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

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Abstract

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.

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

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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
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°57’ 57.78” and 25° 27’ 39.636” N
and longitude 85°9’ 54.9” and 85° 55’
27.084” E and covers an area of about 2367
km² 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                    |

![Profit/Acre (Rs)](chart1.png)

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
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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