

Agri-Horticultural System for Household Livelihood - A Case Study

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ABSTRACT

Integration of fruit crops in croplands is referred to as agri-horticultural landuse system of Agroforestry. Research experiences at NRCAF Jhansi, indicated economic feasibility of agrihorti landuse system on marginal lands under rain fed conditions of Budelkhand regions. In order to test field applicability of agrihorti landuse system on farmer's field, one farmer namely Shri Tiju of village & post Karari, Jhansi, located 12 km away from Jhansi city was selected. Farmer planted Aonla, Ber, Guava, and Pomegranate on his field. As much, 40 plants of each fruit crop were planted in year 1993-94 in an area of 2.5 acre. Observations on impact of agrihorti land use and agri-horticulture system of agroforestry as source of household livelihood have recorded and presented in this case study. In the year 2003, on an average yield of groundnut and wheat was 1.00 and 2.40 tonnes/ha. Production obtained from Guava and Aonla was 748 and 415 kg/ha. The annual net income obtained by the farmer was Rs.11,715/ha. While prior to the adoption of agroforestry technologies, the farmer used to get net income of Rs. 3,400/ha. After ten years of adoption of agrihorticulture technology, Tiju started obtaining fuel wood, fodder, fruit, small timber and food grains from the same piece of the land, while before 1993-94, his wife used to walk 3 to 4 kilometer in the search of fuel wood collection. His standard of living increased considerably. He got better food and clothing, constructed a pucca house and well, cemented irrigation channels and purchased a moped bike. Recovered himself from the loans took from Bank, and from village landlord. Full time employment was provided to Tiju and his wife. He was very much regular in attending the extension activities such as Kisan Mela, Kisan Gosthi and Farmers' days organized by various government and non-government organizations at different places in district and in neighboring district. The farmer preferred for agrihorti landuse system over sole cropping. Aonla based agrihorti system is highly profitable and sustainable as aonla is a regular bearer and exerts comparatively less affect on associated crop and requires low management and inputs.

Key words: Agri-horticultural, Landuse, Livelihood and Household

Integration of fruit crops in croplands is referred to as agri-horticultural land use. Research experiences at NRCAF Jhansi, indicated economic feasibility of agrihorti landuse system on marginal lands under rainfed conditions of Budelkhand regions (Anon 1992). Aonla, ber, guava, citrus etc. were identified as promising fruit crop in this region, fruit crops are first preference of farmers under agroforestry system on account of short gestation period, regular income, risk cover and aesthetic value (Anon, 2000). Agri-horticulture land use is an important component of agroforestry. Agroforestry is a land use that involves deliberate retention, introduction, or mixture of trees or other woody perennials in crop/animal production fields to benefit from the resultant ecological and economic interactions (Nair, 1992). About 50 per cent of the total agricultural land in the country, is estimated to be marginal land and could be more productively used by revegetating with suitable species of trees and grasses in association with crops. Dwivedi

(2002) stated that status of agroforestry extension perspectives in agroforestry research in India is determined by the very character of the problems to be solved by the land-use technologies. In this context Dwivedi and Shukla (1998), stated that Government regulations on felling of trees from agroforestry lands and transport of agroforestry produce has to be carefully deregulated to benefit various strata of farming community. The theoretical perspectives of the contributions that social sciences can make to agroforestry have been superbly reviewed by Burch (1992). The success of agroforestry largely depends upon how it is accepted by our clientele - the farmers. Considering the newness of the concept it was thought worthwhile to probe into the impact of agri-horti land use in Bundelkhand region of central India.

Realising the importance of an efficient development organization, the Report of Agricultural Administration way back in 1958 observed that the problem of increasing agricultural production is more of

management problem than a technical one. This observation holds good even today as recent studies have shown that problems of agricultural development are mainly related to inefficient management practices (Vijayaragavan, 1994). Narsimha and Rao (1982) had also observed that trained women have better knowledge of home science practices in comparison to untrained women.

Bundelkhand region is characterized by undulating topography with sparse vegetal cover. Soils of the region are grouped as Ranker and Parwa (red soil group) and Mar and Kaber (Black soil group). Red soils are located at higher elevations. They are coarse textured, low in organic carbon and poor in moisture retention. Black soils are generally found at lower elevation, fine textured medium in organic carbon and highly moisture retentive. The region experience sub-tropical climate with annual rainfall ranging from 750-1100 mm, and potential evaporation 1400-1700mm. The rural economy in the region is primarily agriculture based and dairying is main subsidiary occupation. Irrigation as well as drinking water comes from porched water. As much, the region suffers from water deficit for most part of the year, In general ground water is deep shallow dug wells are common which fetch water at the most 5-6 hours at a stretch up to February, there afterwards 1-2 hours up to onset of monsoon if water is lifted with 5 HP motor. The socio-economic condition of the farmers is poor due to scarcity of irrigation water, low cropping intensity and crop yields.

The majority of the farmers in the region belong to marginal and small holding. The region is by and large single cropped during rabi and wheat is dominant crop. During kharif oil seeds and pulses are grown large herd of low productive animals is commonly found in the region. The animals are reared in let loose open grazing system. Because of this, plants protection from stray cattle is biggest challenge confronting horticulture development in the region. Poor socio-economic condition of farmers in the region are evident from wide scale use of bullock carts.

METHODOLOGY

In order to test field applicability of agrihorti landuse system on farmers field, one farmer namely Shri Tijju of village & post Karari, Jhansi, located 12 km away from Jhansi city on Jhansi –Gwalior road was selected. The farmer was brought to the research centre and exposed to agrihorticultural activities at the centre. After due motivation, farmer agreed to plant aonla, ber, guava, citrus and pomegranate on their field. As much, 40 plants of each fruit crop were planted in year 1993 in an area of 5.0 acre on farmer's field. The fruit plants were watered during summer only. Crops like ground nut in

kharif and wheat in rabi were sown through out the period. The farmer was in regular touch with the centre for getting technical advice from time to time. Observations on the farmer's field recorded and presented in this study. Data pertaining to seed germination, number of litters per plant were recorded in all four directions under tree canopy and average crop yield of wheat was recorded on the basis of sample plot keeping tree in centre. For calculating returns prevailing market rate of crop (grain + straw) and fruits in 2002 were taken into account.

Pertaining to plant survival, growth of plants, yield from fruit tree and associated crops and farmers perception regarding agrihorti landuse have been recorded and are based on actual survival of trees, Farmers opinion was recorded based on personal interview.

The study site:

Soil : Soil of the study site is parwa (red soil group) with multidirectional, complex mild slope the soil is medium deep, friable good for agriculture. In general these soils are low to medium in nitrogen content, low in phosphorus and high in K content. Organic carbon is around 0.3%.

Irrigation

Facility: The farmers own a shallow dug well on his holding which runs for 5-6 hours in a day during early rabi season when lifted by 5 HP motor by January and it runs for about 2-3 hours/day during summers is runs for about 1 hour at a stretch and meets only drinking water requirements of inhabitants.

The farmer

The farmer Sri Tijju is totally dependent upon agriculture for his livelihood. Due to small holding, partial irrigation facility and low yields he leads a measurable life but now he leads a respectable life and does not work as casual labour on others field. Now he owns a pucca house of two rooms, a Luna and motor pump

RESULTS AND DISCUSSIONS

Application and Motivation : The farmer's motivation to adopt agrihorticulture landuse is evident from critical perusal of data in Table-1. Farmer has put his total holding of 5 Acres under agrihorti systems. NRCAF assisted him in developing 2 Acre area under agrihorti system while he managed on his own to develop remaining 3 Acre area under the said system. In a period of 9 years, maximum plant survival is registered by ber (62.5%) followed by aonla (55%) & guava (50%) Minimum survival is registered in case of citrus spp. (20%) although, pomegranate recorded 50% survival upto year 2001 but the same were uprooted due to low returns on account of high bird damage, theft, poor quality of fruits low yields. Guava was planted in

maximum area (2.5 Acre) which constitute 50 % of his holding. Citrus species (lime and lemon) were planted in about 1.1 Acre land but poor survival due to harsh climate conditions appears to be prohibitive. It appears that farmer was initially more inclined to grow citrus species and guava as they are common fruits crops and hesitated to grow other fruits crops.

Table 1: Fruit Tree Species and Number of Plants

Spacing	Tree Species	No.	Area (Acre)	Survival (%)	Source
8 x 8 m	Aola	40	0.64	55 (22)	NRCAF
8 x 5 m	Guava	250	2.50	50(125)	Self / NRCAF
6 x 6 m	Ber	40	0.36	62.5(25)	NRCAF
6 x 6 m	Pomegranate	40	0.36	-uprooted (in 2001)	NRCAF
7 x 5 m	Citrus (Lemon)	125	1.10	20 (25)	Self / NRCAF
	Kinnow	5	0.02	20 (1)	Self
	Mandarin	5	0.02	40 (2)	Self

Growth of fruit trees : The data recorded on growth of fruit trees in crop lands is presented in Table 2. It is obvious from the data that aonla plants recorded maximum tree height (5.18 m) and collar diameter 17.5 cm followed by guava plants.

Table 2: Growth of plants under agroforestry system after 9 year of planting

Tree Species	Height (m)	C.D. (cm)	Canopy spread
Aonla	5.18	17.5	4.56
Guava	3.27	8.8	2.27
Ber	1.33	11.1	1.72
Citrus (Lemon)	3.99	12.0	3.50

Since, ber is regularly pruned for inducing new flush, tree height is disturbed. However, collar diameter of ber plants, indicated slow growth of ber, Lime and lemon fruits recorded 3.99 m plant height, 12.0 cm collar diameter and produced only 3.50 cm average canopy cover. Aonla plant though produce greater canopy cover but small leaves and deciduous nature of plants results in greater sunlight penetration underneath the canopy. Varying growth of plants is obviously genetic

feature of individual species. Under Agroforestry system trees with wider and sparser canopy are preferred as they are easy to manage / handle.

Germination and Crop Yield: Data on crop yield and attributes of wheat crop is recorded and presented in Table 3. It is obvious from the data that germination of wheat is influenced by presence of trees. Maximum 80% germination was recorded under aonla plantation without any post sowing irrigation followed by citrus (60%). Minimum 30% wheat germination was recorded under guava and ber plantation. However, cent per cent seed germination was obtained with post sowing irrigation under all plantations. This is obviously due to shade effect of trees, on crop and competition for soil moisture between crop and tree roots. Its worthwhile to mention here that tree canopy is in full swing at the time of wheat sowing and crops like ber, guava and citrus are in their reproductive phase hence competition for moisture and nutrients is very high between tree and crop component,. Since, aonla canopy is appreciably reduced at the time of wheat sowing, as such, due to low competition, seed germination under aonla is better as compared to other fruit crops in case no post sowing irrigation is provided to the crop. In case of citrus low canopy cover resulted in fair germination of wheat crop. Similarly, Number of tillers per plant ranged between 2.5 to 1.4 under various fruit trees as against sole crop (2.5 tillers/plant). It is worthwhile to mention here that due to coarse soil texture and high evapotranspiration, resulting in quick moisture depletion, tillering is poor in this region. This is why farmers use high seed rate (200-240 kg/ha) in wheat. Maximum number (2.1 /plant) of tillers per plant were recorded under citrus canopy followed by aonla and ber (1.8 and 1.7 / plant) respectively. Minimum number of tillers were recorded under guava canopy as it had dense canopy full of large leaves. Due to heavy pruning ber canopy was drastically reduced. Accordingly, crop yield was maximum (3245 kg /ha) under citrus plantation followed by aonla (3005 kg /ha). Minimum crop yield was recorded under guava plantation. This may be attributed to reduced tillering on account of shade effect.

Table 3 : Wheat crop yield (t/ ha) under different fruit trees after 9 years of plantation in (2002)

Tree species	Germination		No. of tillers Per plant	Crop yield (kg /ha)
	with post sowing Irrigation(%)	without post sowing Irrigation(%)		
Aonla	100	80	1.8	3005
Guavae	100	30	1.4	2875
Ber	100	30	1.7	2980
Citrus	100	60	2.1	3245
Without tree	100	100	2.5	3800

Table 4 (a) : Returns from fruit based Agroforestry system on farmers field

Species	No. of trees per ha	Fruits yield kg/ha	Returns from fruits (Rs.)	Crop yields (kg/ha)		Returns from crop (Rs.)	Total returns
				Rabi	Kharif		
Aonla	86	6450	64500.00	3005	902	20507	95007.00
Ber	174	3915	15660.00	2980	975	31219	46879.00
Guava	125	5625	22500.00	2875	925	29931	52431.00
Citrus	57	2565	25650.00	3245	1015	33435	59085.00
Sole crop	-	-	-	3800	1278	40226	40226.00

Table 4 (b): Returns from various components under agroforestry systems.

Species	Return from fruit (%)	Return from Crop (%)	Reduction in crop return	Total return
Aonla	67.9	32.1	24.2	95007.00 (136.2)
Ber	37.4	66.6	22.4	46879.00 (16.5)
Guava	42.9	57.1	25.6	52431.00 (30.3)
Citrus	43.4	56.6	16.9	59085.00 (46.9)
Sole crop	-	100	-	40226.00

(Figures in parenthesis indicate per cent increase in total returns under agrihorti system over sole crop.)

Returns from the System : In an attempt to work-out returns from agrihorticultural system it was estimated that total return from the system increased by 16.5 – 136.2% than sole cropping under different fruit crops. Aonla based agrihorti system produced maximum 95007.00 Rs./ha return which was 136.2% higher than sole cropping Ber based agrihorti system yielded minimum 16.5 % increase than sole cropping accruing 46879.00 Rs./ha. Sole cropping yielded 40,226.00 Rs./ha. This, it is amply clear that agrihorti system is profitable than sole cropping in 10th year of its plantation. Further perusal of data in Table-4(a) and 4 (b) indicated that in case of aonla major chunk of returns (67.9%) comes from fruits while in case of other fruit species it ranged between 37.4-43.4%. Consequently share of crop to total returns from the system was worked out to be 32.5% for aonla based agrihorti and 56.6 to 66.6% for other fruit based agrihorti systems. The reduction in crop yields under various systems was 16.9 to 25.6% as compared to sole crop maximum reduction was observed under guava (25.6%) a minimum under citrus based agrihorti system.

Living Standard Increased : After nine years of adoption of above technology, Tijju started obtaining fuel wood, fodder, fruit, small timber and food grains from the same peice of the land, while before 1993-94, his wife used to walk 2 to 3 kilometer in the search of fuel wood collection. His standard of living increased considerably. He got better food and clothing, constructed a pucca house (cemented house) of two rooms and pucca well (cemented well), cemented irrigation channels and purchased a moped bike. Recovered himself from the loans took from Regional Rural Bank (RRB), Jhansi and from village land lord for daughter's marriage, purchase of pump set for irrigation and for digging the well. Full time employment

was provided to Tijju and his wife. He did not meet the social resistance against the adoption of the innovation. The social participation of Tijju and his family was drastically reduced as they did not get enough time for visiting any of their relatives. But he was very much regular in attending the extension activities such as Kisan Mela (Farmers' fair), Kisan Gosthi (Farmers' conference) and Farmers' days organized by various government and non-government organizations at different places in district and in neighboring district. He was invited a number of times by many organizations to express his views about agroforestry.

Thus, Tijju got name and fame as his name and photograph appeared as successful farmer many times in news bulletins, newsletters, news papers, web sites and reports etc. He is being recognized by the village people in all kinds of social functions organised in the village. In the last two years so many visitors which included farmers and farm women from different villages, Agricultural Minister GOI, Director General (DG) Deputy Director General (DDG) and Assistant Director General (ADG) of Indian Council of Agricultural Research (ICAR), Chairman and members of QRT and RAC, scientists of ICAR institutes and state agricultural universities, foreign visitors, government and non-government organisations personnel and media people from New Delhi and Jhansi visited his field and received relevant information. After visiting the field, a number of farmers from the same village and distant villages started agroforestry practices at their fields. In his community Tijju is being referred to as rich man now by villagers. This type of extension efforts are needed to make agroforestry system as an eco-friendly alternative for sustainable rural livelihood (food security) and for sustainable land management to uplift the small and marginal farmers and rural poor, so that they can join the main stream of the society.

Farmer's Opinion on Agrihorti Land use: The farmer's opinions are presented in Table-5. The farmer indicated his preference for agrihorti landuse system over sole cropping. He preferred aonla as associate tree species in crop lands on account of its sparse canopy least bird damage, least theft of fruits, no crop rampage to fruit harvesting as fruits are harvested in November i.e. before sowing of wheat crop, lesser or medium shade effect on crops, high returns and very high market demand for fruits.

Table 5: Farmers opinion on fruit based agrihorti landuse system

Particulars	Aonla	Ber	Guava	Citrus
Bird damage	-	-	-	-
Theft	-	-	-	-
Crop rampage due to fruit harvesting	-	-	-	-
Watch & ward	Medium	High	High	Low
Shade effect on crops.	Local	Local	Local	Local
Marketing Demand in local market	Very high	Low	High	High
Time of fruit harvesting	Nov.	Feb	Jan.	Jan.

The farmer indicated that in near future he is planning to remove his ber and guava plants and replace them by planting aonla. He is not ready to fill the gaps in citrus block rather he wish to plant aonla in those gaps.

CONCLUSION

Aonla based agrihorti system is in great demands. It is highly profitable and sustainable as aonla is a regular bearer and exerts comparatively less affect on associated crop and requires low management and inputs. Integration of fruit crops in croplands is referred to as agri-horticultural landuse

system of Agroforestry. Research experiences at NRCAF Jhansi, indicated economic feasibility of agrihorti landuse system on marginal lands under rain fed conditions of Budelkhand regions. In order to test field applicability of agrihorti landuse system on farmer's field, one farmer namely Shri Tijju of village & post Karari, Jhansi, located 12 km away from Jhansi city was selected. Farmer planted Aonla, Ber, Guava, and Pomegranate on his field. As much, 40 plants of each fruit crop were planted in year 1993-94 in an area of 2.5 acre. Observations on impact of agrihorti land use and agri-horticulture system of agroforestry as source of household livelihood have recorded and presented in this case study. In the year 2003, on an average yield of groundnut and wheat was 1.00 and 2.40 tonnes/ha. Production obtained from Guava and Aonla was 748 and 415 kg/ha. The annual net income obtained by the farmer was Rs.11, 715/ha. While prior to the adoption of agroforestry technologies, the farmer used to get net income of Rs. 3,400/ha. After ten years of adoption of agrihorticulture technology, Tijju started obtaining fuel wood, fodder, fruit, small timber and food grains from the same piece of the land, while before 1993-94, his wife used to walk 3 to 4 kilometer in the search of fuel wood collection. His standard of living increased considerably. He got better food and clothing, constructed a pucca house and well, cemented irrigation channels and purchased a moped bike. Recovered himself from the loans took from Bank, and from village landlord. Full time employment was provided to Tijju and his wife. He was very much regular in attending the extension activities such as Kisan Mela, Kisan Gosthi and Farmers' days organized by various government and non-government organizations at different places in district and in neighboring district. The farmer preferred for agrihorti landuse system over sole cropping. Aonla based agrihorti system is highly profitable and sustainable as aonla is a regular bearer and exerts comparatively less affect on associated crop and requires low management and inputs.

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