Indian Farming **68**(01): 33–34; January 2018

Agroforestry for doubling farmers' income:

a proven technology for trans-gangetic plains zone of India

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Undoubtedly, agroforestry is a sustainable option for enhancing farmer's income. The volatility in price of poplar wood negatively impacted the agroforestry farmers' income in the region. There is situation of market failure and urgent need for government intervention. The price stabilization of poplar wood is a necessary condition for enhancement of farmers' income. There is a urgent need of policy interactions between agroforestry and other related sectors such as price policy for wood, trade policy, credit policy, subsidy policy, energy policy and forest policy, which will substantially effect the development of agroforestry. A significant research effort is thus indispensable both for generating information and for developing an appropriate analytical framework. The gaps in understanding of how inter-sectoral linkages operate should be filled as soon as possible.

Key words: Agroforestry, Farmers' income, Trans-gagetic plains zone

THE farming system approach plays seminal role for enhancement of farmers' income through optimum allocation of scarce resources among various competetive, complemetary and supplementary farm enterprises. The agroforestry system is recognized as an important integrated farming practice since time imemorial to fulfil the necessity of food, fodder, fuelwood, fibre and timber along with aesthetic and environmental services. This system is supported by government due to its role in improvement in soil-health, nutrient cycling, carbon sequestration and better economic return to existing cropping systems with less use of natural resources. However, woody prenials were reduced gradually due to more demand of foodgrains on limited land resources in entire world in general and India in particular. The National Commission on Agriculture, 1976 has suggested for implementation of social forestry programme, which covered farm forestry, extension forestry, reforestation in degraded forests and recreation forestry.

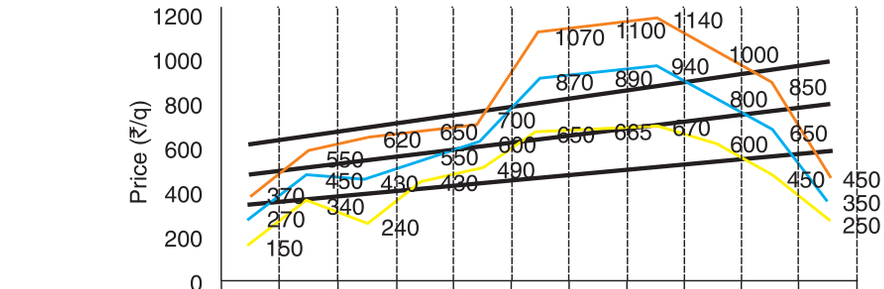
Plate 1. Plant saplings in nursery at Sadura block in Yamunanagar, Haryana

To promote agroforestry, various major policy initiatives such as 'National Agriculture Policy 2000', 'Planning Commission Task Force on Greening India 2001', 'National Bamboo Mission 2002', 'National Policy for Farmers 2007', 'Green India Mission 2010' and finally, a dedicated 'National Agroforestry Policy' was approved by Government of India in 2014. This policy has recommended for setting up of a Mission or Board to address development of agroforestry sector in an organized manner. The Sub-Mission on Agroforestry (SMAF) under 'National Mission on

Sustainable Agriculture' (NMSA) is an initiative to this end. The NMSA, one of the eight mission under 'National Action Plan on Climate Change' (NAPCC) seeks to address issues related to climate change through adaptation and mitigation strategies. The aim of the sub-mission is to expand the tree coverage on farmland in complementary with agricultural crops. Farmers allocate their resources in production of various commodities on the basis of signals they receive from markets. The allocation of area under crops is influenced by the perceived relative profitability of different crops. The growing of tree on farms for market seemed to farmers in many regions of India a more profitable option than field crops. However, in spite of relative higher profitability to farmers and several concerted efforts made by government, the adoption of agroforestry has not yet reached the expected desired level. In common parlance, two factors determine the adoption of agroforestry in any specific region, viz. relative profitability with other crops and price volatility of wood.

Relative profitability of agroforestry system in trans-gangetic plains zone of India

The specific feature of this region is comparatively high land productivity level and delicate water balance as exploitation of ground water has already surpassed 100% of utilizable balance. The yield level of rice and wheat crops experienced stagnancy and net profit showed diminishing trend and created many complications in agro-ecosystem in the region. In such a scenario, farmers of this region need to diversify rotation through appropriate and sustainable land use system to enhance their income. The fast growing exotic tree species like Poplar (*Populus deltoides*) and Eucalyptus (*Eucalyptus tereticornis*) have been introduced at farmers' field to get maximum income from a given land in a short period of time. These tree species proved as economically viable option for crop diversification in the region.



	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Poplar (Over)	370	550	620	650	700	1070	1100	1140	1000	850	450
Poplar (Under)	270	450	430	550	600	870	890	940	800	650	350
Poplar (Sokta)	150	340	240	430	490	650	665	670	600	450	250

Fig. 1. Trend in nominal price of poplar (2005-06 to 2015-16)

Table 1. Status of import and export of wood based products, India (2015-16).

(Value in ₹ Crore)

HS code	Commodity	Import	Share (%)	Export	Share (%)	Net import	Custom duty in 2005 (%)	Custom duty in 2015 (%)
44	Wood and articles of wood; wood charcoal	15502	34.6	2912	23.4	12590	12.5	5
45	Cork and articles of cork	35	0.1	13	0.1	22	12.5	5
46	Manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork	14	0.0	49	0.4	-35	12.5	5
47	Pulp of wood or of other fibrous cellulosic material; waste and scrap of paper or paperboard.	10699	23.9	74	0.6	10625	12.5	5
48	Paper and paperboard; articles of paper pulp, of paper or of paperboard.	16205	36.2	7494	60.2	8711	6.5	10
49	Printed bookds, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans	2288	5.1	1898	15.3	390	6.5	10
	Total	44743	100	12440	100	32303		

Source: Authors estimates based on data from office of the Directorate General of Foreign Trade (DGFT), Ministry of Commerce and Industry, Govt. of India

The comparative economic viability of poplar-based agroforestry system with rice-wheat system showed that agroforestry system is able to enhance farmers' income more than double in seven years and triple, if farmer get value of their carbon sequestered by agroforestry system. If we consider time value of money with discount @ 12%, the estimated net income as ₹ 166,145, 364,142 and 518,131 per ha respectively from rice-wheat system, poplar-based agroforestry without and with reward of carbon sequestration.

Price volatility of poplar and price crash since 2012-13

However, the past trend in volatility of wood price not yet proved as sustainable option to enhance the agroforestry farmers' income. The rosy picture of agroforestry farmers' income faded away due to various known and unknown factors. The price volatility in poplar impacted farmers' income and discourage the investment in new plantations. The nominal prices of the poplar have fallen to ₹ 250, 350 and 450/q for 'Sokta' (25 to 40 cm girth), Under (40 to 60 cm girth)

and Over (above 60 cm girth), respectively, from ₹ 670, 940 and 1,140 during last three years. The trend in nominal price of 'Over' category of poplar shows continuous upward movement during 2005-06 to 2012-13 and sharp declining afterward. The 'Under' and 'Sokta' category of poplar followed the same trend except declining trend in 2006-07 to 2007-08. The highest price of all category of poplar was recorded in 2012-13. The nominal price of the poplar decreased to one-third during last three years. The highest price of all category of poplar recorded in the year 2012-13 (Fig. 1).

Import of wood and wood-based products

Despite of sharpen price crash of wood in India since 2013-14, the quantity of net import of wood and wood-based products is increasing. This is an example of policy fatigue towards agroforestry farmers and discourage them for new plantations, resulted creation of gap in demand and supply especially raw materials for wood-based industries in future.

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SUMMARY

The Government of India has already planned to take many measures to increase farm income, stabilize production and, consequently, improve small farm productivity. Integrated farming system approach involving synergic blending of crops, horticulture, dairy, fisheries, poultry, etc. seems viable option to provide regular income and at site employment to small-land holder, decreasing cultivation cost through multiple use of resources and providing much needed resilience for predicted climate change scenario high-yielding varieties and hybrid seeds are very essential for a successful crop production and increasing the yield by 15 to 20% depending upon the crop and it can be further raised up to 45% with efficient management of other inputs. Micro-irrigation along with the nutrient application can be highly efficient and priority should be given to empower farmers with micro-irrigation. The government is aggressively promoting a new crop insurance (PMFBY) given increased challenges by farmers due to frequent climatic disturbances.

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