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Adoption Status of Improved Ginger (*Zingiber officinale*) Production Technology in Syangja, Nepal

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Abstract The study was carried out from February to July 2021 to assess the adoption status of improved ginger production technology in Syangja, Nepal. The sample population of 80 ginger growers was selected using a simple random sampling technique. The data obtained was analyzed by using Statistical Package for Social Sciences (SPSS) and Microsoft Excel. The chi-square test and independent t-test were applied to determine the association between dependent and independent variables. The analysis showed that the majority of the respondents were male, middle-aged group, literate, and had medium size family. Mulching (93.7%) was the most adopted practice followed by intercropping (88.7%), weeding (87.5%), and rhizome preservation whereas use of recommended fertilizer (13.8%) was the least adopted practice. Socioeconomic factors like level of education, and extension-related factors like training and contact with extension agents had positive and significant relationships with the adoption of improved ginger production technology. The majority of the respondents (67.5%) had not received training related to ginger cultivation, were not in contact with extension agents, and were low adopters of improved ginger production technology. The average annual income and production from ginger cultivation were found to be statistically higher for high adopters. Lack of irrigation facilities, high cost of inputs, incidence of diseases, lack of training facilities, and postharvest loss were the major constraints faced by the farmers in ginger cultivation. The study noted that ginger is the potential spice crop in the Syangja district of Nepal and its productivity can be increased by addressing various factors affecting its production technology.
Keywords Ginger; Production technology; Adoption; Socioeconomic factor

1 Introduction

Ginger (*Zingiber officinalis*) is one of the spice crops of the family Zingiberacea, grown underground for its edible but modified stem. Its rhizome, known for its distinctive aroma and flavor, plays a pivotal role in global cuisine, acting as a spice, flavoring agent, and traditional herbal remedy with anti-emetic, antioxidant, and anti-inflammatory properties (Shahrajabian et al., 2019). It is a warm and humid-loving spice crop, and thus is mostly cultivated in the mid hills of the country at an altitude above 1,600 msl and is very popular in the Syangja district. According to a recent report, Nepal produced 284,000 t of ginger from 23,000 ha of land in 2018 (FAOSTAT, 2020). It has a productivity of 11.40 Mt/ha, a production of 34,644 Mt, and covers an area of 3,038 ha in Gandaki Province (MOALD, 2018/19). The major ginger-producing countries are India, China, Nigeria, Indonesia, Bangladesh, Thailand, Philippines, Jamaica, etc. Nepal is the world's fourth largest ginger producer, after India, Nigeria, and China (FAO, 2019). Ginger has been shortlisted as a comparative advantage crop two years in a row (NTIS, 2016). Around 75% of Nepalese ginger is sold fresh, with the remaining 25% sold in refined forms such as sutho and powdered form.

Ginger is a partial shade-loving plant that needs at least 8-12 hours of direct sunlight per day and an average temperature of 20 °C-30 °C in well-drained soil with a pH of 5.5-6.5. It is sown in April-May to ensure adequate rain for 6-9 months of life, at a depth of 4 times the diameter of the mother rhizome, with a field space of 30 cm plant to plant and 30 cm row to row (Gautam et al., 2018). Ginger is useful in many acute and chronic conditions such as nausea, vomiting, menstrual cramps, reducing gas, joint pain, asthma, congestive conditions, and as an aphrodisiac (Al-Awwadi, 2017). It has been widely used as a flavoring in various food preparations, beverages, gingerbread, soups, pickles, and many soft drinks because of its pungent taste and pleasant odor (Jakkawad et al., 2017). In fiscal year 2018/2019 only an area of 560 ha was cultivated producing a total of only 5,800 Mt which has a productivity of only 10.36 Mt/ha which is severely poor and low in comparison to other ginger-producing districts like Dadheldhura, Okhaldhunga, and Baglung having a productivity of 35.17 Mt/ha, 32.38 Mt/ha and 26.77 Mt/ha and even below the national average of 13.44 Mt/ha (MOALD, 2018/19) , while China has an average yield of around 45Mt/Ha by use of advanced production practices.

Syangja district has huge potential for ginger production and spice-based enterprise establishment but ginger production has not flourished as expected. Many researchers have already studied the diseases and production constraints of ginger farming (Nepali et al., 2000). This region lacks a study on the adoption status of improved ginger production technology, which has been the focus of this study. This study helps to know the complete information about the cultivation practices that have been adopted by the farmers and the technology that is transferred to the community that enables the production process. The outcome of data analysis figures out the problem of the farmer, the reason behind the inability of technology adoption, possible solutions to the problem, the socio-economic status of the community, gender involvement in the production process, and so on.

2 Materials and Methods

2.1 Description of the study site and preliminary survey

Syangja district, a part of Gandaki province, covers an area of 1,164 km^2 and with population of 289,148. Syanja is bounded by Tanahun district to the east, Parbat to the northwest, Kaski to the north, and Gulmi to the Southwest (CBS, 2014). The district has five municipalities Waling, Putalibazar, ChapakotBhirkot, and Galyang. The study site Galyang municipality was formed after the combination of 8 VDCs named Malunga, Jagatradevi, Tindobate, Nibuwakharka, Pindikhola, Pelakot, Pakwadi and Tulsibhanjyang (Municipality Profile, 2016). The research was conducted in Spice zone commanding areas in the district which consists of Malunga (ward no.1), Selawas (ward no.5), Palikot (ward no.7), and Tulsi Bhanjyang (ward no.11) of Galyang municipality. The preliminary study was carried out to collect information regarding different aspects of the survey such as the demographic and socio-cultural condition of the site.

2.2 Sample size, sampling population, and sampling techniques

The target population of this study was ginger growers under the spice zone. Malunga, Pelakot, Selwas, and Tulsibhanjyang were the commanding areas selected purposively. The sample size was calculated using Rao software, using the formula, at 90% level of confidence and 10% level of error. The level of confidence was 90% because of the risk of bias in the response of respondents. The calculated sample size was 59. A sample size of 80 respondents was chosen for the research, exceeding the recommended size of 59 out of the total registered farmers of 416. This decision was made to enhance the accuracy and reliability of the findings by reducing the margin of error and increasing statistical power. The large sample size also ensures a broader representation of the population, capturing more diverse perspectives and improving the generalizability of the results. The formula that was used for the calculation of sample size for a finite population is as follows:

$$n = \frac{z^2Npq}{(N-1)e^2+z^2pq}$$

Where, z = 1.645 at 90% level of confidence; N= population size = 416; p,q = Probability of binomial event; p=q = 0.5, p+q =1; e = Acceptable error; e= 10% = 0.10

2.3 Key informant’s interview, household survey, and focus group discussion

The major key informants - farmers, stakeholders, and DADO officers were asked a series of questions about the present scenario of ginger cultivation and the adoption status of improved ginger cultivation practices. The questionnaire survey, informal discussions, unstructured questions, and field visits were done with farmers, whereas, focus group discussion was conducted with target groups to ensure the information collected through the questionnaire.

2.4 Socio demographic and farm characteristic

The socio-demographic and farm characteristics were used for descriptive analysis of the study areas and study populations. Different variables like family size, ethnicity, and land holding were analyzed by using descriptive statistical tools such as percentage, mode, means, etc.

2.5 Method of data collection

The study was exploratory type, and various sources and techniques for gathering information were used. The study includes primary as well as secondary data. The primary data was collected from the farmers of the respective sites by developing the questionnaire, key informants, farm visits, personal communication, etc. Informal talks were done with local traders, retailers, middlemen, and extension workers to get additional information. The secondary sources of information were collected from the annual report of the Agriculture Knowledge Centre (AKC), Syangja, publications of DDC, DOA, NARC, DADO Syangja profile, journals, and articles.

2.6 Techniques of data analysis

The data collected by field survey were coded, entered, and analyzed using SPSS and MS EXCEL. Descriptive statistics such as frequency and percentage were calculated to determine the distribution of the study variables. The chi-square test and independent t-test were used to test the significance difference between variables and adoption level.

2.7 Measurement of variables

2.7.1 Dependent variable

The dependent variable in the study was improved cultivation practices adopted by ginger growers which are mentioned below (Table 1). Those farmers who adopted these cultivation practices were considered adopters and those not were considered non-adopters. Arbitrary value was assigned for measurement i.e., zero for non-adopters and one for adopters.

Table 1 Dependent variables used in the study

Improved Seed/ varieties	Weeding
Seed treatment	Preservation of seed rhizome
Recommended NPK	Plant protection measure
Value addition	Brunee harvesting
Irrigation	Soil testing
Intercropping	Mulching

2.7.2 Independent variables

Independent variables taken for the study were the socio-economic characteristics of the respondents such as age, gender, level of education, family size, training, and contact with extension agents.

The age of the respondents was measured based on the actual length of their life and expressed in years. Respondents were categorized into three groups by using statistical tools (mean and standard deviation). Gender indicates whether the respondent is male or female. It was expected that gender may have affected the adoption of production technology due to lower female participation in training as well as contacts with extension agents. For the study, education level was categorized into three levels i.e., Illiterate, Literate, and SLC or Above SLC level. Respondents, based on family size were classified into three groups i.e., small size, medium size, and large size using statistical tools (mean and standard deviation). The unit of measurement of landholding size was ropani. Respondents were categorized into three categories i.e., small, medium, and large land holding size by using statistical tools (mean and standard deviation).

The training was provided by DADO, NGO, INGO, and other organizations related to ginger production technology. An arbitrary value was assigned for measurement. 0 for training not received and 1 for training received. Extension contact was classified into two groups i.e., not in contact and contact. An arbitrary value was assigned for measurement. 0 for not in contact, and 1 for in contact.

2.8 Level of adoption of improved ginger production technology

Respondents were categorized into high and low adopters based on the adoption index determined for individual farmers from the data on the extent of adoption of improved ginger production technology. The adoption index was determined from the adoption score which was computed by the sum of scores for adoption of fourteen different practices of ginger cultivation. Respondents were grouped into two categories i.e., low adopters (less than average) and high adopters (average or more than average) based on the adoption index obtained by them. The adoption index of the respondent was measured by an index developed by Karthikeyan in 1994 (Zanu et al., 2012).

$$AI = \frac{\text{Total adoption score obtained by an individual respondent}}{\text{Maximum score one can obtain}}$$

Arbitrary value was assigned for measurement i.e., 0 for low adopters and 1 for high adopters.

2.9 Chi-square test or test of independence

To study the association between two variables i.e., dependent and independent, a chi-square test was applied.

$$\chi 2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Where, χ^2= Chi-square; O_{ij} = observed frequency of each ijth term; E_{ij}= expected frequency of ijth term; i= 1, 2, 3; j= 1, 2, 3

This was tested at 0.05 and 0.01 levels of significance for different degrees of freedom. Independent samples t-test was applied to compare the means of two independent groups to determine whether there is statistical evidence that the associated population means are significantly different.

2.10 Major constraints in the adoption of improved ginger production technology

Major constraints were identified by field survey and focus group discussion. The indexing method was used to rank the problems faced by the farmers in the study area. The index was computed by using the following formula:

Index (I) $=\sum S_i f_i / N$

Where, I=priority index; N= total number of observations; S_i = Scale value at ith priority; F_i = Frequency of ith priority

3 Results and Analysis

3.1 Socioeconomic characteristics of respondents

The findings revealed that the majority of respondents were male (56.3%). In terms of age distribution, 67.4% of respondents were between 40 and 60 years of age, with a mean age of 50.32 years and a standard deviation of 9.84 years. The majority of the respondents were Brahmin (58.8%), followed by Janajati/Adibasi (37.5%), Chhetri (8.8%), and Dalit (7.5%). In terms of education, 47.5% of respondents were literate, 27.5% were illiterate, and 25.0% had completed secondary education (SLC) or higher. Family size includes the majority (61.3%) having medium-sized families and an average family size of 6 members. The primary source of household income for most respondents (82.5%) was agriculture, followed by employment in the service sector (11.3%), remittances (3.8%), and business activities (2.5%). These socio-demographic factors provide a comprehensive overview of the respondents' backgrounds and were pivotal in assessing the level of adoption of improved ginger production technologies.

3.2 Description of extension-related factors

The extension-related factors examined in this study area were training related to ginger cultivation and contact with extension agents. It was found that the majority of the respondents i.e., 67.5% had not received training related to improved ginger production technology (Table 2).

Table 2 Distribution of respondents based on participation in training

Farmer's participation in training	Frequency	Percent (%)
Training received	26	32.5
Training not received	54	67.5
Total	80	100.0

Source: Field Survey, 2021

Table 3 showed that only 25% of the respondents were not in contact with extension agents, rest 75% of the respondents were in contact.

Table 3 Distribution of respondents based on contact with extension agents

Contact with extension agents	Frequency	Percent (%)
In contact	60	75
Not in contact	20	25
Total	80	100.0

Source: Field Survey, 2021

3.3 Description of ginger cultivation-related factors

3.3.1 Information source for ginger farming

Having access to reliable information is important for enhancing ginger farming. Results showed that the majority of the farmers (75%) rely on fellow farmers for cultivation knowledge that emphasizes the value of peer learning (Table 4). Furthermore, 21.3% of farmers attended formal training sessions offered by NGOs or extension organizations, highlighting the importance of structured learning for skill development. ICT-based information sources were used by just 3.8% of respondents, which indicates limited adoption which may be caused by low digital literacy or poor connectivity in rural areas. Peer learning remains dominant over other sources of information for ginger farming. However, there is potential for increased ICT use to enhance the dissemination of agricultural knowledge.

Table 4 Information source for ginger farming

Information source	Frequency	Percent (%)
Fellow farmers	60	75.0
Training	17	21.3
ICT	3	3.8
Total	80	100.0

Source: Field Survey, 2021

3.3.2 Ginger production and income per year from ginger

It was found that the average production of ginger in the study area was 476.06 kg with a minimum of 200 kg and a maximum of 1,200 kg.

3.3.3 Active population, year of experience, and area under ginger cultivation

The results showed that the average number of active populations in a family involved in ginger cultivation was 2.6375 with a minimum of 2 and a maximum number of 4 (Table 5). Similarly, the average year of experience of ginger growers was 4.763 with a minimum of 2 years and a maximum of 9 years. The average area under ginger cultivation was 3.3687 ropani with a minimum of 1.50 and a maximum of 6 ropani.

Table 5 Active population, year of experience, and area under ginger cultivation

Categories	Average	Minimum	Maximum
Active population	2.6375	2.00	4.00
Year of experience	4.763	2	9
The area under ginger cultivation	3.3687	1.50	6.00

Source: Field Survey, 2021

3.4 Extent of adoption of improved ginger production technology

There was a variation in the extent of adoption of different improved ginger production technologies by respondents. Table 6 showed that the majority of the respondents (93.7%) adopted mulching with dry leaves and plant residues followed by intercropping (88.7%), weeding (87.5%), preservation of rhizome (85%), seed treatment (71.3%), plant protection (52.5%), value addition (38.7%), improved seed (35%), brunee harvesting (28.7%), irrigation (21.2%), soil test (15%), and recommended NPK (13.8%).

Table 6 Distribution of the extent of adoption of improved ginger production technology by farmers (N=80)

S. N	Practices	Adoption level			
		Adopters		Non-adopters	
		Number	Percent (%)	Number	Percent (%)
1.	Improved seed	28	35	52	65
2.	Seed treatment	57	71.3	23	28.7
3.	Soil test	12	15	68	85
4.	Recommended NPK	11	13.8	69	86.3
5.	Mulching	75	93.7	5	6.3
6.	Irrigation	17	21.2	63	78.8
7.	Weeding	70	87.5	10	12.5
8.	Intercropping	71	88.7	9	11.3
9.	Plant Protection	42	52.5	38	47.5
10.	Brunee harvesting	23	28.7	57	71.3
11.	Value addition	31	38.7	49	61.3
12.	Preservation of rhizome	68	85	12	15

Source: Field Survey, 2021

The result indicated that the mulching practice had the highest adopters as compared to other improved practices. The reason for the high adoption of mulching might be that this practice does not require a much larger investment than other practices and can be done with locally available materials. The number of adopters was low in chemical fertilizer application (recommended NPK), soil test, and irrigation. The reason for the low adoption of fertilizer was due to the high cost of fertilizers and the unavailability of inputs in time (Yadav et al., 2013).

3.5 Description of production technology adopted by ginger growers

The study showed that maize was the most used crop for intercropping with ginger i.e.,75%, followed by chili (7.5%) and mandarin (6.3%). The majority of the respondents (77.5%) were found to be dependent on monsoon rain for irrigation and only 16.3% of the respondents used plastic ponds as a source of irrigation for ginger farming.

As plant protection measures, the majority of the respondents (42.5%) used bio-pesticides and only 6.25% of respondents used chemical pesticides. The storage of ginger pit was used by the majority of the respondents (61.25%), followed by a polyethylene bag (13.75%).

3.6 Adoption of improved ginger production technology

Table 7 revealed that the majority of the respondents (60%) had a low level of adoption followed by a high level of adoption (40%) of improved ginger production technology.

Table 7 Distribution of respondents according to the level of adoption of improved ginger production technology (N=80)

Adoption level	Frequency
Low (< 0.51)	48 (60)
High (>0.51)	32 (40)
Mean	0.51
Standard deviation	0.159

Note: The figure in parenthesis indicates the percentage (Source: Field Survey, 2021)

3.7 Factors affecting the adoption level of improved ginger production technology

The chi-square test was applied at 0.05 and 0.01 probability tests to measure the association between socioeconomic and extension-related factors with the adoption level of improved ginger production technology. Socio-economic factors include age, gender, education level, family size, and so on and extension-related factors include training and contact with extension agents.

3.7.1 Age

Results revealed that age groups between 40-60 years were found to be high adopters of improved ginger production technology. Table 8 signified that the association between the age of respondents and the adoption level of improved ginger production technology used by them was statistically non-significant. This result indicated that the age of the respondents was not associated with the adoption of improved ginger production technology. Kharjana et al. (2017) reported similar findings, indicating that the age of respondents did not significantly influence the adoption of improved production technologies for ginger.

Table 8 Distribution of respondents by their age and adoption level of improved ginger production technology (N=80)

Adoption level	Age of respondents			Total	Chi-square value	P value
	Below 40	40-60	Above 60			
Low adopter	7 (7.8)	31 (32.4)	10 (7.8)	48 (48.0)	1.908	0.385 at df 2
High adopter	6 (5.2)	23 (21.6)	3 (5.2)	32 (32.0)		
Total	13 (13.0)	54 (54.0)	13 (13.0)	80 (80.0)		

Note: The figure in parenthesis indicates the expected frequency. Non-significant

3.7.2 Gender

Table 9 showed that the association between the gender of respondents and improved ginger production technology used by them was statistically non-significant. This implies that the adoption of improved production technology for ginger was not affected by whether a male or female was involved in it.

Table 9 Distribution of respondents based on gender and adoption level of improved ginger production technology

Adoption level	Gender of respondents		Total	Chi-square value	P value
	Male	Female			
Low adopter	28 (27.0)	20 (21.0)	48 (48.0)	0.847	0.358 at df 1
High adopter	17 (18.0)	15 (14.0)	32 (32.0)		
Total	45 (45.0)	35 (35.0)	80 (80.0)		

Note: The figure in parenthesis indicates expected frequency; P value 0.358 df =1 non-Significant

3.7.3 Education level

It was found that among all the respondents, literate farmers were likely to be high adopters of improved production technology of ginger. Table 10 showed that the association between the education level of respondents and improved practices used by them was statistically significant at a 5% level of significance. This showed that the higher the education level, the higher the extent of adoption. The reason for the increasing extent of adoption with increased level of education might be due to farmers having more education can better manage the problems and hence can get profit resulting in more adoption of improved production technology.

Table 10 Distribution of respondents according to their level of education and adoption level of improved ginger production technology

Adoption level	The education level of respondents			Total	Chi-square value	P value
	Illiterate	Literate	SLC or above			
Low adopter	18 (13.2)	21 (22.8)	9 (12.0)	48 (48.0)	6.594**	0.037 at df 2
High adopter	4 (8.8)	17 (15.2)	11 (8)	32 (32.0)		
Total	22 (22.0)	38 (38.0)	20 (20.0)	80 (80.0)		

Note: The figure in parenthesis indicates the expected frequency, and ** denotes significance at a 5% level of significance

3.7.4 Family size

The study revealed that medium (5-7) family sizes were likely to be high adopters of improved ginger production technology (Table 11). The calculated value of chi-square (1.511) was statistically non-significant. The result indicated that there was no significant association between family size and the adoption of improved ginger production technology.

Table 11 Distribution of respondents by their family size and adoption level of improved ginger production technology (N=80)

Adoption level	Family size			Total	Chi-square value	P value
	Less than 5	5-7	Above 7			
Low adopter	7 (8.4)	32 (29.4)	9 (10.2)	48 (48.0)	1.511	0.470 at df 2
High adopter	7 (5.6)	17 (19.6)	8 (6.8)	32 (32.0)		
Total	14 (14.0)	49 (49.0)	17 (17.0)	80 (80.0)		

Note: The figure in parenthesis indicates the expected frequency

3.7.5 Training participation of respondents

The study revealed that trained respondents were likely to be high adopters of improved ginger production technology. Table 12 showed that the calculated chi-square (10.342) was statistically significant at a 1% level of significance. Training was significantly associated with adoption level. This result indicated that the higher the number of training received by farmers higher the level of adoption of improved ginger production technology.

Table 12 Distribution of respondents based on participation in training and adoption level of improved ginger production technology

Adoption level	Distribution of respondents		Total	Chi-square value	P value
	Training not received	Training received			
Low adopter	39 (32.4)	9 (15.6)	48 (48.0)	10.342***	0.001 at df 1
High adopter	15 (21.6)	17 (10.4)	32 (32.0)		
Total	54 (54.0)	26 (26.0)	80 (80.0)		

Note: The figure in parenthesis indicates the expected frequency, and *** denotes significance at a 1% level of significance (Source: Field Survey, 2021)

3.7.6 Contact with extension agents

The study revealed that farmers who were in frequent contact with extension agents were likely to be high adopters of improved ginger production technology. Table 13 showed that the calculated chi-square (6.086) was statistically significant at a 5% level of significance. The study indicated that contact with extension agents was significantly positively associated with the level of adoption of improved ginger production technology. There was a positive association between the adoption level of improved horticultural cultivation practices with extension agents (Kadian, 1999).

Table 13 Distribution of respondents based on contact with extension agents and adoption level on improved ginger production technology (N=80)

Adoption level	Distribution of respondents		Total	Chi-square value	P value
	Not in contact with an extension agent	In contact with the extension agent			
Low adopter	16 (11.4)	32 (36.6)	48 (48.0)	6.086**	0.014 at df 1
High adopter	4 (7.6)	28 (24.4)	32 (32.0)		
Total	20 (20.0)	60 (60.0)	80 (80.0)		

Note: The figure in parenthesis indicates the expected frequency, and ** denotes significance at a 5% level of significance (Source: Field Survey, 2021)

3.8 t-test of ginger technology adoption, income, and yield

Table 14 showed that the average total production of low adopters and high adopters was 404.583 kg and 583.281 kg respectively. The average annual production of respondents was found to be statistically significant at a 1% level of significance and significantly higher for high adopters. The average annual income of low adopters and high adopters was Rs 12259.483 and Rs 18200.569 respectively. The average total income of respondents was found to be statistically significant at a 1% level of significance and significantly higher for high adopters of improved ginger production technology.

Table 14 Independent t-test of adoption level on improved ginger production technology with total income and production of ginger (N=80)

Variable	Low adopters	High adopters	Mean difference	Standard error difference	t-value	P-value
Total Production (In Kg)	404.583	583.281	178.69792	44.24832	4.039***	0.013 at df 78
Total income (In Rupees)	12259.483	18200.569	12474.895	3402.03097	3.667***	0.014 at df 78

Note: *** denotes significance at a 1% level of significance (Source: Field survey 2021)

3.9 Major constraints for adoption of improved ginger production technology

Different problems were faced by farmers during ginger production. These problems were associated with the adoption of improved ginger production technology. Five-point scaling technique (1, 0.8, 0.6, 0.4, and 0.2) was used for ranking the problem. Table 15 shows that lack of irrigation has the highest index value of 0.904 and the problem of postharvest loss has the lowest index value of 0.441. The relative severity of the problems followed the sequence of lack of irrigation, high cost of inputs, incidence of disease, lack of training facilities, and postharvest loss.

Table 15 Major constraints for adoption of improved ginger production technology

Constraints	Index	Rank
Lack of irrigation	0.904	I
High cost of inputs	0.75	II
Incidence of diseases	0.583	III
Lack of training facilities	0.496	IV
Postharvest loss	0.441	V

Source: Field Survey, 2021

Other problems faced by farmers were damage to fruits by wild animals like monkeys, difficulty in the timely arrangement of inputs such as seed rhizome due to lockdown situation in the country because of the pandemic coronavirus spreading all over the world and some of the respondents also faced marketing problems.

4 Discussion

The study concludes that mulching was the most widely adopted practice among ginger growers, while practices such as intercropping, weeding, and rhizome preservation were moderately adopted. However, value addition, brunee harvesting, soil testing, irrigation, and the use of recommended NPK fertilizers were among the least adopted practices. The majority of respondents were male, middle-aged, belonging to the Brahmin ethnic group, and showed lower levels of adoption of improved ginger production technology. The extent of adoption was significantly associated with factors like education, training, and contact with extension agents, while age, family size, and gender did not play a significant role in adoption levels. Additionally, high adopters of improved production technology achieved statistically higher ginger production. The study also highlighted that most respondents had not received any training related to ginger cultivation nor were they in contact with extension agents. The major challenges faced by farmers included lack of irrigation, high input costs, disease incidence, insufficient training facilities, and postharvest losses, which hindered the adoption of improved ginger production technologies.

This study has several limitations to consider. The sample size of 80 ginger growers and the focus on the Syangja district may limit the generalizability of the findings to other regions with different conditions. The cross-sectional design provides a snapshot in time, missing potential changes in adoption behaviors over time. Reliance on self-reported data introduces the risk of bias, as responses may be influenced by social desirability or memory recall. Additionally, the study did not explore factors like market access, local policies, or environmental conditions in-depth, and the use of only quantitative methods may overlook farmers' nuanced experiences. Data collection during the COVID-19 pandemic may have also impacted results. These limitations highlight areas for further research to better understand adoption behaviors and challenges.

Authors' contributions

SP and SA were involved in conceptualization, conducting the experiment, data curation, editing, data analysis, and writing the original draft. MP, DS, and ST were involved in supervision, manuscript revision, and providing the final structure to the manuscript. BS was involved in the evaluation, editing, guidance, and conceptualizing of the idea of the research and reviewing the manuscript. All authors read and approved the final manuscript.

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Conflict of Interest Disclosure

The authors affirm that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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