Analysis of Socio-Economic Characteristics of Potato Farmers and Trend, Growth Rate of Area, Production of Potato in Nalanda District of Bihar, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

This paper investigates the socio–economic situation of potato farmers and the Growth Rate of Area, Production of Potato in Nalanda District of Bihar, India. Nalanda district was purposively selected because this district has a maximum area under potato cultivation. The required data were collected from 150 randomly selected farmers for the year 2021-22. The average size of land holding and the family size was 1.51 ha. and 5.7 respectively in the study area. Potato farmers are categorized into three different age groups i.e., Below 30 years, 30-50 years and Above 50 years. The majority of farmers (40%) fall into 30-50 age group. Medium farmers are the highest annual income as compared to small and marginal farmers. The result shows that the annual income of

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farmers consists of farm and non-farm sources i.e., 40% and 60% respectively. The trend analysis shows that the growth rate in area and production was negative during periods I (2007–08 to 2011–12) and II (2017–18 to 2021–22), while the growth rate of area and production was positive during periods III (2012–13 to 2016–17). There was a positive trend with annual growth rates of 2.85 percent for area, 0.86 percent for production during period III and 8.82 percent and 2.19 percent for yield during the period of 2007-08 to 2017-18.

1. INTRODUCTION

One of the most important vegetable crops worldwide is the potato (*Solanum tuberosum* L.). It is a significant crop that is grown in the Indian plains during the winter, although even at high fertility levels, productivity varies greatly between regions, between areas within a region, and with cultural practices [1,2]. It ranks fifth in production, yielding about 309.5 million tonnes, behind rice, wheat, and maize [3-5]. it covers about 21.22 million hectares. it is a crop from a temperature area. It has adapted to a variety of climatic conditions. Potatoes need a temperature of 18 to 20 ^{0}c to grow. The PH range of the soil in which the potato is grown is 5.2 to 6.4. In Bihar, potatoes are farmed on 3232.5 hectares, producing 6441.6 tonnes annually with productivity of 20.69 ha in the 2018–19 growing season. All 38 of Bihar's districts cultivate potatoes, but Nalanda is the state's leading producer (81 percent) of the area is made up of Patna, Saran, Samastipur, Gopalganj, Vaishali, East and West Champaran, Muzaffarpur, and Siwan with regard to output [6-9]. With an annual yield of 5.74 million metric tonnes and productivity of 17.78 metric tonnes per hectare, potatoes are produced on 0.32 million hectares in Bihar.

1.1 Research Objectives

1. To study the socio-economic profile of potato growers in the study area.
2. To analyze the trend in Area, Production, and Productivity of potato in the study area.

2. METHODOLOGY

2.1 Sampling Design

Samples were selected by using a multi-stage sampling technique for the selection of districts, blocks, villages, and potato growers (respondents).

2.2 Selection of the Study Area

There are 38 districts in Bihar, and Nalanda district was purposefully chosen as it has the maximum area and production of potato. The Nalanda district has 20 blocks, out of these blocks, Bihar Sharif and Noor Sharai were selected purposively based on potato cultivation. A list of all the villages in each selected block was obtained from the block development office. Bihar Sharif and Noor Sharai comprise 75 Villages and 61 villages respectively. Out of which 6 percent of villages in Bihar Sharif Block and 8 percent of villages in Noor Sharai Block were selected randomly. A complete list of the potato growers in each selected village was obtained from the village Head (Sarpanch/Gram Pradhan). 10 percent of farmers were selected from each village randomly and categorized into three farm-size groups based on the area under cultivation.

2.3 Data Collection

Primary data was collected from 150 randomly chosen farmers during the years of 2021 -2022 through personal interviews in order to address the objectives of the study. The data regarding cropping patterns, land utilizations, area, production and productivity of potato, and general information on districts were collected from Bihar Agriculture Department and the District Statistical Department.

2.4 Statistical analysis

Simple statistical techniques like average, percentage, and Analysis of variance (ANOVA) were used to analyze the data.

3. ANALYTICAL PROCEDURE

The following statistical tools were used in the analysis of data and interpretation of results (socio-economic profile).

Table 1. Sampling framework

State	District	Blocks	No. of selected Villages	No. of selected farmers
			Asaanagar	16
			Aalahdia	14
		Bihar Sharif	Amdaha	14
			Braiapur	13
Bihar	**Nalanda**		Sodhi	15
			Dohia	16
			Ajaipur	12
		Noor Sharai	Andhana	15
			Chandasi	17
			Sordarbigha	18
Total sample size				**150**

3.1 Arithmetic Mean

$$\text{Arithmetic Mean} = \frac{\sum X_i}{N}$$

Where,

$\sum X_i$ = Sum of Variables
N = Total Number of Variables

$$\text{Weighted Mean} = \frac{\sum W_i X_i}{\sum W_i}$$

Where,

W_i = Weight of X_i
X_i = Variable

The following statistical tools were used in the analysis of data and interpretation of results (Growth rate).

3.2 Compound Growth Rate Analysis

The compound growth rate was calculated using an exponential function by analyzing data on the area, production, and productivity of potato crops in the study area.

$$Y = AB^2 \qquad (1)$$

Where,

Y = area/production/productivity/various inputs in the year
A = refers to intercept
t = refers to year (time period) (say t= 1,2, 3 ...., n)

$$B = 1 + \frac{r}{100}$$

Where, r = annual compound growth rate for area, production, and productivity.

with the use of two flanks of the equation's logarithm. Log Y has been transformed into a linear form, with "t" acting as the independent variable.

$$\text{Log } Y_t = \log A + t \log B$$

For ease of writing, we can write this as if log A=a and log B=b.

$$\text{Log } y_t = a + t \qquad (2)$$

Time (t) serves as the independent variable in this semi-log function. We then have typical equations of this type utilizing the ordinary least squares technique.

$$\sum \log y_t = na + b \sum t$$

$$\sum \log yt = a \sum t + b \sum t^2 \qquad (3)$$

Where n is the number of observations in years.

A and B's values have been calculated by resolving the equation (2=3). The approach listed below has been used to derive compound growth rates from obtained regression coefficients.

When b is a positive value, the anti-log of b was obtained, one was deducted from the antilog value b and then the value of b-1 was multiplied by one hundred. As a result, it provides a rising type of compound growth rate (CAGR). The process for determining compound growth rate is the same when b has a negative value, but the growth rate result was negative. When the

compound annual growth rate is negative that means the growth has been slowing down over the time period.

The compound annual growth rate is determined by the following formulae which indicated an even rate of change from one observation to the next-

r = (B-1) x 100

r = (Antilog b – 1) x 100

4. RESULTS AND DISCUSSION

The total number of family members is referred to as family size. Family size has a significant impact on the socio-economic aspects of farm households, particularly those that are connected to the availability of labor and the generation of income. A medium-sized family should make more money and contribute more labor than a smaller-sized household. Therefore, it is assumed that a household with a relatively big number of people will use inputs more effectively and will have greater supervision. Table 2 shows the family size and land holdings of the sample farmer households. The farmer households were divided into three broad categories based on the size of land holdings: marginal (0.47 ha), small (1.34 ha), and medium (3.93 ha). The overall average land holding was 1.51 ha.

The average family size of farmer households was marginal (6.2 members), small (5.8 members), and medium (5.2 members). The average family size was around 6 in the study area. The number of people in a household roughly correlated with their level of labor and ability to save for a farm. According to the current study, there was a negative correlation between the average family size and the average operational holdings of the household, meaning that the size of the family grew as operational holdings declined.

Table 3 shows that 27% of the farmers were old (above 50 years of age), 40% farmers were middle-aged (30–50 years), and 33% were young (Below 30 years). Because most teenagers aren't interested in farming and are instead looking for better employment opportunities in populous areas, is probably the main reason for most of the responses under the time of life category. Another factor is that people in their middle years are more enthusiastic and productive at work than people who are older or younger. An individual may not be able to accept responsibility at an early age. The labor productivity and production of the farmer are projected to be impacted by his age.

The educational background of potato farmers is shown in Table 4. The data in the table shows that all farmers, from those who were illiterate to those who had graduated from high school and higher, were participating in the potato farming industry. The majority of farmers had completed high school education i.e., 20 percent, followed by 19 percent who had completed intermediate level, and 17 percent who had completed all levels of higher education.

The result also shows that a sizable portion (17 percent) of farmers is illiterate (Fig. 2). The farmers' conviction that obtaining a decent education will contribute to their future success is the real justification for it. This might be a result of the farmers' easy access to colleges and universities as well as their high level of understanding of the value of formal education in the current environment.

Table 2. Socio-economic status of sample farmers

S.No.	Particular	Marginal	Small	Medium	Total/overall
1	No. of farmers	80	33	37	150
2	Average Family Size	6.2	5.8	5.2	5.7
3	Average Size of holding	0.47	1.34	3.93	1.51

Table 3. Distribution of farmers according to their age

S.No.	Age Group	Marginal	Small	Medium	Average
1	Below 30 years	24	11	14	16.33 (33)
2	30-50 year	31	13	16	20.00 (40)
3	Above 50 years	25	9	7	13.67 (27)
4	Total	80	33	37	150

Note: Figures in parenthesis indicate the percentage

Table 4. Educational status of farmers

S.No.	Education	Marginal	Small	Medium	Total
1	Illiterate	16	8	2	26 (17)
2	Primary	12	3	4	19 (13)
3	Middle school	11	4	6	21 (14)
4	High school	16	6	8	30 (20)
5	Intermediate	17	5	7	29 (19)
6	Graduate & above	8	7	10	25 (17)
7	Total	80	33	37	150 (100)

Note: Figures in parenthesis indicate the percentage
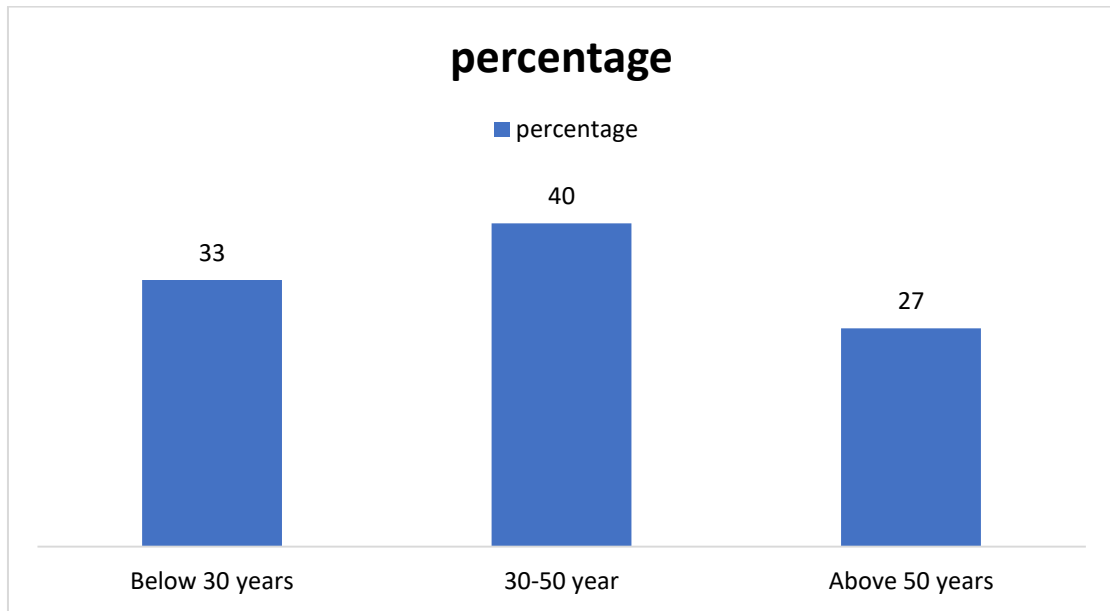
Fig. 1. Distribution of farmers according to their age
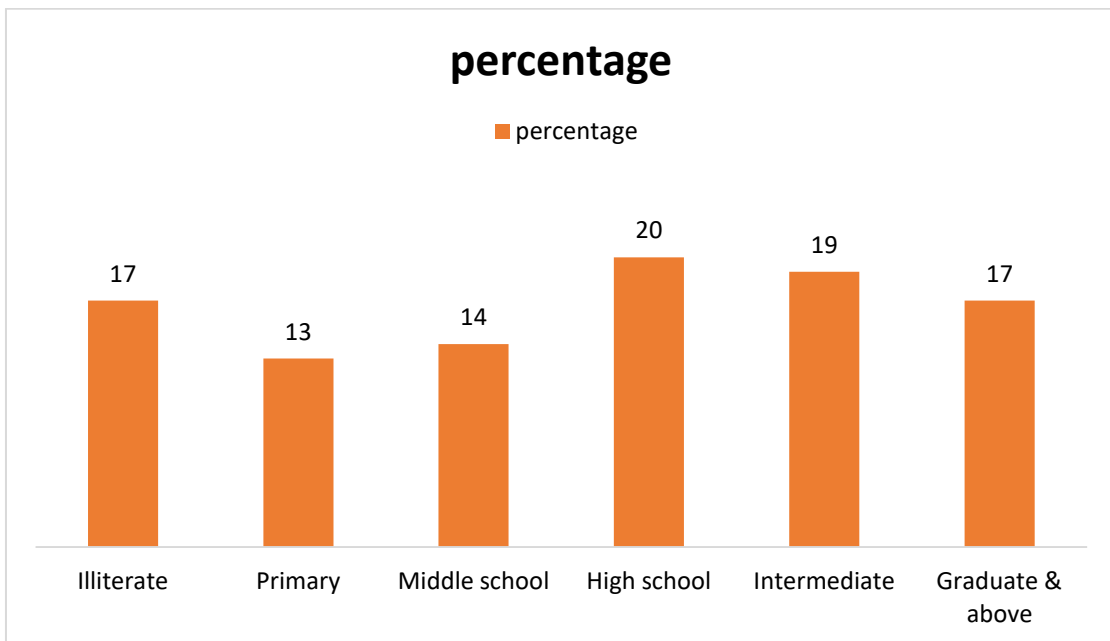
Fig. 2. Educational status of farmers

4.1 The Annual Income of Farmers Household

A farming system strategy aims to use resources more effectively to increase the farmer's income. Distributing the risk among several businesses rather than just one activity also helps to reduce the production risk. Table 5 provides information on the household annual income from the main farming in the Nalanda district. Farm households had the highest annual income (Rs. 500063) of which 40% of income (201116.33) generate from agricultural activities and 60% of income from non-farming activities (Rs.298946.67). This indicates that crop ventures generate less income than non-farming ventures.

4.2 Major Cropping Pattern in the Study Area

The cropping practices used by farmers in the study area under different agroclimatic conditions are shown in Table 6. The table shows that Paddy, maize, arhar, and moong were the main crops in the kharif season. Farm households cultivate wheat, potato, lentils, gram, mustard, maize, and pea as major crops in the rabi season. Zaid also has a short growing season for the vegetable crops such as cucumber, watermelon, and muskmelon.

The compound annual growth rate (CAGR) is the rate of return that would be required for an investment to grow from its beginning balance to its ending balance, assuming the profits were invested at the end of each period of the investment's life span. (Sihmar, R. 2014). The growth rates in respect of area, production, and productivity of Potato in the Nalanda district for the period from 2007-08 to 2021-22 have been depicted in Table 7. The result shows that on an average area, production and productivity are 23999.23 ha., 651894.6 Mt, and 27.5 t/ha. respectively.

Table 5. Annual income of farmers from various sources

				(Rs./Farm household/annum)
Income source	**Marginal**	**Small**	**Medium**	**Average**
Farm (crop+Live-stock)	82709	205750	314890	201116.33 (40)
Non-Farm (Labour, Business, Job, etc.)	104560	387700	404580	298946.67 (60)
Total	187269	593450	719470	500063

Note: Figures in parenthesis indicate the percentage
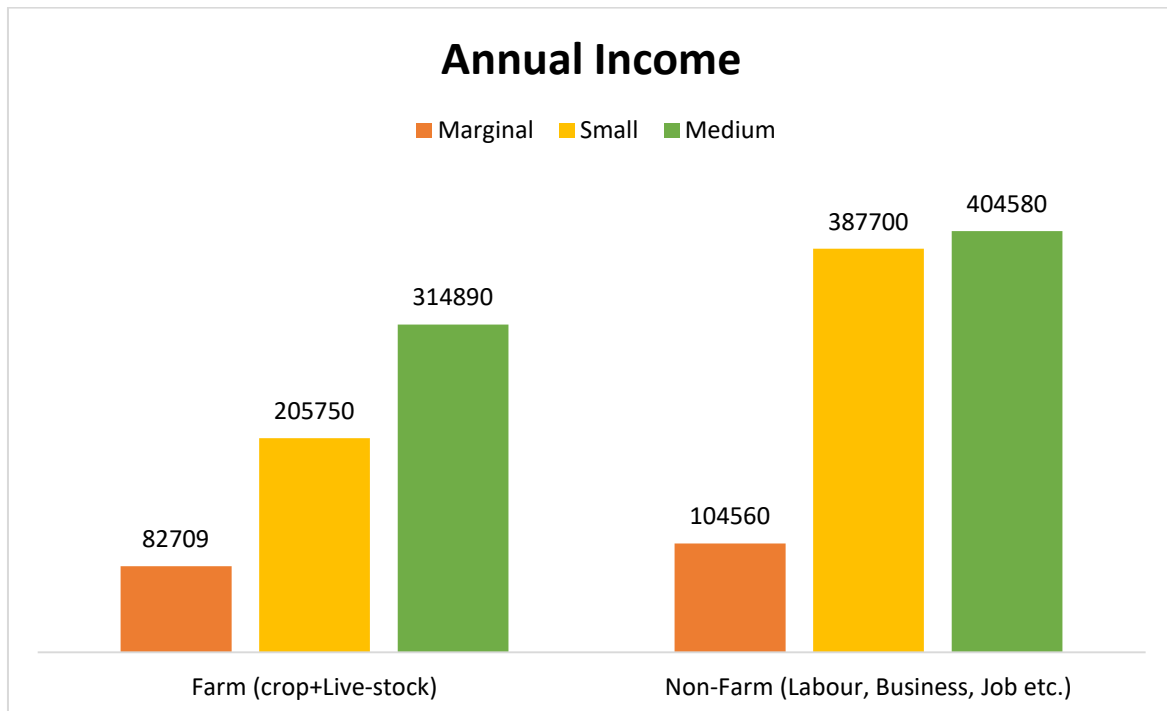
Fig. 3. Annual income of farmers from various sources

Table 6. Cropping pattern in different season

Sl.No.	Seasons	Crops
1	Kharif	Paddy, Maize, Arhar, and Moong,
2	Rabi	Wheat, Potato, Lentil, Gram, Mustard, Maize, and pea
3	Zaid	Vegetables, Watermelon, Muskmelon, and Cucumber

Table 7. Area, production, and productivity of potato crop in Nalanda district

Year / Period	Area (Ha.)	Production (Mt)	Productivity (t/ha)
2007-08	27900	701200	25.13
2008-09	27500	661400	24.05
2009-10	27000	653320	24.2
2010-11	25000	646870	25.9
2011-12	25780	649500	25.2
2012-13	23400	624250	26.7
2013-14	20500	600000	29.8
2014-15	20800	650000	28.8
2015-16	20810	600000	31.2
2016-17	20000	576646	28.8
2017-18	24000	691975	28.8
2018-19	24800	693589	28.0
2019-20	24850	679300	26.5
2020-21	24900	695500	26.3
2021-22	25000	703680	25.27
Average	23999.23	651894.6	27.5

Source: http://horticulture.bihar.gov.in (2021-22)

Table 8. Compound annual growth rate of area, production, and productivity of potato crop

Period		Year	Area	Production	Productivity
Period	I	2007-08 to 2011-12	-8.66**	-9.61**	8.82**
Period	II	2011-12 to 2016-17	-0.06	-2.13	2.19**
Period	III	2016-17 to 2021-22	2.85**	0.86	-3.82**
Overall period		2007-08 to 2021-22	-0.04	-0.36	-0.32

*** 5% level of significance (p < 0.05)*

Table 8 shows that annual expansion for the entire time period under examination, with annual growth rates of the overall period is -0.04 percent for the area, - 0.36 percent for production, and - 0.32 percent for productivity. The ANOVA results had statistical significance at a 5% level of significance (p < 0.05). It is interesting that during periods I and II, both the area and production had negative growth while in period III, productivity had negative growth. This could be attributed to the use of low-quality planting materials and pests and diseases.

5. CONCLUSION

The findings demonstrate that the respondent's socio–economic condition was moderate, with a strong economic background and greater access to all assets. The study shows that the source of income of farmers is getting more from non-farming than agriculture. The farmers' decisions to accept different sorts of fertilizers for their crops and to increase soil fertility are greatly influenced by the season. Scientists and extension agencies must perform extension activities such as training, result demonstrations, technique demonstrations, meetings, exposure visits, and discussions in order to provide farmers with a broad understanding of the situation and enable them to take further action. Statistics showed that the growth values were significant. The majority of farmers (40%) fall into the 30-50 age group. Medium farmers are the highest annual income as compared to small and marginal farmers. The result shows that the annual income of farmers consists of farm and non-farm sources i.e., 40% and 60% respectively. The trend analysis shows that the growth rate in area and production was negative during periods I (2007–08 to 2011–12) and II

(2017–18 to 2021–22), while the growth rate of area and production was positive during periods III (2012–13 to 2016–17). There was a positive trend with annual growth rates of 2.85 percent for the area, 0.86 percent for production during period III and 8.82 percent and 2.19 percent for yield during the period of 2007-08 to 2017-18. In this context, access and provision of organic manures and fertilizers, quality seeds, and irrigations are emerging as a major contributing factor to inputs also leads to discussions on inputs and agricultural subsidies to achieve the larger goal of agricultural credit and sustainable rural livelihoods. The marginal farmers' productivity is also relatively low when compared to small and medium farms. They must employ high-quality seeds and appropriate agronomic procedures to increase productivity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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