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Adoption Status of Improved Coffee Production Technology in Arghakhanchi District, Nepal

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Abstract. *A study was conducted in 2023 to assess the adoption status and influencing factors related to improved coffee production technologies among coffee farmers in Arghakhanchi, Nepal. The research focused on a purposively selected coffee zone command area. A total of 80 households were sampled through simple random sampling and were interviewed using a pre-tested semi-structured questionnaire. Data analysis was performed using descriptive statistics, indexing, and binary logistic regression with SPSS and MS Excel software. The majority of coffee producers adhered to recommended practices for fertilizer application (92.5%), intercropping (71.25%), and shading (73.75%). Moderate levels of adoption were noted for pit size and spacing (52.5%) and mulching practices (42.5%), whereas adoption of pruning (37.5%), irrigation (30%), and stumping (15%) was relatively low. Binary logistic regression analysis demonstrated that training had a significant and positive impact on the adoption of most improved production technologies. Additionally, factors such as years of experience, plant population, age, family size, and education were significant in influencing the adoption of various practices. Key motivations for coffee farming included favorable returns, reduced wildlife damage, and positive neighbor feedback, while major challenges encompassed inadequate rainfall, poor irrigation infrastructure, insufficient training and technical knowledge, and pest issues.*

Keywords: Coffee production, Common cultivation practices, Adoption of recommended practices, Improved technologies

Introduction

Coffee is one of the most widely traded cash crops globally, valued for its popularity as a beverage. It belongs to the Rubiaceae family, and the *Coffea arabica* species, in particular, is known for its pleasant taste, distinctive aroma, health benefits, and stimulating effects attributed to its high caffeine content (Aresta and Zambonin, 2023). While commercial coffee cultivation began in Yemen during the fourteenth century, it was introduced to Nepal only in 1938 AD. The country's diverse climate and soil conditions are highly conducive to producing high-quality coffee, especially within the altitude range of 800 to 1,400 meters above sea level (Dahal, 2020). Of

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the two primary species, *Coffea arabica* and *Coffea robusta*, only *C. arabica* is grown in Nepal, where coffee is currently cultivated across 44 districts. In the 2020/21 fiscal year, Nepal produced 315 metric tons (MT) of green beans from 3,052 hectares, resulting in a productivity rate of 103.21 kg/ha (MoALD, 2022).

Studies have demonstrated that coffee cultivation is significantly more profitable compared to other crops, offering higher income potential, superior unit value, and robust profitability across various production systems (Turco et al., 2017; Satish Kumar CH et al., 2019; Baronchelli et al., 2024).

Coffee farming is notably more labor-intensive than alternative crops, with research highlighting its high labor requirements and substantial gross margins (Njuki et al., 2004). The absence of synthetic pesticides and chemical fertilizers, combined with strict adherence to organic standards, means that most coffee produced in Nepal is organic and thus fetches a premium price in international markets (Dahal, 2020). However, Nepalese coffee faces challenges in scaling its presence in global markets due to the small scale of production and occasional quality inconsistencies. Despite these hurdles, Nepal's highland coffee is highly sought after for its excellent cupping quality and distinctive aroma. Nevertheless, the overall productivity of Nepal's coffee sector remains low when compared to global standards.

The Nepalese coffee industry grapples with several challenges, including the lack of environment-specific technologies, limited access to essential inputs like irrigation and fertilizers, and inadequate adoption of essential intercultural operations such as shading, mulching, and timely pruning. These factors have contributed to persistently low productivity rates over the years. For example, coffee productivity in the Arghakhanchi district is notably lower than in other major coffee-growing regions, with production fluctuating erratically between 11.6 MT and 31 MT over the past five years, currently standing at 16 MT or approximately 123 kg/ha. Neighboring districts in similar or even less favorable geographic conditions, such as Nuwakot (170 kg/ha) and Palpa (140 kg/ha), report higher productivity levels (MoALD, 2022). In contrast, leading coffee-producing nations like Brazil, Vietnam, and Ethiopia achieve much higher yields of 1.65 MT/ha, 2.71 MT/ha, and 0.64 MT/ha, respectively (Ayele et al., 2021).

To improve productivity, a range of advanced coffee production technologies can be adopted, including the correct maintenance of pit spacing, mulching, plant shading, regular pruning, efficient irrigation, comprehensive nutrient management, adherence to plant protection measures, and timely harvesting. These practices are proven to enhance economic outcomes; however, their benefits cannot be fully realized without widespread adoption, which necessitates a clear understanding of the factors influencing farmers' willingness to adopt these practices (Uaiene, 2011). This study, therefore, seeks to evaluate the level of adoption of recommended coffee production technologies among farmers and the factors influencing these adoption decisions in the Arghakhanchi district. The study aims to provide stakeholders — farmers, researchers, extension workers, and policymakers — with valuable insights to guide decision-making, recommend effective measures, and develop targeted programs. These efforts are designed to boost the adoption of improved coffee production practices and enhance the overall productivity of coffee in Arghakhanchi district.

Material and methods

Description of study area

Arghakhanchi district is located in the lower midhills of Lumbini province, with an elevation ranging from 305 to 2,515 meters above sea level. Geographically, the district lies between 27°45' to 28°6' North latitude and 80°45' to 83°23' East longitude, covering a total area of 1,193 km². Among its six local administrative units, coffee cultivation is mainly concentrated in Chhatradev Rural Municipality and Sitganga Municipality, which fall under the coffee zone of Arghakhanchi. Consequently, the study was conducted in Sitganga Municipality and Chhatradev Rural Municipality (Figure 1).

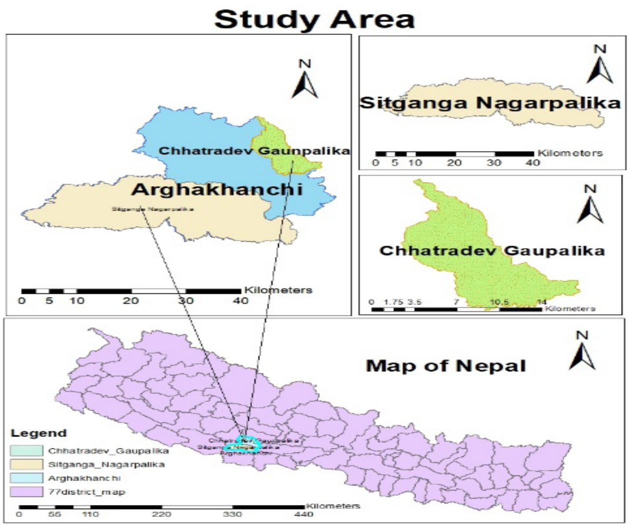

Figure 1. Map of the study area

Sample and Sampling technique

The study targeted coffee growers registered under the PMAMP coffee zone program at the study site. A complete list of these farmers was obtained from the PMAMP PIU Arghakhanchi office database, creating a sampling frame of 270 farmers. The required minimum sample size was calculated using Raosoft software, with a 95% confidence level and a 10% margin of error, resulting in a sample size of 72. To ensure a robust sample, 80 farmers were randomly selected, with 40 households surveyed from each of the Sitganga and Chhatradev municipalities.

Research Instrument and Design

Key informant interviews were conducted with selected stakeholders, including progressive farmers, PMAMP officers, cooperative members, and village leaders, to gain deeper insights into the research site. The interviews focused on common cultivation practices, the adoption of recommended practices, extension services related to improved technologies, and overall regional trends.

Based on insights gathered from key informant interviews and a preliminary survey, a questionnaire was developed and refined through pre-testing. Household surveys were then conducted using this finalized questionnaire. Both qualitative and quantitative data on various aspects of coffee cultivation and the adoption of recommended technologies were collected through face-to-face interviews. A total of 80 sample households were surveyed using a personal interview schedule (PIS).

Following the completion of the household surveys, Focus Group Discussions (FGDs) were conducted in the study areas using a pre-determined semi-structured checklist. These discussions aimed to supplement and verify the information collected earlier.

Data Analysis

Quantitative and qualitative data obtained from the survey were coded, entered, cleansed, and analyzed. SPSS (Statistical Package for the Social Sciences) and Microsoft Excel software was used for analysis.

Descriptive statistics such as frequency and percentage were calculated along with mean and standard deviation to study the distribution of variables. The descriptive statistics were used for describing the respondents' socio-demographic characteristics like gender, family size, landholding, education, membership in organizations, etc.

The decision to adopt various improved production practices is influenced by the socioeconomic status of farmers. Depending on their understanding of a technology, farmers may choose to adopt or reject a practice, making the adoption decision inherently binary. Given this binary nature, a binary logistic regression model was employed to identify factors influencing the adoption of management practices. The model helped determine the key determinants and their impact on the likelihood of adopting improved orchard management practices. Seven major practices were identified as dummy variables, and the model was applied separately to each practice. Practices such as FYM application, which was adopted by nearly all respondents, were excluded from the analysis. A description of the variables used in the binary logistic regression is presented in Table 1.

Logistic equation used in this study is given by

$p(1-p) = e\text{\^{}}(b_0 + b_1x_1 + \ldots\ldots\ldots\ldots + b_7x_7)$

Where,

- $p/(1-p)$ is odds of an event
- p is the probability

- e is base of natural logarithm
- $b_0 \ldots b_7$ are coefficients
- $x_1 \ldots\ldots x_7$ are independent variables.

Logit form of equation can be obtained by taking natural log on both sides,

$$\log[p/(1-p)] = b_0 + b_1x_1 + \ldots\ldots\ldots\ldots + b_7x_7$$

Table 1. Definition of variables

Variables	Description of variables
Gender (dummy)	Gender of respondent (0=male, 1=female)
Age (continuous)	Age of respondent (years)
Education (continuous)	Education status of respondent (years)
Family Size (continuous)	Total number of members in family
Experience (continuous)	Experience in coffee farming (years)
Plant population (continuous)	Total number of coffee plants at present
Training received (dummy)	Whether respondent has received any trainings on improved coffee production technology or not (0=no, 1=yes)
Market distance (continuous)	Walking distance from farmer to collector in minutes
Pit size and spacing (dummy)	Have followed the recommended spacing and pit size or not (0=no, 1=yes)
Shade management (dummy)	Have shade trees in coffee orchard or not (0=no, 1=yes)
Mulching (dummy)	Practice mulching in coffee or not (0=no, 1=yes)
Pruning (dummy)	Follow the recommended pruning practice or not (0=no, 1=yes)
Intercropping (dummy)	Practicing intercropping in coffee orchard or not (0=no, 1=yes)
Irrigation (dummy)	Irrigate coffee field at critical stages or not (0=no, 1=yes)
Stumping (dummy)	Follow stumping practice or not (0=no, 1=yes)

The challenges and influencing factors associated with coffee production in the Arghakhanchi district were identified through household surveys, focus group discussions (FGDs), and key informant interviews. To assess the relative severity of production problems and the motivations behind coffee cultivation, a five-point scaling technique was employed. Farmers' perceptions regarding the significance of various production constraints or motivational factors were analyzed using a five-point scale, ranging from 1 for major factors or problems to 0.2 for minor ones.

The index of importance was computed by using the formula:

$$I_{imp} = \sum(S_iF_i/N)$$

Where,

I_{imp} (index of importance) = $0<I<1$

$\sum$ = summation

S_i= ith scale value

F_i= frequency of ith importance given by the respondents

N = total number of respondents

Ethical Consideration

The research adhered to ethical guidelines and principles through the data collection process. This study was approved by Prime Minister Agriculture Modernization Project, PIU, Coffee Zone, Arghakhanchi, Nepal, and Agriculture and Forestry University, Rampur, Chitwan. Informed written consent was obtained from all participants, who explicitly agreed to participate in the study after being informed about its purpose. Participants were assured that their information would be kept confidential, with their identities protected even if the data needed to be shared for research purposes.

Results and discussion

Socio-economic and demographic characteristics

The socio-economic characteristics of households in the study area are summarized in Table 2 and Table 3. The sample consisted predominantly of female-headed households, accounting for 68.75%, while male-headed households comprised 31.25%. In terms of ethnicity, the majority were Brahmin (90%), followed by Dalit (5%), Janajati (3.75%), and Chhetri (1.25%). The age distribution showed that most respondents were between 45-69 years old (67.5%), with 15% being younger than 45 years, and 17.5% aged 70 and above. Regarding education levels, 41.25% of the participants had primary education, 17.5% had secondary education, 16.25% received informal education, and 11.25% had higher education, while 13.75% were illiterate. Farming experience varied, with 45% of households having 11-20 years of experience, 39% with less than 10 years, 14% with 21-30 years, and only 3% had more than 30 years of experience. Additionally, 83.75% of households were involved in cooperatives, while 16.25% were not. Training on coffee production was received by 62.5% of the respondents, whereas 37.5% had no training.

Table 2. Socio-economic and demographic characteristic of study area

Particulars	Frequency	Mode category
Gender of household		Male
Female	25 (31.25)	
Male	55 (68.75)	
Ethnicity		Brahmin
Brahmin	72 (90)	
Dalit	4 (5)	
Janajati	3 (3.75)	
Chhetri	1 (1.25)	
Age		45-69 years
Less than 45 years	12 (15)	
45-69 years	54 (67.5)	
70 and above years	14 (17.5)	
Education level		Primary
Illiterate	11 (13.75)	
Informal	13 (16.25)	
Primary	33 (41.25)	
Secondary	14 (17.5)	
Higher	9 (11.25)	
Experience in farming		11-20 years
Less than 10 years	31 (39)	
11-20 years	36 (45)	
21-30 years	11 (14)	
Greater than 30 years	2 (3)	
Involvement in cooperatives		Yes
Yes	67 (83.75)	
No	13 (16.25)	
Training on coffee production		Yes
Yes	50 (62.5)	
No	30 (37.5)	

Note: Figures in Parentheses represent percentage.

Household family sizes varied from 2 to 9 members, with an average of 5.30 members (SD = 1.57). Landholding patterns among households showed considerable diversity, with total land areas ranging from 0.051 to 2.49 hectares and an average size of 0.88 hectares (SD = 0.57). On average, 0.65 hectares (SD = 0.50) of this land was used for cultivation, while the area dedicated specifically to coffee cultivation ranged from 0.007 to 2.31 hectares, with a mean of 0.14 hectares (SD = 0.32). These figures suggest that coffee cultivation occupies a relatively small portion of the total land, which may indicate that it plays a supplementary role in household economies or that households face constraints such as limited capital, labor, or suitable land for expanding coffee cultivation. Walking distances to the nearest market ranging from 0 to 60 minutes and an average of 17.20 minutes (SD = 12.543). The total number of trees in coffee orchard ranged from 10 to 3500, with a mean of 206.5 (SD = 490.21). Similarly, the total number of fruit bearing plants ranged from 0 to 300, with a mean of 47.38 (SD = 60.25). It indicates that most of the newly developed orchards are yet to reach the yielding stage.

Table 3. Socio-economic and demographic characteristics of study area

Particulars	Max	Min	Mean	Standard deviation
Family size	9	2	5.30	1.57
Land holding (ha)				
Total land area	2.49	0.051	0.88	0.57
Land under cultivation	2.49	0.051	0.65	0.50
Land under coffee cultivation	2.31	0.007	0.14	0.32
Walking distance to market (minutes)	60	0	17.20	12.543
Total trees in orchard				
Total trees	3500	10	206.4	490.21
Bearing trees	300	0	47.38	60.25

Status of adoption of recommended coffee production technology

Table 4 details the adoption status of various coffee production technologies in the study area, reflecting the use of practices recommended by the National Tea and Coffee Development Board (NTCDB). Proper pit size is crucial for optimal root development and plant growth (Baitelle et al., 2018). Proper spacing and appropriately sized pits enhance light penetration and air circulation, which are crucial for minimizing disease incidence and supporting healthy plant growth (Samsuri et al., 2022). The recommended pit dimensions are 25 cm in width and 45 cm in depth, with a spacing of 2 m between rows and 2 meters between plants (NTCDB, 2018). The survey found that 52.5% of farmers adhered to these recommended practices for pit size and spacing, while 47.5% did not.

Mulching involves covering the soil around plants with various materials to promote optimal growing conditions (Bhardwaj, 2013). This practice is particularly beneficial for coffee plants, as it improves soil health and plant productivity. Mulching enhances seedling survival, conserves soil moisture, and boosts resilience to moisture stress, especially in drought-prone regions (Amin et al., 2018). It also helps to prevent weed growth, supports proper root development, and avoids soil compaction. According to the survey, 42.5% of farmers adopted mulching, whereas 57.5% did not use any mulching materials.

Coffee naturally thrives in shaded conditions, and providing shade offers numerous benefits. Shade trees protect coffee plants from environmental stresses such as high soil temperatures and low humidity by creating a cooler microclimate (Imru et al., 2015; Lara-Estrada et al., 2023). Shaded coffee plants exhibit improved physiological traits, including enhanced photosynthesis and greater leaf area, which contribute to better plant performance and higher fruit quality compared to those grown in direct sunlight (Imru et al., 2015). The NTCDB (2018) recommends using temporary shade during the first year after transplanting and then integrating specific shade trees such as *Parkia platycephala, Moringa oleifera, Jackaranda mimosifolia,* and *Grevillea robusta*. The survey indicated that 73.75% of farmers utilized shade trees in their coffee orchards, while 26.25% grew coffee without any shade.

Pruning is a vital practice in coffee cultivation, designed to promote vegetative growth, enhance productivity, and prolong the plant's productive life (Muliasari et al., 2021). This technique involves removing unproductive branches to maintain healthy, productive plant tissue (Somarriba and Quesada, 2022). Without pruning, coffee plants can become overly bushy, weakened, and age rapidly (Million et al., 2020). The NTCDB (2018) recommends pruning by removing branches within the bottom 30 cm of the main stem, cutting the top of the main stem after it reaches a height of 1.5 to 1.75 meters, and pruning secondary and tertiary branches after 2-3 years of fruit bearing. The survey found that only 37.5% of farmers adhered to these pruning guidelines, while 62.5% did not.

Coffee plants require between 1500 and 2000 mm of water annually, making it essential to provide adequate water through rainfall or irrigation during key growth stages for optimal yield. According to NTCDB (2018), there are four critical irrigation periods for coffee cultivation: i) the first two years after transplanting (Falgun – Jestha), ii) flowering time (Chaitra), iii) fruit setting time (Baishakh to Jestha), and iv) fruit development period (Shrawan - Bhadra). Proper irrigation during these stages can boost coffee yield by 40-60%. Despite this, only 30% of farmers adhere to the recommended irrigation schedule, while 70% do not provide water at all the critical stages.

Intercropping in coffee plantations provides numerous advantages, such as increased crop diversity and greater economic returns. This approach allows for the cultivation of staple crops alongside coffee, which can result in higher land equivalent ratios and overall increased productivity (Mekonnen et al., 2020). The NTCDB (2018) recommends planting crops such as vegetables, potatoes, sweet potatoes, turmeric, and medicinal plants between rows of coffee plants, maintaining a distance of at least 60 cm from the coffee plants during the first two years after transplanting. According to the survey, 71.25% of farmers practiced intercropping in their coffee orchards.

Although application of chemical fertilizers in right amount is recommended in training nowadays, no farmer was found to apply any chemical fertilizers on their coffee orchards till the study date. A total of 92.5% of the farmers applied organic manure as recommended by NTCDB (2018).

Stumping is an essential practice in coffee production aimed at rejuvenating old, low-yielding trees and boosting productivity. It is also used when coffee branches are damaged or infested by pests or diseases. The NTCDB (2018) recommends performing stumping by cutting the coffee tree 30 cm from the ground during the months of Falgun or Chaitra, following rainfall. However, only 15% of farmers in the study area employ this practice, while 85% do not engage in stumping.

Table 4. Status of adoption of Coffee production technology

Type of technology	Coffee farmers response to adoption strategy			
	No of adopters	No of non-adopters	% of adopters	% of non-adopters
Pit size and spacing	42	38	52.5	47.5
Mulching	34	46	42.5	57.5
Shading	59	21	73.75	26.25
Pruning	30	50	37.5	62.5
Irrigation	24	56	30	70
Intercropping	57	23	71.25	28.75
Fertilizer application	74	6	92.5	7.5
Stumping	12	68	15	85

Note: Figures in Parentheses represent percentage.

Factors affecting the adoption of coffee production technology

Table 5 illustrates the impact of various socio-economic factors on the adoption of coffee production technologies. Age was found to be significantly and negatively associated with the adoption of mulching practices ($\beta = 0.06^{**}$, $p < 0.05$). Specifically, with each additional year of age, the likelihood of adopting mulching decreases by 0.989 times. This suggests that younger farmers are more inclined to adopt mulching practices compared to older farmers. The reluctance of older farmers may be attributed to their extensive experience with traditional methods and a risk-averse attitude that makes them less open to new technologies (Brown et al., 2019). Conversely, younger farmers tend to be more innovative, technically skilled, and willing to take risks (Million et al., 2020; Lee et al., 2022). These findings are consistent with previous studies by Luzinda (2018) and Million et al. (2020), which also reported a negative correlation between age and the adoption of improved coffee technologies.

Coffee growing experience was found to be significant and negatively correlated with pit size and spacing ($\beta = -0.108^{**}$ $p < 0.05$) and mulching ($\beta = -0.104^{**}$ $p < 0.05$) while positively correlated with shading ($\beta = 0.133^{**}$ $p < 0.05$) and stumping ($\beta = 0.116^{**}$ $p < 0.05$). One year of increase in coffee farming experience decreases the odds of adopting recommended pit size, spacing and mulching practices by 0.898 and 0.901, respectively. Similarly, one-year increase in farming experience would increase the odds of adopting recommended shading and stumping practices by 1.142 and 1.018, respectively. This indicates that coffee growing experience has complex relationship with adoption of various production technologies. The experienced farmers might have strong preference for practices that have worked for them in the past and might perceive certain practices such as precise pit size and spacing as unnecessary or overly prescriptive. Many studies have reported negative association between farming experience and adoption of improved or recommended farming practices (Knowler and Bradshaw, 2007; Million et al., 2020), which align with our findings. However, experienced farmers might also recognize the long-term benefit of certain practices such as shading and stumping in improving long-term coffee health and productivity. Tegegne et al. (2015) and Temesgen and Debeb (2024) have reported positive correlation between coffee farming experience and adoption of improved/ recommended practices.

Training in coffee production was found to significantly and positively impact the adoption of various recommended practices. Specifically, training was positively correlated with the adoption of optimal pit size and spacing ($\beta = 1.864^{**}$, $p < 0.05$), mulching ($\beta = 1.785^{****}$, $p < 0.05$), shading ($\beta = 2.238^{***}$, $p < 0.05$), intercropping ($\beta = 1.007^{*}$, $p < 0.05$), and stumping ($\beta = 2.979^{***}$, $p < 0.01$). Receiving training increases the odds of adopting these practices by 6.452 times for pit size and spacing, 5.962 times for mulching, 9.379 times for shading, 2.737 times for intercropping, and 19.70 times for stumping. These findings are consistent with previous research by Million et al. (2020), which also reported a positive association between training and the adoption of practices such as stumping, pruning, shading, and mulching. Similarly, studies by Kijima (2022) and Grimm and Luck (2023) have highlighted the positive effects of training on the adoption of improved farming practices. Training enhances farmers' knowledge about advanced production technologies and raises awareness of their benefits (Million et al., 2020).

Family size was found to be significantly and positively associated with the adoption of mulching ($\beta = 0.617^{**}$, $p < 0.05$) and pruning ($\beta = 1.053^{**}$, $p < 0.05$). An increase in family size by one unit raises the likelihood of adopting mulching and pruning practices by 1.85 and 1.06 times, respectively. Larger families are better equipped to provide the additional labor needed for labor-intensive practices such as mulching and pruning, which might be challenging for smaller households with fewer workers. This observation aligns with findings by Million et al. (2020), who reported a positive association between family size and the adoption of various improved coffee production technologies. Additionally, studies by Asfaw et al. (2011) and Borthakur et al. (2015) also highlighted the positive effect of family size on the adoption of recommended farming practices.

The level of education was found to be significantly and positively associated with the adoption of the recommended irrigation schedule (β = 1.062**, $p < 0.05$). Educated farmers are more likely to implement coffee production technologies, likely due to their enhanced access to information and a better understanding of the benefits compared to illiterate farmers (Million et al., 2020). This finding is consistent with previous studies by Luzinda (2018) and Temesgen and Debeb (2024), which also reported a positive impact of educational attainment on the adoption of recommended coffee production practices. Additionally, plant population in the orchard was found to be significantly and positively associated with the adoption of the recommended pit size and spacing (β = 0.12**, $p < 0.05$).

The adoption of coffee production technologies is significantly influenced by socio-economic factors such as age, coffee growing experience, training, family size, and education level. Younger farmers, those with formal training, larger families, and higher education levels are more likely to adopt recommended practices, while experience with traditional methods and risk aversion among older farmers can hinder adoption. These findings underscore the need for targeted interventions to support different farmer demographics in improving their coffee production practices.

Table 5. Factors affecting the adoption of various coffee production technologies

Variables	**Coffee production technology**							
	Pit size & spacing		**Mulching**		**Pruning**		**Irrigation**	
	Cfc	**ExP(B)**	**Cfc**	**ExP(B)**	**Cfc**	**ExP(B)**	**Cfc**	**ExP(B)**
Age	-.011	0.989	-.060**	.942	.014	1.014	-.016	.984
Gender	.827	2.286	.235	1.265	-1.015	.362	.127	1.136
Plant Population	.012**	1.012	.002	1.002	.000	1.000	.002	1.002
Experience	-.108**	0.898	-.104**	0.901	.014	1.015	.047	1.048
Training	1.864***	6.452	1.785***	5.962	0.58	2.587	-.461	.631
Family size	-.092	0.912	.617**	1.852	1.053*	1.060	.012	1.012
Education	.499	1.647	.089	1.093	.552	1.737	1.062***	2.891

	Intercropping		Shading		Stumping	
	Cfc	ExP(B)	Cfc	ExP(B)	Cfc	ExP(B)
Age	-.001	.999	.000	1.000	-.006	.994
Gender	-.259	.772	.159	1.172	.626	1.871
Plant Population	.000	1.000	.007	1.007	.000	1.000
Experience	.018	1.018	.133**	1.142	.116**	1.123
Training	1.007*	2.737	2.238***	9.379	2.979***	19.670
Family size	.083	1.086	.154	1.166	-.154	.857
Education	-.136	.873	.288	1.333	.736	2.088

Notes: *** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.
Legend: Cfc – Coefficient, ExP (B) – Exponentiated coefficient

Motivations and Challenges in Coffee Farming

Table 6 ranks factors encouraging coffee production among farmers in Arghakhanchi District, Nepal, using a weighted scoring system from first (P1, score 1.0) to fifth (P5, score 0.2). "Good Return" was the top motivator (Rank I) with a weightage score of 66.4 (index 0.83), followed by "Less Wild Damage" (Rank II, score 52.8, index 0.66), and "Neighbors' Influence" (Rank III, score 47.2, index 0.59). "Less Intensive Work" was fourth (Rank IV, score 46.4, index 0.58), and "Prior Knowledge" ranked last (Rank V, score 28.0, index 0.35), indicating economic returns as the primary driver for coffee production, with practical and social factors being less influential.

Table 6. Ranking of factors encouraging coffee production

Factors	P1 (1.0)	P2 (0.8)	P3 (0.6)	P4 (0.4)	P5 (0.2)	Weightage	Index	Rank
Good Return	39	23	11	05	02	66.4	0.83	I
Neighbors influence	16	15	13	21	15	47.2	0.59	III
Less wild damage	14	20	25	18	03	52.8	0.66	II
Prior Knowledge	03	05	10	13	49	28.0	0.35	V
Less intensive work	08	19	20	23	10	46.4	0.58	IV

Note: Figures in parentheses indicate the score used and 'P' stands for priority (Ex. P1= First priority and so on)

Table 7 ranks the problems faced by coffee farmers in Arghakhanchi District, Nepal, using a weighted priority system from first (P1, score 1.0) to fifth (P5, score 0.2). The most significant issue identified was "Poor Rainfall/Lack of Irrigation" (Rank I), with the highest weightage score of 68.6 (index 0.857), indicating it as the primary challenge in coffee farming. "Lack of Knowledge/Training" ranked second (Rank II) with a weightage score of 56.6 (index 0.707), highlighting the need for better educational support. The issue of "Disease/Insect Attack" was ranked third (Rank III), with a score of 42.2 (index 0.527), reflecting moderate concern among farmers. "Labor/Workforce Unavailability" ranked fourth (Rank IV) with a weightage score of 42 (index 0.525), while "Quality Seedling Unavailability" was the least pressing issue (Rank V), scoring 30.4 (index 0.38). Overall, inadequate rainfall and irrigation are the most critical challenges, with training, pest management, labor, and seedling availability as additional concerns. According to Moreira-Morrillo et al. (2023) and Koutouleas (2023), significant diseases such as coffee leaf rust, Cercospora leaf spot, and thread blight pose major threats to coffee production and the industry as a whole. Similarly, Sarvina et al. (2021) identified key challenges in Indonesia's coffee sector, including low fertilization rates, reliance on traditional cultivation methods, and the absence of quality local clones. In India, Das et al. (2020) highlighted pest infestations, limited market access, and uncertainties related to seasonal rainfall as primary obstacles to coffee production.

Table 7. Ranking of problems related to coffee production

Problems	P1 (1.0)	P2 (0.8)	P3 (0.6)	P4 (0.4)	P5 (0.2)	Weightage	Index	Rank
Poor rainfall/ lack of irrigation	52	14	3	7	4	68.6	0.857	I
Lack of knowledge/training	18	31	14	4	16	56.6	0.707	II
Disease/ Insect attack	3	12	30	21	15	42.2	0.527	III
Quality seedling unavailability	7	14	17	14	29	30.4	0.38	V
Labor/Workforce unavailability	4	5	16	40	13	42	0.525	IV

Note: Figures in parentheses indicate the score used and 'P' stands for priority (Ex. P1= First priority and so on)

Conclusion

This study assessed the adoption status of coffee production technologies and the factors influencing their adoption. The majority of coffee producers implemented recommended practices for fertilizer application, intercropping, and shading. Moderate adoption levels were observed for pit size, spacing, and mulching practices, while pruning, irrigation, and stumping were adopted by only a small fraction of producers. Training significantly and positively influenced the adoption of most improved production technologies, and factors such as years of experience, plant population, age, family size, and education also played significant roles in adopting various practices. The main reasons for engaging in coffee farming were identified as good returns, reduced damage from wild animals, and positive feedback from neighbors. Conversely, major challenges in coffee production included inadequate rainfall, poor irrigation facilities, lack of training and technical knowledge, and pest incidence and damage. To enhance coffee production, authorities should prioritize improving irrigation facilities, providing targeted training programs, and disseminating technical knowledge to farmers. Future research should explore the long-term impacts of various coffee production technologies on yield and quality under different environmental conditions. Additionally, studies could investigate the socio-economic barriers to adoption and develop tailored strategies to support small-scale farmers in overcoming these challenges.

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