Organic Farming through Sustainable Production, Its Socio-Economic Impacts in Rural Livelihood and for Community Development

Md Abdullah [1*], Sefali Sultana Parvin [2]

Abstract

Background: Organic farming has gained global attention due to its socio-economic and environmental advantages. In Sikkim, India, the adoption of organic farming has been promoted since 2003, transforming it into a key livelihood source, especially for rural communities. However, the dynamics between organic farming, non-farm activities, and the socio-economic well-being of the cultivators remain underexplored, particularly across the state's four districts. Methods: This study employed a mixed-methods approach to assess the socio-economic impact of organic farming in Sikkim. Quantitative data were collected through household surveys and analyzed using ordinary least squares (OLS) regression to identify factors influencing per capita income. Qualitative insights were gathered from interviews with group-based organic cultivators to explore gender participation and community dynamics. Results: Findings revealed that non-farm activities contribute a higher percentage of household income than farm activities across all districts, with the East district exhibiting the largest disparity due to urbanization and diverse employment opportunities. Female dominance in group-based organic farming groups indicates the potential of organic farming to Empower women economically and socially. Furthermore, the socio-economic profiles of organic cultivators improved significantly, with enhanced living standards, better health, and stronger community cohesion. The study also highlighted that education, farming experience, and access to government facilities positively and significantly influence per capita income. Despite these benefits, challenges such as limited market access, inadequate transportation, and insufficient educational facilities hinder the full potential of organic farming in Sikkim. Conclusion: The study underscores the transformative impact of organic farming in Sikkim, benefiting both rural livelihoods and the broader economy.

Keywords: Organic farming, Socio-economic development, Rural livelihoods, Women empowerment, Agricultural sustainability

Significance | Organic farming in Sikkim enhances socio-economic conditions, empowers women, promotes sustainability, and fosters rural development through supportive governmental policies.

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Introduction

Organic farming, a method of agricultural production that prioritizes harmony with nature, has gained global attention for its promise of sustainability and environmental health. Unlike conventional agriculture, organic farming focuses on techniques that protect the ecosystem, maintain soil fertility, and ensure the well-being of people and communities involved in farming activities. As a holistic approach, it considers the farm an integrated system where soil, plants, animals, microorganisms, and humans interact synergistically to create a self-regulating and stable environment (Lampkin et al., 1999).

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Organic farming reduces dependency on external inputs, including synthetic fertilizers and pesticides, and instead relies on natural methods to enhance crop yields and combat diseases. These principles align with the International Federation of Organic Agriculture Movements (IFOAM), which advocates environmentally, socially, and economically sound agricultural practices tailored to local cultural, climatic, and socio-economic conditions (IFOAM, 2000). Globally, the organic movement has established itself as a viable alternative to conventional farming, with organic agriculture practiced in over 130 countries, covering approximately 30.4 million hectares or 0.65% of global agricultural land (Willer et al., 2008).

Global and National Perspectives

Countries such as Australia, China, Argentina, the United States, and Italy lead the world in the extent of land devoted to organic farming (Willer et al., 2008). Meanwhile, India, a predominantly agrarian economy, is emerging as a significant player in this domain. Agriculture contributes 14.6% to India's Gross Domestic Product (GDP) and supports the livelihoods of over 58% of its population (GOI, 2010). With 528,171 hectares of certified organic farmland, India ranks 10th globally in cultivable land under organic certification. Key organic products from India include sugarcane, basmati rice, cotton, spices, and tea, alongside non-edible outputs like organic cotton fibers and functional foods (APEDA, 2013).

Among Indian states, Madhya Pradesh holds the largest share of organically certified land (1.1 million hectares), followed by Maharashtra (0.96 million hectares) and Odisha (0.67 million hectares). States like Uttarakhand and Sikkim have made significant strides toward organic agriculture, with the latter achieving a unique milestone as India's first fully organic state by 2016.

Organic Farming in Sikkim: A Model for Transformation

Sikkim, a mountainous state in northeastern India, has long been characterized by its traditional reliance on organic farming. Before the advent of chemical fertilizers and pesticides, the state's farming community employed organic inputs to sustain soil fertility and crop production. However, the Green Revolution of the 1970s introduced synthetic chemicals into Indian agriculture, leading to widespread dependence on these inputs in irrigated areas. In contrast, Sikkim, with its predominantly rain-fed agriculture, maintained relatively low usage of synthetic fertilizers and pesticides. Consequently, many of its crops, including fruits, spices, and medicinal plants, remained untouched by chemicals, making the transition to organic farming more feasible.

Recognizing the ecological and economic potential of organic farming, the Government of Sikkim launched an ambitious organic mission in 2003. The mission aimed to eliminate synthetic inputs and promote bio-fertilizers and other organic practices across the state. By 2010, nearly 60% of Sikkim's cultivable land had been converted to organic farming, with total certified organic cultivation reaching 1,726.34 hectares and producing 5,174.44 tonnes of organic crops (Yadav, 2012). The state's agricultural sector contributed 7.4% to the State Gross Domestic Product (SGDP) during 2012–2013, underscoring its economic importance. Sikkim's organic produce, including cardamom, ginger, oranges, and medicinal plants, commands high demand in both domestic and international markets. These crops are well-suited to the state's agro-climatic conditions and provide lucrative opportunities for farmers. Despite these advancements, challenges persist in scaling up organic farming. Issues such as limited availability of organic supplements, lack of market access, and inadequate infrastructure continue to hinder its widespread adoption.

Challenges and Constraints in Sikkim's Organic Farming

Although Sikkim's organic initiative has been a model for other Indian states, its farming community faces several constraints. These include:

- Limited Access to Resources: Organic farming requires substantial organic inputs, such as compost and bio-fertilizers. However, the availability of these resources remains insufficient, particularly in remote areas.
- Market Limitations: Farmers often struggle to access markets that value organic produce, resulting in reduced financial returns compared to the premium prices organic products typically command.
- Lack of Awareness and Training: Many farmers lack knowledge of best practices in organic farming, emphasizing the need for continuous training and support.
- Small Landholdings: The fragmented nature of landholdings in Sikkim restricts economies of scale, making it challenging for small-scale farmers to compete in the organic market.

These challenges have led to some reluctance among farmers to fully transition to organic methods. Unlike conventional farming, where benefits are immediately visible, the advantages of organic farming such as improved soil health and long-term sustainability take time to materialize, often discouraging farmers.

Socio-Economic and Livelihood Implications

Organic farming in Sikkim has broader implications for community development and sustainable livelihoods. The practice has diversified livelihood options, providing opportunities in agri-tourism, organic certification, and value-added processing of organic products. Moreover, community-based farming initiatives have empowered marginalized groups, particularly women, who play a pivotal role in agricultural activities. By integrating organic farming with other rural development programs, Sikkim has successfully linked ecological sustainability with socio-economic advancement.

The study of organic farming in Sikkim offers valuable insights into the interplay between environmental conservation and economic development. It highlights the potential of organic agriculture to

address pressing issues such as food security, land degradation, and rural poverty. Moreover, it underscores the importance of tailored policy interventions to support organic farming, including financial incentives, market development, and capacity-building programs.

Materials and Methods

Sampling Design

The study was conducted in various villages across the four districts of Sikkim: East, West, North, and South. A combination of multistage sampling and convenience sampling was utilized. The multistage sampling approach consisted of several stages, beginning with the selection of broader units (districts), followed by subdivisions (villages), and ultimately narrowing down to individual households. This approach ensured that the sample was both representative and practical for data collection in remote regions. Convenience sampling was employed to address accessibility challenges, particularly in geographically isolated areas, ensuring the inclusion of diverse stakeholders in organic farming.

Data Collection

Primary Data

Primary data was gathered through pre-structured questionnaires and semi-structured interviews. These tools were designed to elicit comprehensive information from stakeholders engaged in organic farming in Sikkim. Surveyed households provided detailed data on variables such as family size, educational qualifications, average age, gender distribution, per capita income, household expenditures, net savings, occupational diversity, and years of farming experience. Additional data encompassed land ownership patterns, productive activities, access to government facilities, and income sources from different occupations.

Secondary Data

Secondary data was sourced from government reports, institutional publications (e.g., Indian Council of Agricultural Research reports), and databases maintained by non-governmental organizations (NGOs). These sources supplemented the primary data, offering context and validation for the study findings (Government of Sikkim, 2018; ICAR, 2020).

Analytical Tools

1. Gini Coefficient

The Gini coefficient was employed to measure income inequality among organic farmers. This statistical dispersion metric ranges from 0 (perfect equality) to 1 (maximum inequality). The study applied the following model:

$G=1/n2\mu\Sigma\Sigma(xi-xj)fifj\ldots\ldots xi>xj$

In case of a set of n values of X say $x_1.,x2.,x_3\ldots..,xn$ with frequencies $f_1,f_2,f_3,\ldots..,fn$, where, is

the mean of the X values and x_1, $x_2,\ldots\ldots$, xn are the per capita incomes of the respondents with

the corresponding frequencies $f_1,f_2,\ldots\ldots\ldots,fn$ of the distribution.

2. Hirchman-Herfindahl (HH) Index

The HH index was utilized to examine livelihood diversification. Defined as the sum of the squares of market shares, its inverse indicates income diversification among households. The formula used was:

$HHi = \alpha0 + \alpha1\ (WM)i + \alpha2\ (AAGF)i + \alpha3\ (EDN)i + \varepsilon i$.....(1)

Where HHi represent Herfindahl-Hirschman Index for Livelihood Diversification, WMi,AAGFi and EDNi are number of working members, average age and educational qualification of the individual household respectively.

3. Regression analysis

Multiple regression models were applied to assess the influence of independent variables (education, experience, government facility utilization) on household diversification and per capita income. The regression equation was:

$Yi = \beta1 + \beta2\ X2i + \beta3\ X3i + ui$

Where Y is per-capita income of the respondent, X2 represent educational qualification and X3 is the total year of experience in particular occupation of the household, u is the stochastic disturbance term, and the suffix i refer to the ith observation; in case of time series data the subscript t will denote the tth observation.

4. ANOVA

Analysis of variance (ANOVA) was used to compare means and variances of household diversification indices across different villages (Snedecor & Cochran, 1989).

5. Ordinary Least Squares (OLS)

OLS regression examined how variables like education, experience, and government facility utilization influenced per capita income:

$PCIi = \beta1 + \beta2\ (EDN)i + \beta3\ (EXPR)i + \beta4\ (UGF)i + \alpha1\ Di + ui$.....(2)

Where PCIi denotes per-capita income of the respondent, EDNi is average educational qualification of the family, EXPRi represent total year of experience in particular occupation of the household, Di is dummy in case of group based as well as individual growers. Where Di = 1 for utilisation of government facilities for both individual and group-based growers and Di = 0 for not utilisation of government facilities, ui is the stochastic disturbance term, and the suffix i refer to the ith observation.

The OLS method has been used for looking into how organic farming leads to community development as well as its contribution to the trust cohesion, social and human capital, etc.

6. Standard Normal Test Statistic (z-Test)

The z-test was applied to evaluate economic conditions before and after group-based organic farming. Key indicators included changes in bank loan usage, household savings, and income levels.

Study Area

Sikkim, a Himalayan state in northeastern India, was selected for the study due to its prominence in organic farming. The state's four districts—East, West, North, and South—differ significantly in demographics, geography, and agricultural practices (Government of Sikkim, 2011).

• East District: Gangtok, the state capital, was a focal point. Data was collected from peri-urban and rural households, reflecting diverse income sources.

• West District: Villages near Geyzing were surveyed. Known for its rich cultural heritage, the district has significant organic farming activity.

• North District: Upper Singhik and Dzongu were studied. The area is characterized by low population density and traditional farming systems.

• South District: Namchi and surrounding areas were explored, emphasizing the contribution of organic cash crops such as ginger and flowers.

These districts represent a cross-section of Sikkim's organic farming landscape, ensuring the findings are representative and actionable.

Results

Description of Variables

The table 1 represents the various variables utilised for the purpose of foregoing study. From the above Table 2, it is clear that the percentage share of non-farm activities to total income of the households remain higher than that of share of farm activities for all the four districts of Sikkim and in case of East district, the share of non-farm activities is much higher than farm activities, which are 70.49 and 29.51 respectively.

Again, from the Table 3, we can conclude that after considering the group-based organic cultivators, most of the groups are dominated by female participant or we can say that the female members are much more interested to carry out those kinds of activities. In case of East district, we have seen that most of the women participant were leading their groups and became more successful to promote the organic farming. In other words community based organic farming is more popular in East district of Sikkim.

Results and Analysis of Socio-Economic Conditions of the Respondents of the Study in terms of Gini-Coefficient

The economic well-being of a family is a major element that affects many areas of the life of the members, including how they view society and the world at large. Naturally it can be expected that income of a family and hence its economic status will have an important bearing on their attitude towards organic farming. Hence it would be pertinent to examine the extent of income homogeneity among the respondents, as it can be reasonably assumed that those coming from similar socio-economic backgrounds will harbour similar sentiments towards organic farming. The Gini coefficient is the most appropriate tool for measuring income inequality. In the present case the Gini coefficient has been used to evaluate the extent of income inequality among the respondents from the different districts of Sikkim.

Table 4 reflects the value of Gini Coefficient of income inequality (G) among the respondents from the four districts of Sikkim. A consideration of the value of G makes it clear that in terms of the income inequality the four districts are quite similar to each other; this implies there is no such strong income inequality between them. Furthermore, careful observation of the value of G reveals that the income inequality is comparatively higher in the West and North districts of Sikkim.

Group-based organic farming activities using the Standard Normal Test Statistic.

In order to examine the hypothesis that group-based farming activities lead to better socio-economic conditions for the participants, we considered changes in family income and savings with the help of the z test.

Change in Family Income of the Respondents

In order to fulfill the basic necessities of life, people choose specific occupations based on their interests, capabilities and education and accordingly make a living. Table 5 presents the comparison between the family income before and after joining the group

Let the null hypothesis be that there is no significance difference in the average family income of the respondent before and after joining the group, so that the alternative hypothesis is that the mean family income of the respondent before joining the group is lower than that after joining the group. This can be symbolically represented as

H0: $\mu 1 = \mu 2$ against alternative, i.e., H1: $\mu 1' < \mu 2'$

The above Table 6, the calculated value of $|Z| = 5.509$ is greater than critical value of 1.64 at 5 % level of significance. Hence the null hypothesis is rejected. Thus, we can conclude that there is a significant difference in the family income before and after joining the group. This also indicates that the mean income of the respondent has increased after joining the group. This could be because of proper utilisation of available resources like governmental facilities (financial assistance, training or workshop, high quality seeds, bio-fertilisers, vermi compost, polyhouse, etc), homemade manure or compost; especially cow dung/urine, and other low-cost inputs, which lead to better productivity in quantity as well as quality.

Change in Bank Savings of the Respondents

The amount of savings is an important factor for the purpose of economic planning of group-based organic cultivators. Banks are regarded as a good option for safeguarding of savings; in addition, there is the benefit of interest accrued on the amount deposited. Table 7, 8 gives the data on the savings of the respondents before and after joining the group.

Let the null hypothesis be that there is no significance difference between bank savings of the respondent before and after joining the group, with the alternative hypothesis being that the mean savings of the respondent before joining the group is less compared to the mean savings after joining the group. The symbolic representation would be

H0: μ1 = μ2 against alternative, i.e., H1: μ3' < μ4'

Since the calculated value of |Z| = 8.492 is greater than the tabulated value of 1.64 at 5 % level of significance, the null hypothesis is rejected. This means that there is significance difference in the savings and also suggests that the mean savings of the respondents has increased after joining the group. The savings of the members can be attributed to better banking facilities.

Livelihood Diversification through HH Index

Securing the basic necessities of life and the capacity to acquire those necessities by working either individually or as a group while exploring different avenues for earning can lead livelihood to diversify. To examine these, let us first consider the following table

To analyse the issue of livelihood diversification, we categorise the households into two broad categories, viz.- (i) households that are completely dependent on farming and (ii) households that adopt both farm and non-farm activities.

From Table 9, we can conclude that, farming is considered as the primary source of livelihood because almost all the households are engaged in farming activities. However, a substantial dependence on non-farm activities is still evident. About 80%, 70%, 76%, and 88 % of the sample households of East, West, North and South district are dependent on non-farm activities. This implies that the income generated from farming is insufficient for fulfilling the increasing necessities of the people of Sikkim.

Let us now consider the following model for studying the impact of different explanatory variables on livelihood diversification through OLS.

$HHi = \alpha 0 + \alpha 1\ (WM)i + \alpha 2\ (AAGF)i + \alpha 3\ (EDN)i + \varepsilon i$…… (1) 5.5.1

The above estimated coefficient results from equation 5.5.1 and Table 10, suggests that all variables except WM (working member) are found to be insignificant. The coefficient is positive; about 27% variation of dependent variable (HHi) is explained by independent variable (WM). This implies that the increase in the number of working members leads to greater livelihood diversification. It seems 1 unit change in working variable leads to 27 units change in livelihood diversification. It also implies that, the greater the number of working family members the greater would be the diversification. This could be due to the fact that members of the same household engage in different activities in search of better earnings or better alternative source of earning. Factors like urbanisation, development of infrastructure, transport facilities and communications, growth in employment opportunities, etc, or change in governmental policies may also have further encouraged such livelihood diversification.

Effect of the Diverse Variables on the Household Diversification Indices through Multiple Regression Analysis

With a view to examining the effects of variables like educational qualifications, experience and utilisation of government facilities on the per capita income (PCI) of both individual growers and group-based growers; we have employed the following model;

$PCIi = \beta 1 + \beta 2\ (EDN)i + \beta 3\ (EXPR)i + \beta 4\ (UGF)i\ *Di + ui$……. (2)

The estimated coefficients from equation (2) for Sikkim as a whole are shown in column 1 of Table 11, while in case of the four districts, the estimated coefficients from the same equation are shown in column 2, 3, 4 and 5. In order to examine linear relationship through ordinary least square method, we have considered per capita income (PCI) as a dependent variable and educational qualification (EDN), experiences and utilisation of government facilities (UGF) as independent variables. Apart from this, we have introduced the dummy variable (Di) for utilisation of government facilities for both the individual as well as group-based cultivators.

Where Di = 1 for utilisation of government facilities group-based growers and Di = 0 for individual cultivators. From the value of dummy variable (Di) it is clear that, the utilisation of government facilities (UGF) is found to be significant at 5% level of significance. Furthermore, we can conclude that increase in the government facilities leads to increase in per-capita income of the respondents and from the value of intercept, -1632.470, it is clear that the mean per capita income of the individual growers is less than that of group-based growers by 3274.14.

The value of the estimated coefficients for educational qualifications and experiences in case of respondents from the combined sample are found to be statistically significant at 1 % and 5 % level of significance. This implies that the higher the level of education and greater will be the chance of increasing per capita income of the household. The years of experience also has the same impact on the per capita income of the respondents. Further, in case of all the sampled districts except North and East, the impact of these two variables (EDN and EXPR) is found to be insignificant.

For district wise comparison, the utilisation of governmental facilities is found to be significant at 10 % in case of the East district and highly significant at 1 % level of significance in North district, which means that optimum utilisation of facilities leads to a rise in the per capita income of the respondents.

Household diversification across Districts through ANOVA

For testing the equality of the mean and variance indices, we have considered the four districts of Sikkim. From the Table 12, it is clear that there is significant difference in the mean level of diversification across the four districts of Sikkim, which is revealed by the F-value. Furthermore, the difference among variance figures

Table 1. Description of Variables Used in the Study

	Variable Name	Description of the variables
1	PCI	Per Capita Income of the Family
2	HHI	Herfindahl-Hirschman Index for Livelihood Diversification
3	WM	Numbers of Working Member in a Family
4	AAGF	Average Age of the Family
5	EDN	Average Educational Qualification of the Family
6	EXPR	Experience of the Members of the Households in their Particular Occupations
7	UGF	Utilisation of Government Facilities for Organic Farming
8	Di	Utilisation of Government Facilities for Organic Farming =1; otherwise, 0
9	LD_N	Livelihood Diversification of North District of Sikkim
10	LD_S	Livelihood Diversification of South District of Sikkim
11	LD_E	Livelihood Diversification of East District of Sikkim
12	LD_W	Livelihood Diversification of West District of Sikkim

Table 2. Descriptive Statistics of the Study (individual cultivators)

District	Total Household Surveyed	Average family size	Average age of the workers	Average Education level of the workers	Percentage share of farm to total income	Percentage share of no-farm activities to total income
East	60	4.86	40.10	8.02	29.51	70.49
West	60	5.00	39.95	8.27	34.54	65.46
North	60	4.01	42.45	6.27	40.68	59.32
South	60	4.54	37.42	6.31	42.29	57.71

Table 3. Descriptive Variables of the Study (group-based cultivators)

District	Total Group surveyed	Average age of the member	Average Per-capita Income	Average educational qualification	Percentage of female members	Percentage of male members
East	4	39.80	8333.33	7.55	79.16	20.84
West	1	42.55	5500.00	3.36	100	000
North	1	40.43	7500.00	2.33	000	100
South	1	44.60	7272.72	6.81	000	100

Table 4. District-Wise Results of Gini-Coefficient

	District	Gini-Coefficient
	East District	0.143
	West District	0.177
	North District	0.178
	South District	0.158

Table 5. Comparison of the Family Income of the Respondent before and after joining the Group

Sl.	Monthly Income	Before joining	After joining
No.	(In Rupees)		
1	0-5000	51	23
2	5000-10000	19	36
3	10000-15000	4	7
4	15000-20000	0	4
5	20000-25000	0	4
Total		74	74

Table 6. Calculation for Mean and Standard Deviation of the Respondent

Particulars	Before joining	After joining
Mean (in Rs.)	3624.324	7371.622
Standard Deviation	2897.557	5083.59
(in Rs.)		
Sample size	74	74

Table 7. Comparison of the Change in Banks Savings of the Respondent before and after joining the group

Amount of savings	Before Joining	After Joining
(In Rupees)	(No. of Respondent)	(No. of Respondent)
0-1000	56	18
1000-2000	12	20
2000-3000	3	16
3000-4000	3	9
4000-5000	0	3
5000-6000	0	1
6000-7000	0	7
Total	74	74

Table 8. Calculation for Mean and Standard Deviation of the Respondent

Particulars	Before joining	After joining
Mean (in Rs.)	445.9459	2247.297
Standard Deviation (in Rs.)	752.0181	1662.497
Sample size	74	74
Source: Author's Calculation		

Table 9. Percentage of Household Engaged on Farm and Non-Farm Activity. Name of the Sample Districts of Sikkim

	East	West	North	South
	District	District	District	District
Percentage of households engaged on	10	30	24	12
only farming activity				
Percentage of households engaged on	56	36	60	58
farming and one more occupation				
Percentage of households engaged on	24	28	14	22
farming and two more occupation				
Percentage of households engaged on	10	6	2	8
farming and three more occupation				
Source: Author's Calculation				

Table 10. Livelihood Diversification – Regression Results

Explanatory Variables	Estimated Coefficient
	(Marginal Effects)
	0.120**
WM	(2.05)
	0.003
EXPR	(0.54)
	0.005
EDN	(0.02)
	1.140***
CONS	(6.60)
Observations	240
R-Squared	0.030
Adjusted R-Squared	0.122
F-Statistics	1.820
P-Value	0.145

Note: ***, ** and * indicates the significance at 1%, 5% and 10% level respectively. Figures within the brackets represents the t-statistics

Figure 1. Map of Sikkim. Study sites and the surrounding large-cardamom growing areas in Sikkim. (Map courtesy of The Mountain Institute, India)

Table 11. Results of OLS method on the Impact of Different Explanatory Variables for increasing Per Capita Income

Explanatory	**Estimated Coefficients**				
variables					
	Combined	**East**	**West**	**North**	**South**
EDN	548.683***	260.264***	195.504	330.450***	28.2006
	(10.13)	(4.57)	(1.17)	(3.301)	(0.294)
EXPR	193.652**	84.210	272.470	-65.253	22.320
	(2.06)	(0.66)	(1.586)	(-0.329)	(0.120)
UGF	23.778	57.362*	223.316	408.904***	-215.113
	(0.31)	(-2.07)	(0.-1.602)	(-2.744)	(-1.895)
D_i	4906.98**				
	(10.97)				
CONS	-1632.470**	1112.330*	2003.918	2287.069	2784.544***
	(-2.38)	(1.48)	(0.525)	(1.526)	(0.027)
Observations	240	60	60	60	60
R-Squared	0.4789	0.4393	0.1002	0.3437	0.0768
F- Statistics	61.59	11.752	1.671	7.856	1.248
P- value	0.0000***	0.0000***	0.1866	0.0002***	0.303

Note: ***, ** and * indicates the significance at 1%, 5% and 10% level respectively. Figures within the brackets represents the t-statistics

Table 12. ANOVA Result for Equality of Mean Test

Method	**Degree of freedom (df)**	**Value**	**Probability**
All District Anova F-test	(3, 232)	40.47066	0.00000
LD_E	235	1.81886	0.078537
LD_S	235	0.777813	0.067147
LD_W	235	1.64927	0.094394
LD_N	235	1.883636	0.079939

Table 13. ANOVA Result for Equality of Variance Test

Method	**Degree of freedom (df)**	**Value**	**Probability**
Barlett	3	6.699436	0.0821
Levene	3,232	2.744929	0.0438
Brown-Forsythe	3,232	3.356861	0.0196

for the diversification indices is also found to be significant, as revealed in Table 13. By considering all three methods (Barlett, Levene and Brown-Forsythe), we can conclude that there is great difference in the patterns of diversification to non-farm activities across the four districts of Sikkim.

Most of the household members in each district are engaged in multiple economic activities so as to ensure better earnings. Particularly in the East and South districts each and every household member is engaged in multiple activities while being less concerned about the agricultural jobs. This could be due to better alternative employment opportunities. On the other hand, in case ofthe North and West districts most of the household belongs to farming class and/or farming is their basic livelihood. This could be due to poor infrastructures and favourable climatic condition conducive to the cultivation of agricultural products.

Discussion

Income Inequality among the East, West, North and West District by Gini-Coefficient The extent of income homogeneity among the respondents, as it can be reasonably assumed that those coming from similar socio-economic backgrounds will harbour similar sentiments towards organic farming. From the value of Gini-Coefficient of income inequality shown in Table 5.2 suggested that the income inequality the four districts are quite similar to each other; this implies there is no such strong income inequality between them. Furthermore, careful observation of the value of G reveals that the income inequality is comparatively higher in the West and North districts of Sikkim.

The respondents of the study area show homogeneity in nature irrespective of their level of income. In case of East and South districts, the value of Gini-Coefficient suggested that there is equal distribution of income among the respondent, this could be due to the fact that their perception regarding organic farming is more or less similar and the revenue generated by selling their produce are comparable. The study also reveals that, in case of East district the group-based cultivators are able to find proper market channel to sell their organic produce, and demand for organic products, higher as compare to other districts of the state. Whereas in south district most of the cultivators were motivated by governmental as well as other non-government organisation and are more focused for promoting the organic farming.

East, West, North and South District by Multiple Regression Model

In order to examine relationship through ordinary least square method, we have considered per capita income (PCI) as a dependent variable and, educational qualification (EDN), experiences (EXPR) and utilisation of government facilities (UGF) as independent variables. Apart from this, we have introduced the dummy (Di), where Di = 1 for group-based growers and Di= 0 for individual growers.

From the value of estimated coefficient of table 5.6, we can conclude that the impact of variables like educational qualification is found to be significant at 1 % level of significance for East and North District and found insignificant for rest of the two districts. Which means the educational qualification is playing imperative role to increase the per-capita income of the respondent of East and North district. In case of West and South district the education has not much impact on increasing the per-capita income. While for all four districts impact of experience is found to be insignificant.

The utilisation of governmental facilities is found to be significant at 10 % in case of the East district and highly significant at 1 % level of significance in North district, which means that optimum utilisation of facilities leading to a rise in the per capita income of the respondents. Further, we may conclude that, the government facilities were properly utilising by the cultivators of North districts than those of East, West and South district.

As per the field survey, we found that there is strong correlation between educational qualification and utilisation of government facilities. This means, the facilities provided by government for promoting the organic farming is being properly utilised by the household whose average education qualification is high and vice versa. Likewise, if we compare group based and individual organic cultivators, the governmental facilities were effectively utilised by group based than individual cultivators across the four districts of Sikkim.

East, West, North and South District by applying ANNOVA

From the ANNOVA results shown in table 5. 7, it is clear that there is significant difference in the mean level of diversification across the four districts of Sikkim, which is revealed by the F-value. Furthermore, the difference among variance figures for the diversification indices is also found to be significant, as revealed in table 5.7.1. By considering all three methods (Barlett, Levene and Brown-Forsythe), we can conclude that there is great difference in the patterns of diversification to non-farm activities across the four districts of Sikkim.

Most of the household members in each district are engaged in multiple economic activities so as to ensure better earnings. Particularly in the East and South districts each and every household member is engaged in multiple activities while being less concerned about the agricultural jobs. This could be due to better alternative employment opportunities. On the other hand, in case of the North and West districts most of the household belongs to farming class or farming as their basic livelihood. This could be due to poor infrastructures and favourable climatic condition conducive to the cultivation of agricultural products.

There is dissimilarity in diversification pattern among the respondent of the study area. In East district apart from farming,

the members of sampled households are engaged in business activities like running a shop, restaurant, hotel, tours and travels, employed in private companies, government services etc. while considering the remaining districts, they work on daily wages basis like MGNREGA, driving and other non-farm activities. Each and every household has a member working on daily wages and less participated in other activities like business, working at private sector and so on. In South and North districts most of the working members are self-employed and work as a vendor in nearby local markets like Namchi of South district and Mangan of North District.

Conclusion

Organic farming has proven to be a transformative force in Sikkim, driving socio-economic development and setting a global example for sustainable agriculture. The study highlights the significant role of organic farming in improving living standards, empowering women, and fostering community cohesion. Despite its many advantages, challenges like limited market access, inadequate infrastructure, and education gaps persist. Addressing these issues through equitable resource distribution, enhanced training, better transportation, and improved educational opportunities is crucial. With continued government support and targeted initiatives, Sikkim can fully realize the potential of organic farming, benefiting producers and consumers alike. Strengthening agricultural institutions and linking farmers to markets will ensure fresh produce reaches consumers efficiently, further boosting the local economy. By solidifying its status as a fully organic state, Sikkim can inspire sustainable agricultural practices worldwide.

Author contributions

M.A. conceptualized the project and developed the methodology and conducted a formal analysis and drafted the original writing and contributed to the methodology. S.S.P. conducted investigations, provided resources, visualized the data and contributed to reviewing and editing the writing.

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Competing financial interests

The authors have no conflict of interest.

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