by employing local residents to promote employments in the neighbourhood so that local communities who are in need can improve their living standards. This way, contract farming also provides employments to the whole farming and local communities (Figure 2). Yield from the plantation varies from site to site.
to site having varied climatic conditions. Plantation showed better results in terms of yield in area having high rainfall where the rain was recorded 2000-2500mm whereas yield affected where the rainfall was very low i.e. 500-650mm. In some of the area exceptionally high yield in MT from few locations fall in high rainfall. Average yield from the plantation recorded from 25-30 MT in one acre.

Figure 2 Field plantation of various eucalyptus clones.

Returns to farmers from plantation

Farmers are being paid directly for the amount against the pulpwod received from his field on actual basis. Being a facilitator SARA also being paid felicitation charges for the handing of pulpwod from farmer’s field to Company. Yield from the plantation after 5 years showed better. Except those area where the rain fall was very low i.e. 500-750 mm as compared to high rain fall areas where better yield obtained. Since farmers were not invested a single penny on the land the payable amount given to him accordingly by calculating the expenditures on plantations and its manintence. Farmer’s outstanding returns from his crop without investing any amount also it would improve the health of soil. Further looking to the return from the first crop farmers offered the plantation for second rotation crop which again would be beneficial for both farmers and SARA-WCPM as a win-win situation as farmer will be getting the same return from coppice crop with early maturity period of 4 years. This would also helpful for Industry to secure raw material in a sustainable manner with the same spirit in future with reduction in cost on new plantation and its maintenance.

Benefits to industry

Amidst continuous mismatch between demand and supply for wood, SARA’s commitment to ensure the steady supply of raw materials to West Coast Paper Mills Limited has resulted to over 0.26 million metric tons of pulpwod from SARA-affiliated plantations. To date, plantations under SARA’s projects have yielded an estimated 25-30 metric tons per acre after every five-year harvest. Further, overwhelming response of farmers towards second rotation plantations after harvesting of first crop showed a positive sign to industry to meet put its raw material demand in the future. Undertaking coppice crop, farmer as well industry would be benefitted with their assured income with the same return as in the first crop. SARA-WCPM have a great advantage by taking such coppice plantations of farmers as it would definitely reduce the cost towards establishment of new plantations and its maintenance with no risk of crop failure.

Role of SARA-WCPM for agro forestry promotion and development

In addition to providing quality planting materials of Eucalyptus, Subabul, Casuarina and Acacia to the farmer-partners for contract farming, SARA also makes available the same quality planting materials at a subsidized price to farmers who are practicing Agro forestry. Simultaneous with the distribution of planting materials is the provision of technical assistance to guide the farmers on how to improve yield. These initiatives are part of the Farm Forestry Program.

Under the program, SARA guides the farmers on how to intercrop Eucalyptus with agricultural crops like Maize, ground nut, Tomato and other crops (Figure 3). Eucalyptus is recognized as a commercial crop in India. It is also widely cultivated at a large-scale on farm lands and waste land by the farmers of Karnataka Maharashtra and Andhra Pradesh. Eucalyptus is widely used as source of raw material for pulp, boards and furniture and also used as fuel wood. Integrating Eucalyptus in the farm lands has proven to be a big source of income to the farmers. In support of agro forestry farm establishment, SARA provides fodder to the livestock such as Stylosanthes scabra and S. Hamata. These are also integrated in the agro forestry farms. In some areas, the farmers are earning extra income by intercropping maize, cashew, peanut and ginger.

Figure 3 Clonal Eucalyptus intercrop with ground nut

Contribution of SARA-WCPM for livelihood security and employment opportunities

The initiatives of SARA in contract farming, clonal propagation of pulpwod species, pulpwod harvesting and agro forestry implementation not only provide numerous benefits to the paper industry but also to the farmer and his family. Overall, these initiatives help conserve and enrich our natural resources thereby reducing the pressure to source wood from natural forests. At the same time, saline lands are rehabilitated, soil erosion is reduced and carbon is effectively sequestered from the atmosphere. Promoting use of genuine, genetically improved, truthfully labelled and certified planting stock and strengthening of technical extension services including use of electronic as well as print media for mass communication are the foremost requirements for real progress.

Local employments providing employment opportunities through their plantation and harvesting operation and the same will remain continue to thrive where the plantations are located. About 324 person-days per hectare per year are spent on land development, transplanting, and plantation maintenance, while 460 person-days per hectare per year are spent on harvesting, debarking and loading. Long-term income to the land owners is also secured with SARA’s contract farming project.
Government policies for promotion of agro forestry

India is the first nation in the world to adopt a comprehensive agro forestry policy when it launched the National Agro forestry Policy (NAP) at the World Agro forestry Congress held in Delhi in February 2014. The National Agro forestry Policy addresses the problems faced by the agro forestry sector including adverse policies, weak markets and a dearth of institutional finance. National Agro forestry Policy-2014 can serve better to promote Agro forestry in the country and it would encourage farm communities for their interest in Agriculture and as well in forestry. This is an outstanding attempt of Ministry of Agriculture, Government of India to strengthened farm communities the government of India. Further to this NAP-2014 aims to promote value chain, climate resilient technology development and pave way for region-based marketing linkages in agro forestry. The Policy also suggests massive extension programmes in order to broadcast the outcomes of intensive Rand D activities in the field of Agro forestry. National Agro forestry Policy should be implemented whole heartedly by central and state governments with allocation of adequate budgetary support and human resources (Figure 4).

Figure 4 Harvesting of plantation by local labours

Conclusion

Agro forestry systems due to diverse options and products provide opportunities for employment generation in rural areas. Increased supply of wood in the market has triggered a substantial increase in the number of small-scale industries dealing with wood and wood based products in the near past. Such industries have promoted agro forestry through major plantations initiatives and contributed significantly to increasing area under farm forestry. Recognizing agro forestry as a viable venture, many business corporations, limited companies such as ITC, WIMCO, West Coast Paper Mills Ltd., Hindustan Paper Mills Ltd., financial institutes such as IFFCO have entered into the business and initiated agro forestry activities in collaboration with farmers on a large scale. Have indicated the potential of agro forestry for rural development and employment generation to the tune of 5.763million human day’s yr-1 from Indian Himalayas alone. Apiculture, lac culture and sericulture area are also the option for augmenting farmer’s income.

To date, still big gap is there between pulpwood demand and supply. With the help of these initiatives this gap may be filled to a very good extent. Otherwise there will be an undue situation will arise in lack of raw material before paper industry and other wood based industry for their survival. We must keep in our mind that millions of people are directly and indirectly depends on these industries for their livelihood. Further it would not be out of place to mention here that without such actions we cannot imagine our self in a better and safe position.

Such plantation activities would be a major breakthrough to promote agro forestry in the area as it would provide lots of opportunity to farmers so that they can improve their livelihood. It has no doubt that such practises would be helpful to conserve the Natural resources which are under great pressure and threats. SARA-WCPM have the comparative advantage in cost effective production of wood because of congenial sub-tropical climate, land and water resources, enterprising and progressive farmers, adequate labour and talented scientists.

Central and State Government should also come forward to promote Agro forestry and plantations by launching good policies in the favours of farmers as well for industries who are the backbone of Indian economy. Farm grown trees should be fully exempted from regulatory regimes related to felling and timber transit permits and modern regulated markets should be established for ensuring transparent timber trade. National Agro forestry Policy-2014 should be implemented whole heartedly by central and state governments with allocation of adequate budgetary support and human resources. In last, we can achieve self sufficiency in fuel wood, timber and wood based products consistent with environmental amelioration if we harness full potential of agro forestry, convert part of our open degraded forests into technology based productive plantations in a time bound manner and improve growing stock and productivity of our natural forests on sustainable basis.
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