Determinants of vegetable farmers' income in the Garhwal region of Uttarakhand

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Abstract

Agriculture is the principal source of livelihood in India, particularly in rural areas like Uttarakhand, where farmers' income remains low and irregular. Therefore, there is a need to investigate how vegetable production and socio-economic factors influence farmers' income. In this study, we identify the socio-economic status of rural farmers and evaluate the influence of income determinants in the Garhwal region of Uttarakhand. For this study, we conducted a field survey in the Garhwal region, visiting various locations and collecting data from 308 respondents through interviews. Descriptive and multiple regression analyses are employed. The results of the present study reveal that the majority (89 per cent) of respondents are male household heads and business operators in the agribusiness. Most farmers (57.1 per cent) are in the age group of 40-55 years. The annual income of most farmers (53.2 per cent) is between Rs 50001 and Rs 100000. It presents farmers' income levels as insufficient to raise their living standards. We found low to medium levels of socio-economic status among farmers. Most respondents (36.7 percent) hold a land size between 1-2 hectares and grow high-value vegetables such as tomatoes, potatoes, peas, beans, green leafy and cauliflower. The key findings of the study reveal that determinants such as vegetable production, gender, landholding, and family size positively influence farmers' income. At the same time, age, education, and training show no significant effects. The findings suggest the need for a policy intervention to promote vegetable commercial farming among farmers, thereby enhancing their economic conditions in the region.

Keywords: Vegetable production, Income rural farming, Socio-economic characteristics, Rural farmers, India

1. Introduction

Agriculture is an important part of sustaining livelihood for rural people around the world. It provides livelihoods to a large section of the population, contributes significantly to national income, employment generation, poverty reduction and food security. Agriculture is identified as an economic activity that underpins the socio-economic development of rural households, particularly in developing countries such as India (Food and Agriculture Organisation of the United Nations 2022). Therefore, understanding the vegetable production and socio-economic dynamics has become crucial for enhancing economic growth.

The agriculture sector faces structural barriers, including fragmented landholdings, high dependence on natural resources, and limited mechanisation. These challenges are more pronounced in the hill region, where geographical constraints limit livelihood options and market connectivity, thereby affecting farmers' incomes. Variation in incomes, productivity, and livelihoods can be seen across regions, indicating the importance of the interlinked process among socioeconomic, vegetable production and context-specific factors (Roy *et al*., 2020). This context underscores the need for a deeper understanding of region-specific socio-economic conditions and the dynamics of vegetable production that drive farmers' livelihoods and incomes.

Horticultural crops have evolved in farming as one of the agricultural business activities. Among these crops, vegetable cultivation is one of rural India's most important farming activities (Kabir *et al*., 2019). So, several vegetables are cultivated in rural areas, such as tomatoes, potatoes, green peas, onions, ginger, garlic, and chilli, which have become high-value crops due to their importance to daily diets and livelihoods. Economically, vegetable farming has higher market demand and profitability than paddy rice and other cereal crops (Mariyono *et al*., 2017 [11]; Mohanty *et al*., 2013) [1].

Within this context, farmers face persistent challenges related to low and unstable income, limited access to resources, rising input costs and environmental uncertainty. These problems create economic hurdles and are deeply embedded in structural conditions such as fragmented landholding, infrastructure constraints and limited institutional support. These challenges adversely affect food security, well-being, livelihood, and socio-economic development (Raghav & Sen, 2014 [18]; Effiong *et al*., 2021) [4]. This situation calls for a systematic understanding and empirical examination of the factors that affect farmers' income.

Several studies have examined how vegetable production and socio-economic factors affect farmers' income, emphasising

the role of credit access, education, land-holding and farming experience (Nzabakenga *et al*., 2013 [14]; Olawepo, 2010) [15]. However, limited empirical research has conducted on vegetable production and the socio-economic aspects of farmers' income in rural areas of Uttarakhand, where unique geographical conditions pose several challenges. This creates a significant research gap in understanding the determinants of farmers' income in the region.

In view of the identified research gap, there is a need to undertake a focused and systematic investigation of major determinants shaping farmers' income outcomes in the hill region of Uttarakhand. A deeper understanding of the socio-economic and vegetable production and their influence on farmers' income is crucial for formulating effective and region-specific development interventions. It also seeks to assess the relationships among the major determinants of income and to identify the study's key contributors. This study is expected to contribute to academic knowledge by enriching micro-level empirical evidence and providing practical insights for policy-makers, planners and development agencies.

2. Review of literature

A farmer's income is the total earnings generated through agricultural activities, of which vegetable production is one of the cash crops of farming. Vegetables can be grown within a short period and sold at a better price than other crops. India has a wide range of climates and soils, which provide opportunities for cultivating vegetables as a source of income (Mohanty *et al*., 2013) [1]. Further, several studies have identified the role of socio-economic factors and output in influencing the farmers' income. Existing studies have examined multiple independent variables of farmers income and livelihoods, such as farm output, input costs, access to credit, transport, gender, education level, farm size, access to electricity, family size, access to non-farm income, use of high-yielding seeds, number of income sources, extension contact and social participation (MukaiLa *et al*. 2021; Kalita, 2020; Bosede *et al*. 2020 [3]; Meena *et al*., 2017 [12]; Panda, 2015 [16]; Fadipe *et al*. 2014 [5]; Nzabakenga *et al*., 2013; Olawepo 2010) [15]. Therefore, the socio-economic status of farmers plays a vital role in the adoption of improved farm practices (Roy *et al*., 2013).

However, some studies emphasise the role of factors that influence vegetable production efficiency. Authors have identified the major factors affecting vegetable production, including educational level, social contact, increased labour input, and household size, which influence their production efficiency (Joshi *et al*., 2006) [8]. Farmers continuously grow vegetables even in the off-season when market demand is high due to low supply, which contributes significantly to their income and rural economies (Huong *et al*., 2013 and Gyawali *et al*., 2022) [6]. It can potentially provide higher income and profits for all farmers (Mariyono *et al*., 2017). A sustainable vegetable production system can become a way of development in rural areas (Huong *et al*., 2013). Despite the importance of vegetable farming, factors such as inadequate finance and fragmented landholding negatively influence vegetable production and farmers' livelihoods (Effiong *et al*., 2021) [4]. Addressing these challenges is necessary to increase the contribution of vegetable farming to farmers' livelihood and economic status (Huong *et al*., 2013).

Although existing studies have examined the multiple factors influencing farmers' income in national and international contexts, limited attention has been given to the role of vegetable production and socio-economic factors in the farmers' income in the Garhwal region of Uttarakhand. This gap is significant because vegetable production and socio-economic factors strongly affect farmers' income. Therefore, the present study aims to assess the major factors influencing farmers' income in the Garhwal region.

Objectives

- To identify the socioeconomic status of vegetable growers
- To evaluate the impact of vegetable production and the socio-economic characteristics of farmers on their income.

3. Materials & Methods

The study was undertaken in the Garhwal region of Uttarakhand. The primary data, a total of 308 samples, were collected from rural vegetable farmers using purposive and snowball sampling techniques. Descriptive statistics are used to understand the socio-economic characteristics of rural farmers, and the multiple regression is applied to recognise the key determinants of income using SPSS (Statistical Package for Social Sciences) software. Additionally, the socio-economic characteristics of rural farmers are used as dummy variables to examine their impact on farmers' income. The interview Schedule was adopted for this study with minor modifications (Pradeep Kumar, 2016).

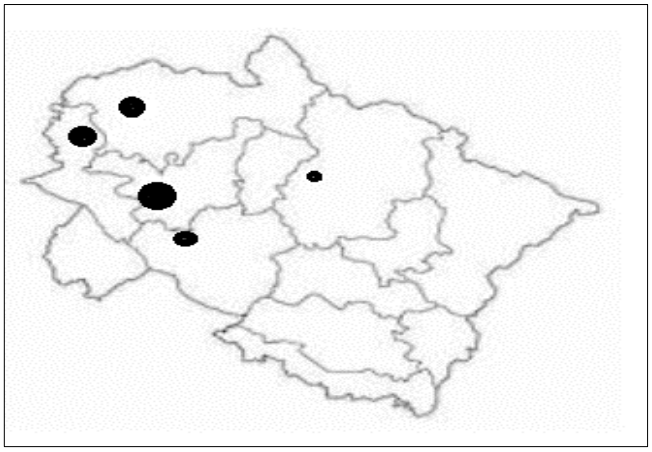

Fig 1: Represents the respondents according to black dot sizes in the districts of Uttarakhand

3.1 Socio-economic status of vegetable farmers in the Garhwal region of Uttarakhand

The socio-economic status of rural farmers is exhibited in Table 1 in the proposed areas of study. With 11 per cent of women and 89 per cent of men engaged in vegetable farming as head of household. This highlights the unequal distribution

of agricultural activities between women and men, indicating a lack of gender equality in rural areas. As regards the age group, 21 per cent of farmers fall in the age group of 25- 40 years, 57 per cent are in the 40–55 year group, and 20 per cent are above 55 years of age. This indicates that most farmers are from the age group of 40–55 years. The family size categories of farmers are as follows: 45.1 per cent have 5-10 members, 27.6 per cent have more than 10 members and 27.3 per cent have up to 5 members. It shows that most farmers have sufficient family members to perform farming activities. Regarding the experience of farmers, 38.3 per cent have 15–20 years, 29.2 per cent have more than 20 years, and 20.5 per cent of farmers have 10–15 years. However, this allocation reflects the different levels of farming experience among farmers; it requires more farming experience for modern farming practices. In terms of landholding, 25.3 per cent of farmers have land up to 1 hectare, 36.7 per cent have land between 1-2 hectares, 30.2 per cent have land between 2-4 hectares and 7.8 per cent have land more than 4 hectares. Most farmers hold land between 1-2 hectares. This distribution provides insights into the landholding of farming communities.

3.2 Multiple regression equation is presented as follows

Multiple regression was employed to assess the impact of farmers' vegetable production and socioeconomic characteristics on their income Fadipe *et al*., 2014 [5]; Mukaila *et al*., 2021). This relationship is explicitly expressed as:

$Y=\beta_0+\beta_1 P+\sum\beta_i X_i+e$……(1)

Where Y represents annual income (in rupees), P stands for vegetable production (in quintals), β_0 is the intercept, Xi represents the other socio-economic variables as dummies, and e represents the error term.

Before conducting Multiple Regression Analysis, key statistical assumptions were tested. Linearity was examined through scatter plots, the Durbin Watson statistic was used to test the independence of errors, normality of residuals was assessed by histogram and normal probability plots homoscedastic was checked through residual scatter plot. Multicollinearity among independent variables were checked through the variance inflation index and tolerance values. The results found that all the required assumptions were satisfied, revealing the suitability of the data for multiple regression analysis.

Table 1: Presents the field survey data on the socio-economic characteristics of vegetable farmers.

Variables	Categories	Frequency	Percentage
Gender	Female	34	11.0
	Male	274	89.0
Age	Less than 25 years	3	1.0
	25–40 years	65	21.1
	40–55 years	176	57.1
	Above 55 years	64	20.8
Family size	Up to 5 members	84	27.3
	5–10 members	139	45.1
	Above 10 members	85	27.6
Experience	Less than 10 years	37	12.0
	10–15 years	63	20.5
	15–20 years	118	38.3
	Above 20 years	90	29.2
Land holding	Up to 1 hectare	78	25.3
	1–2 hectare	113	36.7
	2–4 hectare	93	30.2
	Above 4 hectares	24	7.8
Education	Illiterate	85	27.6
	School education	208	67.5
	Higher education	15	4.8
Training	Untrained	199	64.6
	Trained	109	35.4

Regarding the education (see Table 1) of the farmers, 39.9 per cent are literate, 27.6 per cent are illiterate, 16.9 per cent are 10^{th} passed, 10.7 per cent are 12^{th} passed, and 4.8 per cent are higher educated. This data reveals that most farmers belong to the literate categories. Regarding the training programs, about 64.6 per cent of farmers are untrained, while 35.5 per cent have participated in training programs. This allocation shows that most farmers are untrained.

3.2.1 Determinants of farming income of rural farmers

Table 2: Shows the variables of the study and categorical variables are used as dummy variables

Variables	Definition	Measures
(Income) dependent variable	Total income from vegetable farming in rupees	Numeric
Production	Total produced vegetables in a year in quintals	Numeric

Gender	Male and female	Dummy variable
Household size	Up to 5 members, 5-10 members and above 10 members	Dummy variable
Farm size	Upto1 hectare, 1-2 hectares, 2-4 hectares and above 4 hectares	Dummy variable
Training	Trained and untrained	Dummy variable
Experience	Less than 10 years, 10–15 years, 15–20 years, above 20 years	Dummy variable
Education	Illiterate, school education, higher education	Dummy variable
Age	Less than 25 years, 25–40 years, 40–55 years, above 55 years	Dummy variable

4. Results and Discussions

4.1 Multiple regression analysis

Table 3: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.837[a]	.700	.683	22467.671	1.496

b. Dependent Variable: Income

Table 3 provides the findings of multiple regression between the predictors of income and farmers' income, showing that the determinants of income contribute significantly to the model. R is 0.83, which shows a strong relationship between dependent and independent variables. In this study, independent variables explain a 70 per cent variance of dependent variables. The adjusted R^2 value is 0.683, which satisfies the robustness of the model after adding the number of explanatory variables. Durban Watson is near 1.496 indicate no autocreation in data.

Table 4: ANOVA[a]

Model		Sum of Squares	DF	Mean Square	F	Sig.
1	Regression	342470899398.824	16	21404431212.427	42.402	.000[b]
	Residual	146895708506.744	291	504796249.164		
	Total	489366607905.569	307			

Table 4 shows the P value of ANOVA is.000 which is less than 0.05. So, the null hypothesis is rejected, which means all the IDVs jointly affect the dependent variable income of farmers. So, it confirms that the model is a good fit.

In Table 5, the P value of the IDVs is less than 0.05 at the 5 % significance level. We reject the null hypothesis that all Beta Coefficient is equal to zero. In other words, all the IDVs individually affect the income of farmers. Furthermore, one unit change in 'production' leads to 0.648 units of positive change in income. The gender dummy shows the positive and significant values, revealing that male farmers earned more income than females. The landholding categories of farmers are significantly and positively influenced by farmers' income. One unit change in farm size leads to a positive change in income. Among the experience category, only 15-20 years group shows a significant effect on farmers' income. Socio-economic characteristics such as age, education and training do not show any significant effect on farmers' income. From the coefficient table, it is found that production has a higher standardised beta of 0.648. So, vegetable production has the highest positive impact on income.

Table 5: Coefficients[a]

Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4968.761	7651.433		.649	.517
	Production	1230.257	72.917	.648	16.872	.000
	Male	11954.547	4353.205	.094	2.746	.006
	1-2 Hectare	7383.142	3774.224	.089	1.956	.051
	2-4 Hectare	15681.136	4302.207	.181	3.645	.000
	Above 4 Hectare	26759.170	6237.612	.180	4.290	.000
	5-10 Members	7920.352	3573.189	.099	2.217	.027
	Above10 Members	10857.615	4237.713	.122	2.562	.011
	Less than 25 yrs	437.744	13870.486	.001	.032	.975
	25-40 yrs	3346.567	5181.643	.034	.646	.519
	40-5 5yrs	-2031.167	3826.580	-.025	-.531	.596
	10-15 yrs	7280.765	5287.763	.074	1.377	.170
	15-20 yrs	12687.616	5491.965	.155	2.310	.022

	Above 20 yrs	7076.427	5821.262	.081	1.216	.225
	Trained	1577.561	2979.613	.019	.529	.597
	Higher education	-2767.550	4012.291	-.023	-.690	.491
	School education	-2812.580	2918.359	-.033	-.964	.336

Notes: Dependent Variable: Income

4.1.1 Vegetable production: It contributes significantly to farmers' income. It is one of the critical determinants of farmers' income. It plays a vital role by contributing to farmers' livelihood, economic status, and well-being, such as nutrition, children's education, vehicles, social status, comfortable homes and capital (Ridwan *et al*., 2021; Huong *et al*., 2013 and Basuki *et al*., 2009) [2]. Hence, farmers mostly grow vegetables in rural areas to maintain their livelihoods. It is necessary to increase vegetable production, which creates employment opportunities for a large section of the population and meets their demands.

4.1.2 Gender: Males increased farmers' income more compared to females. Gender (male) covers all aspects of agricultural activities, including input procurement, decision-making and selling. However, women's participation is limited by social constraints.

4.1.3 Landholding: It positively influences the farmers' income. Job *et al*. (2021) stated that farmers allocate a substantial share of their land to vegetable production due to the cash nature and ability to get quicker returns than other cereal crops. So, cultivable land is required for growing various vegetables throughout the year.

4.1.4 Family size: It increases farmers' income more than the reference category of up to five members. This category negatively affects the farmers' income. If the farm size is large, it can play a significant role in vegetable production. Rao (2020) found that everyday labour is required for performing farming activities.

5. Conclusion

The results of the present study reveal that the majority (89 per cent) of respondents are male, as the business operators of agribusiness. They mostly make all decisions regarding marketing activities, indicating gender inequality in rural areas. Most farmers (57.1 per cent) are in the age group of 40-55 years. The annual income of most farmers (53.2 per cent) is between 50001 Rs and 100000 Rs. It presents farmers' income levels as insufficient to raise their living standards. The main findings of this study show that vegetable production, gender, landholding and family size of farmers contribute significantly to farmers' income. Therefore, vegetable production and socio-economic characteristics are important factors in increasing farmers' income and encouraging them to adopt commercial farming.

Based on the findings of this paper, there is a high gender inequality and most rural farmers are deprived of attending training programs due to limited access. The farmers have low to medium-level socio-economic status in rural areas. Due to low-income levels, they face issues such as poverty and food insecurity. These findings can provide insights for policymakers, development planners, and extension officers. Training programs can empower farmers to make informed decisions about vegetable cultivation, thereby increasing productivity. This can also help reduce gender inequality and is crucial for enabling farmers to increase earnings.

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