Int.J.Curr.Microbiol.App.Sci (2020) *9*(2): 1899-1904

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 9 Number 2 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.902.217

Integrated Study of Current Land use Pattern and Possibility of Agroforestry Model in Nalanda District of Bihar

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Keywords

Agroforestry, Sustainable, Land use, Intercropping, Mango, Mushroom

Article Info

Accepted:
15 January 2020
Available Online:
10 February 2020

A B S T R A C T

Land is a non-renewable natural resource and centre to all crop production systems. Due to increasing population, per capita land availability decreases, but increasing aspirations of the people make it important to get greater returns from land per unit of land. To achieve the maximum and sustainable return, agroforestry provides security to improve the economic status and livelihood with traditional agriculture. To study the present land use scenario in Nalanda district of Bihar, a field study was conducted through questionnaire survey among 140 families in 75 percent blocks of the district. The result showed that agriculture is the main source of income; the farmers follow conventional system of agriculture. In comparison with traditional agricultural crops *viz.* Wheat (*Triticum aestivum*) (Rs. 4022.34 /acre) and Rice (*Oryza sativa*) (Rs. 3750.15 /acre), Mustard (*Brassica nigra)* and Chick pea *(Cicer arietinum)*, it was found that Mustard and Chickpea were more profitable to the farmers with the returns of Rs. 15976.28 / acre and Rs. 9834.12/acre, respectively. The most preferable forestry species were bamboo species, *Tectona grandis* (Teak), *Dalbergia sissoo*(Sissoo), *Melia azedarach* (Bakaina) and *Borassus flabellifer* (Wine palm) and horticultural species were *Citrus species* (Chakotra), *Mangifera indica* (Mango), *Emblica officinalis* (Amla) and *Musa paradisiaca* (Banana). Villagers prefer plantation of horticultural trees (12.65 % area) in comparison with forestry trees (6.35 % area). As per the survey, 42.14% of the respondents believe that trees reduce yield of agriculture crop. Other reasons behind less popularity of agroforestry include lack of market (33.57%), small land holding (30.71%), lack of awareness (25.71%), late returns (23.57%) and restrictions on felling and transport of trees (7.85%). In this region Mango cultivation is being done preferably by the farmers with return of Rs. 12,504.78 /acre /year. The return of the farmers may be increased with shade preferred other intercrops like mushroom cultivation. The farmers can earn additional income of about Rs. 4, 60, 650 /acre /year, if they use intercrop mushroom under the shade of mango or other horticultural / forestry crops. Hence, Mushroom cultivation under mango orchard/ other forestry spp. was proposed as a new agroforestry model for additional source income of the farmers. However, some study should be conducted to test social acceptability, ecological feasibility and economic viability of this model.

Introduction

Land is a non-renewable natural resource and centre to all crop production systems. Due to increasing population, per capita land availability decreases, but increasing aspirations of the people make it important to get greater returns from land per unit of land. The term land use relates to the human activities associated with specific piece of land, factors present on the earth surface. Kumar, (1996) defined land use as, the surface utilization of all developed and vacant land on a specific point, at a given time and

space. In short, land use is the use made of the land by man, as surveyed and mapped in series of recognized categories. The land use is a dynamic process. It changes over time due to a number of factors, including increasing population, changes in cropping system and technology.

Agroforestry is collective land use system where woody perennials and other crops and animals are deliberately use the same unit of land in temporal and spatial arrangement for optimum crop and land productivity (Pankaj and Panwar, 2007). The agroforestry provides the maximum and sustainable return with security to improve the economic status and livelihood with traditional agriculture.

Materials and Methods

Study area

Nalanda district is located within the Mid-Ganga basin, in the southern margin of the Gangetic plans with the Chhota Nagpur Gneissic Complex (CGC). It lies between latitude $24^0$57' 57.78" and 25^0 27' 39.636" N and longitude $85^0$9' 54.9" and 85^0 55' 27.084" E and covers an area of about 2367 km^2 and represents mainly flat alluvium terrain except Rajgir hills in the south. The average annual rainfall of district was 1002.2 mm, about 92.55% of the rainfall received during June to October by south-west monsoon.

Methodology

All the necessary data for the study gathered through household questionnaire survey conducted from February to March 2017. The data used for this study obtained from both primary and secondary sources. Out of twenty blocks in the district, 75 per cent blocks (i.e. fifteen blocks in total) were randomly selected distributed throughout the district.

In each block, 5 to 6 villages were taken up for detailed study. In each village, minimum five families were selected at random and the number of respondents was increased in proportion of population and area of village.

At the stage of survey, informal group contacts and personal i.e. door-to-door contacts and transect walks across each village were undertaken to understand the general agricultural and socio-economic situation of the population of study area. The data was collected in locally used unit Bigha.

Some progressive farmers in the district were found practising more profitable land use practices than the general farming practices. The family-wise data was compiled. Data analysis was carried out with the help of using MS Excel software. Landless families were ignored during computation of cost and returns from different land uses per family.

Results and Discussion

The result showed that the average land holding per family for a household was 2.19 acre, which ranged from 0 to 22.08 acre and land per capita of Nalanda district was 0.30 acre that ranges from 0.040 to 3.68 acre. The agriculture is the main source of income; the farmers follow conventional system of agriculture.

In comparison with traditional agricultural crops *viz.* Wheat (*Triticum aestivum*) (Rs. 4022.34 /acre) and Rice (*Oryza sativa*) (Rs. 3750.15 /acre) preferred by more than 80 % of the families (Table 1), Mustard (*Brassica nigra)* and Chickpea *(Cicer arietinum),* was found more profitable to the farmers with the returns of Rs. 15976.28 / acre and Rs. 9834.12/acre, respectively {(Chart 1), excluding the hidden costs} preferred by only 16.4 % & 32.1 % of families, respectively.

Table.1 Area coverage by different crops

Crops	Scientific name	Area (Acre)	% of total area	Families preferences (%)
Wheat	*Triticum aestivum*	106.02	28.99	82.1
Rice	*Oryza sativa*	130.52	35.70	88.5
Chickpea	*Cicer arietinum*	42.36	11.58	32.1
Linseed	*Linum usitatissimum*	26.28	7.18	36.4
Coriander	*Coriandrum sativum*	23.09	6.31	12.1
Mustard	*Brassica nigra*	22.77	6.22	16.4
Groundnut	*Arachis hypogaea*	1.60	0.43	0.71
Maize	*Zea mays*	0.80	0.21	0.71
Garlic	*Allium sativum*	0.40	0.1	2.80
Fenugreek	*Trigonella foenum*	1.80	0.49	20.71
Cabbage	*Brassica oleracea*	0.40	0.1	0.71
Pea	*Pisum sativum*	0.51	2.6	10.70

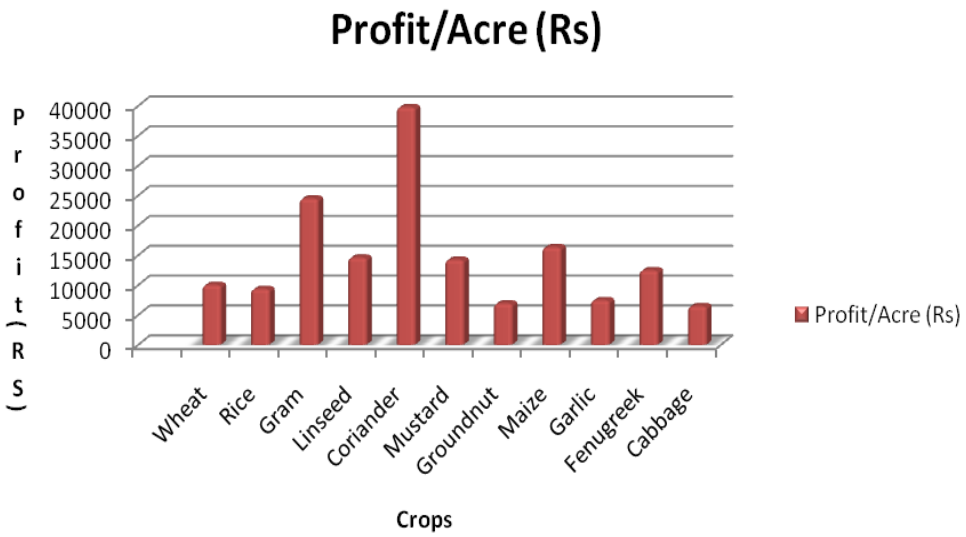

Chart.1 Profit/ acre from agricultural crops

Table.2 Average production per Acre

Crops	Total production (kg)	Cropped area(Acre)	Average production/Acre
Triticum aestivum	209900	106.02	1979.73
Oryza sativa	258359	130.52	1979.73
Cicer arietinum	34180	42.36	806.71
Linum usitatissimum	23380	26.28	889.47
Coriandrum sativum	21420	23.09	927.57
Brassica nigra	18030	22.77	791.79
Arachis hypogaea	450	1.80	249.00
Zea mays	2000	1.60	1245.00
Allium sativum	1200	0.80	1494.00
Trigonella foenum	80	0.40	199.20
Brassica oleracea	300	0.40	747.00
Pisum sativum	8630	9.51	906.69

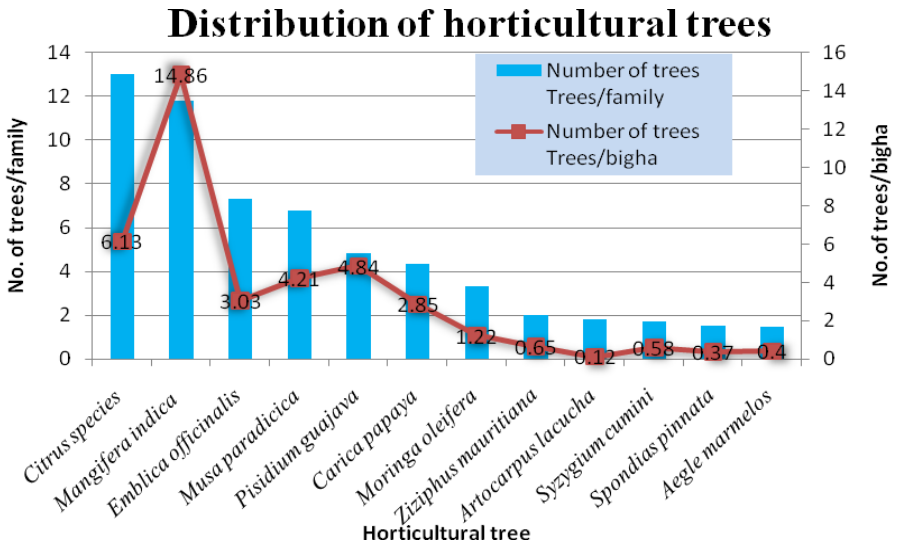

Chart.2 Horticultural species in Nalanda, Bihar

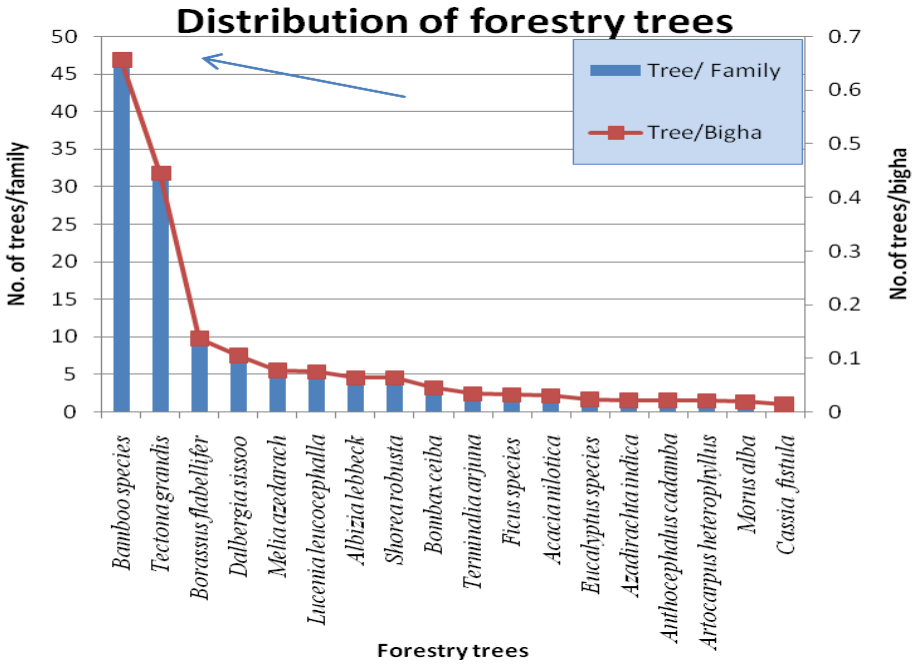

Chart.3 Forestry in Nalanda, Bihar

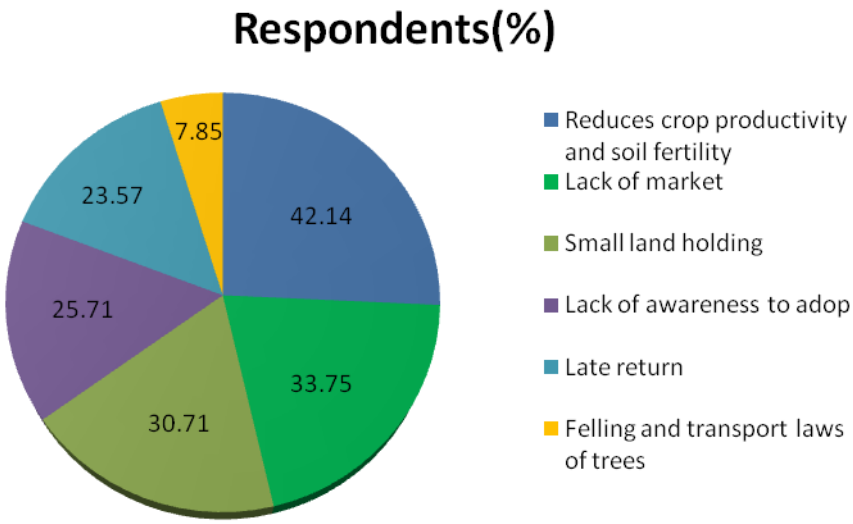

Chart.4 Constraints for adopting agroforestry

The most preferable forestry species were bamboo species, *Tectona grandis* (Teak), *Dalbergia sissoo* (Sissoo), *Melia azedarach* (Bakaina) and *Borassus flabellifer* (Wine palm) (Chart 2) and horticultural species were *Citrus species* (Chakotra), *Mangifera indica* (Mango), *Emblica officinalis* (Amla) and *Musa paradisiaca* (Banana) (Chart 3). Villagers prefer plantation of horticultural trees (12.65 % area) in comparison with forestry trees (6.35 % area). As per the survey, 42.14% of the respondents believe that trees reduce yield of agriculture crop. Other reasons behind less popularity of agroforestry include lack of market (33.57%), small land holding (30.71%), lack of

awareness (25.71%), late returns (23.57%) and restrictions on felling and transport of trees (7.85%) (Chart4). In this region Mango and mushroom cultivation preferably doing by the farmers with return of Rs. 12,504.78 /acre /year and Rs. 460,650 /acre /year respectively. Mushroom required humidity and shade for their growth. Hence, Mushroom cultivation under mango orchard/ other forestry spp. was proposed as a new agroforestry model for additional source income of the farmers. Medicinal plants like *Rauwolfia serpentine* (Sarpagandha), *Piper longum* (Long pepper), *Urginea indica* (kanda) can be cultivated on these lands depending upon the age of the orchard, plant habit of the species and adjustment under the canopy microclimate. However, some study should be conducted to test social acceptability, ecological feasibility and economic viability of this model.

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How to cite this article:

Arpana Pandey, Prem Ranjan Sinha and Dinesh Kumar. 2020. Integrated Study of Current Land use Pattern and Possibility of Agroforestry Model in Nalanda District of Bihar. *Int.J.Curr.Microbiol.App.Sci.* 9(02): 1899-1904. doi: https://doi.org/10.20546/ijcmas.2020.902.217