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Factors affecting the level of farmer participation in the agricultural extension services of cereal production in Bhutan

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ABSTRACT: The purposes of this study were to assess the participation level of cereal farmers in agricultural extension services in Bhutan and to examine the factors affecting their participation. Data were collected by interviewing 251 farmers with a simple random sampling method from eight Gewogs (a group of villages), selected from four districts; consisting of the western, northern, southern, and eastern regions of Bhutan. Descriptive statistics were employed to analyze socioeconomic characteristics and the participation levels in extension services of the farmers. In addition, Chi-square statistics were used to examine the factors influencing the farmers' participation in extension services. The results determined that the participation in extension services of cereal farmers was generally low in Bhutan, with most accessing services through home visits, training, and mobile phone communication. Analysis of the relevant socioeconomic factors found that several factors influenced the participation of farmers in various extension service methods. In particular, the district where the farmers lived had a significant relationship with their participation in in-home visits, group discussions, and mobile phone communication. Age was also a significant factor in participation in in-home visits, mobile phone communication, and demonstrations. The total cultivated land owned by the farmers was significantly related to their participation in in-home visits, group discussions, and demonstrations. Gender was significantly associated with the farmers' participation in information sharing through TV or radio, while education level was directly related to their participation in study tours. Lastly, changes in production costs affected farmers' participation in training. Based on these findings, we suggest that agricultural extension service methods should be customized to meet the specific needs of farmers based on their socioeconomic contexts.
Keywords: farmer participation; extension services; cereal production

Introduction

Agriculture in Bhutan has remained a significant portion of the national economy. The government placed a strong emphasis on agriculture in the 11th Five-Year Plan (2013-2018) to achieve goals for equitable and sustainable economic development, food and nutrition security, and poverty reduction (Royal Government of Bhutan, 2013). In 2020, Bhutan's agricultural sector contributed 19.23% to the gross domestic product, which was 7,723.08 million BTN. Bhutan's population relies heavily on agriculture, with roughly 55.78 percent employed in this sector (National Statistical Bureau, 2021). Most Bhutanese farmers are smallholders that practice subsistence farming. The country's limited amount of arable land, less than 2.93% of the entire country (38,394 square kilometers), is a significant

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challenge to agriculture and food security growth. As a result, the household landholding size is generally small, with an average of 3.4 acres, and located on a steep slope (Ministry of Agriculture and Forests, 2017).

Cereal comprises the primary agricultural production in Bhutan, accounting for 102,216 metric tons from a harvested area of 71,356 acres in 2020; followed by fruits, roots and tuber, oilseeds and legumes, vegetables and spices, and mushrooms; with 57,080, 46,655, 18,438, 12,243, and 229 metric tons, respectively. The main cereal crops grown in Bhutan are paddy, maize, buckwheat, wheat, millet, barley, and quinoa; accounting for 54,089, 40,965, 2,701, 1,623, 1,613, 1,123, and 102 metric tons, respectively (Ministry of Agriculture and Forests, 2021). Cereal production in Bhutan is primarily carried out by smallholder farmers using traditional farming methods, relying on rain-fed agriculture. The challenge to cereal production is further exacerbated by mountainous terrain, soil erosion, land degradation, limited water resources, pests and diseases, poor transportation infrastructure, limited access to inputs and know-how, shortage of labor, and a low level of mechanization. In addition, a low level of technology adoption and inadequate market access for farmers are constraints in the shift to commercial farming. These provide significant obstacles to enhancing cereal productivity and food security in the country (International Fund for Agricultural Development, 2015).

In a developing country like Bhutan, adequate infrastructural facilities and efficient extension services are essential for developing agricultural sectors. Extension services play an important role in increasing the agricultural productivity of Bhutan’s available arable land (Dendup, 2018). Transferring knowledge and technology to enhance crop productivity is carried out through agrarian extension services under different programs and projects of the Ministry of Agriculture and Forest. Extension services are delivered by local extension workers, who are placed in all 205 administrative blocks (locally known as Gewogs) and work directly with the farmers at grassroot levels. However, transferring new knowledge, skills, technologies, and interventions can be challenging. The outcomes may not always be as expected for several reasons from the perspectives of both the extension worker and farmer. Similarly, extension services in cereal production have faced several challenges; including limited resources and funding, lack of trained extension personnel, lack of infrastructure, limited access for farmers located in remote areas, and the farmers’ limited adoption of new technologies. Despite these challenges, extension services in Bhutan have worked to overcome these barriers and have improved their ability to support farmers in enhancing cereal production.

However, the technological adoption of cereal farmers has relied significantly on their participation in extension services. Previous research on the effects of extension services on Bhutan's agricultural production demonstrated the need for better service delivery. According to a study on the socioeconomic effects of agricultural subsidies in Bhutan, poor and non-poor communities received different levels of extension services. Poor farmers had less access to agricultural subsidies than non-poor inhabitants (Wang et al., 2019). The extension department is critical in facilitating services and providing technical skills to farmers. Poor extension services and the farmers’ lack of awareness of extensions hindered poultry production in Bhutan (Dorji and Gyelsthen, 2012). The professional assistance, expertise, and experience of qualified extension agents were also necessary for effectively mobilizing and facilitating farmer's groups to support the development of rural communities (Sonam and Martwanna, 2021).

Furthermore, a lack of collaboration between central programs, research, and extension at the institutional level made it difficult to successfully implement an appropriate technology. At the block level, extension agents without diplomas lacked the knowledge and abilities to effectively promote the country's agricultural innovations.

The country's geophysical characteristics further caused dispersion within the Gewogs. An extension agent or anyone who wished to visit a rural area had to travel for hours or even days, due to the remote area's few far-flung homes. As a result, the distance, dispersed communities, and challenging terrain impacted the availability and accessibility of extension services at the village level. Farmers resisted new technology and risk-taking due to their low literacy level (Ministry of Agriculture and Forests, 2021).

However, the cereal farmers' low adoption of production technology was caused by their participation level in the knowledge and technology transfer between extension workers. Improvements in agricultural production, profitability, and sustainability were the primary means of reducing poverty among smallholder farmers (World Bank, 2008). New or improved agricultural technologies were critical to transforming livelihoods, dissemination, and the adoption of improved agricultural technology, and were considered strategies for facilitating these transitions (Besley and Case, 1993).

To address these concerns, Bhutan developed strategic guidelines for the efficient provision of extension services. A participatory approach aimed to involve the farmers in recognizing issues, coming up with solutions, creating workable plans, and carrying them out. The strategy, based on commodities, identified opportunities and limitations at each stage of the growth of the commodity and offered suggestions and programs through research. Through direct encounters between extension workers and farmers, training and visitation strove to improve the delivery of extension services. The 'lead farmer' strategy supports the roles of research and extension, addressing the technology transfer gap. Ultimately, farmers and the Department of Agriculture collaborate through cost-sharing models to boost food production, farmers' revenue, and each sector's overall viability.

Numerous strategies have been employed to improve communication between farmers and extension staff to persuade farmers to participate in agricultural extension, through both phone calls and social media engagements. Group techniques; like field days and demonstrations, training sessions, group meetings, field trips, and exhibits were utilized. Moreover, broadcast media, such as radio and TV, was used to share information on crop production technologies with farmers, however, it was not very widely used. However, there is a gap in the updated research on the involvement of cereal farmers in Bhutan's various array of extension services. The assessment of farmers' participation in agricultural extension services is essential for understanding the access and effectiveness of each extension service method. This study aimed to measure the farmers' participation levels and to examine the factors affecting the farmers' participation in agricultural extension services in cereal production. We intended that the study results be applied by policymakers or extension agents to determine the most appropriate method of agricultural extension services for Bhutan's cereal farmers based on their socioeconomic characteristics. Farmer participation in agricultural extension services may increase their adoption of new technologies and practices and improve the productivity and efficiency of their cereal farming operations, ultimately leading to food security and poverty reduction in Bhutan.

Methodology

Data were collected by interviewing 251 farmers with a simple random sampling method from eight blocks (Gewogs) selected from Bhutan's four regions: the Chukha district in the west (27.0523° N, 89.5757° E); Mongar district in the east (27.2754° N, 91.2398° E); Tsirang district in the south-central (27.0322° N, 90.1870° E); and Punakha district in the northwest (27.5921° N, 89. Two sample blocks were selected from each of the four districts; Darla and

Phuentsholing from the Chukha district, Mongar and Tsamang from the Mongar district, Lingmukha and Shelngana from the Punakha district, and Dunglagang and Tsirangtoe from the Tsirang district, as shown in **Figure 1**.

Data reliability was confirmed through Cronbach's alpha, in which three Likert scales were evaluated. With a Cronbach's rating of 0.903, reliability was high. Descriptive statistics; such as frequency, percentage, mean, and standard deviation were employed to analyze the farmers' socioeconomic characteristics and their level of participation in extension services. Three levels of farmers' participation were identified: 1 = Low; 2 = Medium; and 3 = High. The means of their level of participation were interpreted as follows:

A mean ranging between 1.00 – 1.66 represents a low level of participation.

A mean ranging between 1.67 – 2.33 represents a medium level of participation.

A mean ranging between 2.34 – 3.00 represents a high level of participation.

In addition, quantitative analyses through Chi-square statistics were further conducted to examine the factors affecting farmers' participation in extension services related to cereal production in Bhutan.

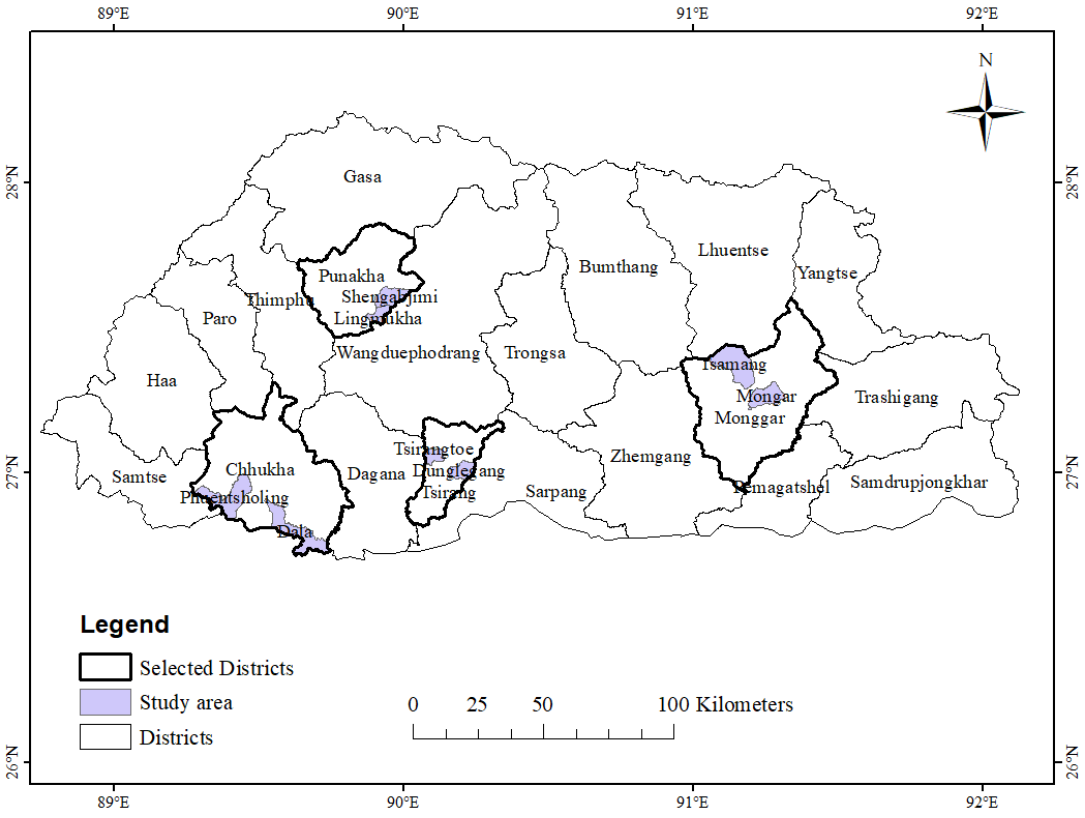


Figure 1 The study sites used in collecting farmer data

Results and discussions

Socioeconomic characteristics of the farmers

The socioeconomic information of cereal farmers in Bhutan included their district location, gender, age, education, annual income, permanent number of household members, farm-family members, the total area of cultivated land, and changes in production costs **(Table 1)**.

Cereal farmers were prevalent in the Tsirang district with 70 respondents (27.9%), followed by districts of Punakha, Mongar, and Chukha with 63, 60, and 58 respondents accounting for 25.1, 23.9, and 23.1%, respectively. In the Tsirang district, maize and paddy are the primary cereal crops grown, followed by millet, buckwheat, and wheat (Ministry of Agriculture and Forests, 2021). Its two study blocks, Dunglagang and Tsirangtoe, are characterized by a temperate highland tropical climate with cool and dry winters, have fairly good road access, and are located approximately 8-13 km from the local market. Furthermore, a Renewable Natural Resource (RNR) Center is present in both areas to offer agricultural extension services to local farmers.

The Punakha district is primarily known as the rice bowl of western Bhutan, with paddy as its primary crop. Additionally, maize, wheat, and buckwheat are also cultivated (Ministry of Agriculture and Forests, 2021). The two study blocks in the Punakha district, Lingmukha and Shelngana, are located in the northwest of Bhutan, are situated 8-12 km from the local market, and are characterized by a cool continental climate. The Punakha district, formerly a capital city, has a road infrastructure in fair condition. The construction of farm roads connects to all block centers, extending to several major villages. Notably, both study blocks have a Renewable Natural Resource (RNR) Center.

In the Chukha district, the main cereal crops grown are paddy and maize, followed by buckwheat, millet, and wheat (Ministry of Agriculture and Forests, 2021). The two study blocks in the Chukha district, Darla and Phuensholing, are located in the Southwest of Bhutan in a humid subtropical climate. Although cereal crops are the primary crops grown in Darla and Phuentsholing, the farmers' main income sources are obtained from the sale of mandarins, cardamom, and ginger. Phuentsholing borders the Indian town of Jaigaon, where cross-border trade has resulted in a thriving local economy.

The Mongar district in Bhutan's Eastern Central Valley ranges from 400 to 4,000 meters above sea level. The southern and lower areas have a humid subtropical climate, whereas the northern higher areas have a subtropical oceanic highland climate. Maize is the leading cereal crop grown in this district, however, other cereals; such as paddy, barley, buckwheat, and quinoa are cultivated in small quantities. The Mongar district contains two study blocks, Mongar and Tsamang, which are remote from local markets. The farm roads in both blocks are in poor condition, resulting in difficulty in travel from the Renewable Natural Resource (RNR) Center to the cereal farms.

The gender of cereal farmers showed that 126 respondents (50.2%) were male and 125 respondents (49.8%) were female, indicating an even distribution of gender in cereal farming. Most cereal farmers aged between 41-60 years old (129 respondents or 51.4%), followed by farmers between 20-40 years old (30.7%), and above 61 years old (17.9%); resulting in an overall mean age of 48.47 years. Regarding the educational level of cereal farmers, 84 farmers (33.5%) had not been to any formal school, 76 (30.3%) had a non-formal education, 60 (23.9%) had a primary level education, and 31 (12.4%) had an education above the secondary level.

Table 1 The farmers' socioeconomic characteristics

Variable		Frequency (n=251)	Percentage
District	Chukha	58	23.1
	Mongar	60	23.9
	Punakha	63	25.1
	Tsirang	70	27.9
Gender	Male	126	50.2
	Female	125	49.8
Age	20-40 years old	77	30.7
(Mean = 48.47 years old)	41-60 years old	129	51.4
	Above 61 years old	45	17.9
Education	No education	84	33.5
	Non-formal education	76	30.3
	Primary	60	23.9
	Secondary and above	31	12.4
Annual income	Below 50,000 BTN	98	39.0
(Mean = 79,752.99 BTN)	Above 50,000 BTN	153	61.0
Residents permanently at home	1-2 people	65	25.9
(Mean = 4.08 people)	3-4 people	100	39.8
	5-6 people	54	21.5
	Above 7 people	32	12.7
Farm-family labor	1-2 people	114	45.4
(Mean = 3.10 farmers)	3-4 people	97	38.6
	Above 5 people	40	15.9
Total cultivated land	0.00-0.99 acres	42	16.7
(Mean = 2.57 acres)	1.00-1.99 acres	80	31.9
	2.00-2.99 acres	47	18.7
	3.00-3.99 acres	32	12.7
	Above 4.00 acres	50	19.9
Change in production costs	Decreasing	8	3.2
	Constant	67	26.7
	Increasing	176	70.1

Source: Author's calculation (2022)

The annual income of cereal farmers ranged from 30,000 to 200,000 BTN, with an average annual income of 79,752.99 BTN. Roughly 153 farmers (61.0%) had a yearly income of more than 50,000 BTN, and 98 (39.0%) had

an annual income of less than 50,000 BTN. The number of residents permanently living at home ranged from 1 to 11, with an average of 4 individuals. Farm family labor ranged from 1 to 10, with the mean of 3.10 farmers working full-time. Most farmers had a total cultivated land area between 1.00 to 1.99 acres with 80 farmers (31.9%), followed by 50 farmers with 4.00 acres of cultivated land representing 19.9%. The total cultivated land ranged from 0.25 to 13.50 acres, with an average of 2.57 acres; which consisted of 1.74 acres of cultivated dryland and 0.83 acres of farmed wetland.

An even distribution of males and females among the farmers revealed an equal involvement of both males and females in farming, as Bhutanese agriculture is characterized by gender flexibility, which allows women and men to participate equally in agricultural cultivation, agribusiness, and livestock husbandry. The farmers' age was a significant factor in determining the productive age for farming. Similar to the findings of a previous study by Suvedi et al., 2017; the average age of the farmers studied was 48.5 years old, versus 48.7 herein, which is considered a productive age range. Lastly, farmers with formal education were an essential indicator to assess their understanding of the extension services provided.

In Bhutan, the paddy field is regarded as a wetland owing to the irrigated nature of the land. Wetlands are used for cultivating paddy during the rainy season and utilized to grow other crops during the dry season. Drylands are where cereals and other cash crops are grown. The current state of the farmers' understanding of the cost of cereal production herein suggests that extension services had no impact on reducing the costs of cereal production.

Farmers' level of participation in agricultural extension services

Table 2 shows the farmers' participation in agricultural extension service methods; such as home visits, group discussions, exhibitions, information sharing via mobile phone, TV, and radio, information sharing via printed materials, study tours, field days, demonstrations, and training. Overall, the participation level of cereal farmers in agricultural extension service methods was low, with mean values ranging from 1.02 to 1.73. The level of the farmers' participation in in-home visits had the highest mean value ($\overline{X}$ = 1.73), interpreted as medium participation. This is consistent with a study conducted in Balochistan, Pakistan, in which farmers received home visits or farm visits, which were the most preferred method of extension (Mengal et al., 2012). The mean level of farmers' participation in training was the second highest ($\overline{X}$ = 1.55), followed by information shared via mobile phone ($\overline{X}$ = 1.51), and demonstrations ($\overline{X}$ = 1.33). Information sharing via printed materials had the lowest participation level of cereal farmers ($\overline{X}$ = 1.02).

We found that a high participation level in agricultural extension services was achieved for home visits, information shared via mobile phone, and training, at 27.9, 21.1, and 17.9%, respectively. A moderate level of farmer participation was found for demonstrations, field days, and training, at 24.7, 19.9, and 18.7%, respectively. Conversely, a low level of farmer participation was found for information sharing via printed materials, information sharing via TV and radio, and study tours, at 98.4, 96.8, and 93.2%, respectively.

In keeping with the findings of Suvedi et al. (2017), cereal farmers have had limited access to extension services, and the delivery of these services has proven ineffective, which may be impacting technology adoption and the productivity of cereal crops. Low participation in extension services may be due to ineffective methods for delivering or disseminating the services, farmers' inability to attend meetings, or the lack of awareness about the benefits (Kassem et al., 2021). This may also be because the agricultural extension services provided did not meet

the needs of the farmers. In Bhutan, each block has an extension services center, however, the farmers' engagement is not always influenced by the accessibility of services, but by the quality of services, good sharing of information and communication, relevancy, and the diversity of services (Debnath et al., 2016; Lotfy and Adeeb, 2016; Baiyegunhi et al., 2019; Kassem et al., 2021).

According to Nahayo et al. (2017), farmer participation in extension service programs was influenced by personal benefits, economic benefits, and agricultural production. In addition, the effectiveness of extension services was determined by many factors; such as the delivery of the services, the methods used to deliver the services, and the relevance of the benefits to the needs of farmers. According to Shalaby et al. (2011), private sector involvement in agricultural extension services had limited the interaction between coordinating authorities and farmers, impacting farm productivity and environmental performance. The quality of extension services was affected by accessibility, relevance, diversity of services, and the information communication media and technologies used to conduct the services (Baiyegunhi et al., 2019; Kassem et al., 2021). Extension services, therefore, must be integrative of knowledge development, economic incentives, and effective service delivery (Noga et al., 2018).

Table 2 Farmers' level of participation in extension services

Extension services	**Farmers' level of participation *(n=251)***			**Mean**	**Standard**	**Meaning of**
	Low	**Medium**	**High**	**($\bar{X}$)**	**deviation**	**participation level**
Home visit	137 (54.6%)	44 (17.5%)	70 (27.9%)	1.73	0.87	**Medium**
Group discussion	211 (84.1%)	16 (6.4%)	24 (9.6%)	1.26	0.62	**Low**
Exhibition/ Display	233 (92.8%)	9 (3.6%)	9 (3.6%)	1.11	0.41	**Low**
Information sharing via mobile phone	175 (69.7%)	23 (9.2%)	53 (21.1%)	1.51	0.82	**Low**
Information sharing via TV/ radio	243 (96.8%)	5 (2.0%)	3 (1.2%)	1.04	0.26	**Low**
Information sharing via printed materials	247 (98.4%)	2 (0.8%)	2 (0.8%)	1.02	0.20	**Low**
Study tour	234 (93.2%)	10 (4.0%)	7 (2.8%)	1.10	0.38	**Low**
Field day	194 (77.3%)	50 (19.9%)	7 (2.8%)	1.26	0.50	**Low**
Demonstration	178 (70.9%)	62 (24.7%)	11 (4.4%)	1.33	0.56	**Low**
Training	159 (63.3%)	47 (18.7%)	45 (17.9%)	1.55	0.78	**Low**

Source: Author's calculation (2022)

Factors affecting the farmers' level of participation in agricultural extension services

The socioeconomic characteristics of farmers were considered to determine the factors affecting the farmers' level of participation in agricultural extension services on cereal production. Pearson Chi-square statistics were used to analyze the relationships between the participation levels in extension service methods and various socioeconomic factors; including the farmers' district, gender, age, education, annual income, total cultivated land area, and changes in production costs, as shown in **Table 3**.

The agricultural extension services, as well as the farmers' relative level of participation, are expressed as follows:

1) Home visit

The district and age of the farmers were found to have a statistically significant relationship with the level of participation for in-home visits at the 0.01 level. Descriptive results showed that the farmers in the Punakha and Tsirang districts would have higher levels of participation in in-home visits compared to farmers in the Chukha and Mongar districts. The study blocks in Punakha and Tsirang districts had fairly good road access and were located not far from the block centers, making it convenient for extension workers to reach local farms. These findings align with the study by Kilpatrick and Williamson (1996), which stated that farm distance was a barrier to the participation of extension services. Elderly farmers (aged 60 years and older) were more likely to have high participation in-home visits compared to other lower age groups. The results of the study herein align with the findings of Arene (1994), which stated that age influenced the adoption rate of extension services, denoting that older farmers were more likely to adopt extension services if they did not need to travel a long distance. Additionally, the total cultivated land owned by the farmers had a statistically significant relationship with the level of participation in in-home visits at the 0.05 level. Our findings determined that farmers with more than a single acre of total cultivated land were more likely to have higher participation in in-home visits compared to farmers harvesting plots of less than one acre. The results of Dwijanti et al. (2018) supported the idea that there is a significant positive relationship between cultivated land areas and the respective farmers' participation.

2) Group discussion

The district where the farmers lived was found to have a statistically significant relationship with their level of participation in group discussions at the 0.01 level. The results of the descriptive analysis demonstrated that farmers in the Punakha and Tsirang districts were more likely to have higher participation rates in group discussions than farmers in the Chukha and Mongar districts. The study blocks in the Punakha and Tsirang districts had fairly good road access and were located near the block centers, making it convenient for farmers to join group discussions. Kilpatrick and Williamson (1996) stated earlier that farm distance was a barrier to the participation of extension services. Furthermore, the total cultivated land owned by the farmers also had a statistically significant relationship with their level of participation in group discussions at the 0.05 level. The findings indicated that farmers with more than one acre of total cultivated land were more likely to have higher participation in group discussions compared to farmers with less than a single acre of total cultivated land. Their findings were in line with the study of Dwijanti et al. (2018), in which there was a significant positive relationship between the cultivated land areas and farmers' participation rate in the development of community forests.

Table 3 Pearson chi-square statistics of factors affecting the level of farmers' participation in extension services on cereal production in Bhutan

Factors Extension services	District	Gender	Age	Education	Annual income	Total cultivated land	Changing in production costs
Home visit	70.075**	1.108	51.062**	11.184	3.993	19.174*	8.844
	(P<0.001)	(P=0.575)	(P<0.001)	(P=0.083)	(P=0.136)	(P=0.014)	(P=0.065)
Group discussion	25.451**	1.667	5.942	4.260	1.915	16.756*	2.015
	(P<0.001)	(P=0.434)	(P=0.203)	(P=0.641)	(P=0.384)	(P=0.033)	(P=0.733)
Exhibition/ Display	9.627	0.257	5.540	1.161	1.211	10.813	5.569
	(P=0.141)	(P=0.879)	(P=0.236)	(P=0.979)	(P=0.546)	(P=0.213)	(P=0.234)
Information sharing via mobile phone	33.974**	0.549	12.233*	2.284	0.883	11.772	3.893
	(P<0.001)	(P=0.760)	(P=0.016)	(P=0.892)	(P=0.643)	(P=0.162)	(P=0.421)
Information sharing via TV/ radio	5.627	8.033*	2.486	5.510	0.977	4.739	1.852
	(P=0.466)	(P=0.018)	(P=0.647)	(P=0.480)	(P=0.614)	(P=0.785)	(P=0.763)
Information sharing via printed material	8.727	2.032	1.225	5.481	1.387	7.846	1.732
	(P=0.190)	(P=0.362)	(P=0.874)	(P=0.484)	(P=0.500)	(P=0.449)	(P=0.785)
Study tour	8.196	3.155	6.024	13.509*	5.272	4.724	2.264
	(P=0.224)	(P=0.206)	(P=0.197)	(P=0.036)	(P=0.072)	(P=0.787)	(P=0.687)
Field day	5.608	1.302	3.567	6.864	0.067	10.224	1.604
	(P=0.469)	(P=0.521)	(P=0.468)	(P=0.334)	(P=0.967)	(P=0.250)	(P=0.808)
Demonstration	2.080	2.408	11.442*	11.954	0.697	25.006**	8.254
	(P=0.912)	(P=0.300)	(P=0.022)	(P=0.063)	(P=0.706)	(P=0.002)	(P=0.083)
Training	6.208	0.266	4.852	3.982	0.888	12.111	13.160*
	(P=0.400)	(P=0.875)	(P=0.303)	(P=0.679)	(P=0.641)	(P=0.146)	(P=0.011)

Source: Author's calculation (2022)

Noted: ** is P < 0.01 and * is P < 0.05

3) Exhibition or display

None of the socioeconomic factors were found to have a relationship with participation in exhibitions or displays.

4) Information sharing via mobile phone

The farmers' district had a statistically significant relationship with participation in information sharing via mobile phone at the 0.01 level. The findings of our descriptive analyses indicated that farmers in the Punakha and Tsirang districts were more likely to have higher participation in information shared via mobile phone compared to farmers in the Chukha and Mongar districts. The study blocks in the Mongar district were located in valleys far from the block centers, resulting in poor internet signals and hindering access to information sharing via mobile phones. This finding is in keeping with the study results of Kilpatrick and Williamson (1996), which stated that farm distance was a barrier to the participation of extension services. In addition, farmers in the Chukha district were interested in cash crops such as mandarins, cardamom, and ginger; resulting in low participation in extension services for cereal crops. Age also had a statistically significant relationship with participation in information sharing via mobile phone

at the 0.05 level. The findings indicated that farmers over 40 years of age were more likely to have high participation in information sharing via mobile phone compared to farmers aged between 20-40 years. The study of Fu and Akter (2016) demonstrated that mobile phone technology intervention had a considerable positive impact on the quantity, quality, and speed of service delivery. The findings also revealed that the use of mobile phones to avail themselves of extension services varied with age; older farmers displayed a preference to utilize cell phones for access to extension services versus younger farmers.

5) Information sharing via TV/ radio

Our descriptive analyses of the farmers' gender produced a statistically significant relationship with participation in information sharing via TV/ radio at the 0.05 level. Female farmers were found to have higher participation levels in information sharing via TV/ radio compared to male farmers. However, there was no noticeable pattern of television usage based on gender. While the approach and process differed, both men and women were equally likely to watch television (Gillwald et al., 2010). This suggests that, in the current study, gender had a significant correlation with information shared via TV and radio, with higher participation from females than males. We may infer that the empowerment and equality of women in agriculture contribute to the effectiveness of the extension services (Diaz and Najjar, 2019). In contrast, men in African nations typically listened to the radio for greater periods than women (Gillwald et al., 2010).

6) Information sharing via printed materials

None of the socioeconomic factors presented herein were found to be related to participation in information sharing via printed materials.

7) Study tour

The farmers' education level outlined a statistically significant relationship with participation in study tours at the 0.01 level. The descriptive results showed that farmers with a minimum secondary-level education were more likely to have higher participation in study tours than those with lesser educational achievements. These findings are consistent with the study of Dwijanti et al. (2018), which stated that a significant positive relationship exists between the farmers' educational level and their participation in the development of community forests.

8) Field day

None of the socioeconomic factors were found to have a relationship with participation regarding field days.

9) Demonstration

The total cultivated land owned by the farmers was found to have a statistically significant relationship with the level of participation in demonstrations at the 0.01 level. The findings of our descriptive analyses indicated that farmers that own more than two acres of total cultivated land were more likely to have higher participation levels in demonstrations compared to farmers with smaller plots of cultivated land. Their findings align with the study of Dwijanti et al. (2018), which observed that there was a significant positive relationship between a farmer's cultivated land area and their participation in developing community forests. Age also had a statistically significant relationship with the level of participation in demonstrations at the 0.05 level. Contrary to the participatory results obtained via the information shared via mobile phone, farmers aged between 20-40 years were more probable to exhibit higher participation in demonstrations compared to farmers over 40 years of age. Issa et al. (2011) agreeably

determined that age significantly influenced farmers' level of participation in agricultural extension programs in northwestern Nigeria.

10) Training

Changes in production costs were found to have a statistically significant relationship with the farmers' level of participation in training at the 0.05 level. The descriptive analyses herein indicated that farmers who experienced a decrease in production costs were more likely to have higher participation levels in training compared to other farmers. It is possible that previous training had helped them in increasing their productivity and reducing their production costs.

Conclusion

The study herein examined the level of participation in agricultural extension services of cereal farmers in Bhutan, as well as the factors that influenced their participation. Ten extension services were assessed, and socioeconomic characteristics were hypothesized to influence the farmer's participation in extension services. Study results showed that the farmers' participation levels in extension services were generally low, with most accessing services through home visits, training, and information shared through mobile phones. Contrastingly, printed materials, TV/ radio, and study tours produced the lowest levels of participation among all extension services.

The analysis of the socioeconomic factors affecting the farmers' participation in agricultural extension services revealed several significant relationships. These factors included the farmers' district, age, total cultivated land, gender, education level, and changes in production costs. The district where farmers lived had a significant relationship with their participation in in-home visits, group discussions, and mobile phone communication. In particular, farmers living in Punakha and Tsirang were more likely to have higher participation in these extension services. Age was also a significant factor in participation, with older farmers being more likely to participate in in-home visits and mobile phone communication, whereas farmers aged between 20-40 years were more likely to participate in demonstrations. The total cultivated land owned by the farmers was significantly related to their participation in in-home visits, group discussions, and demonstrations, with farmers owning more than one acre of land more likely to have a high participation level in these extension services. Gender was also found to be a significant factor in participation, with female farmers demonstrating higher participation in information sharing through TV and/or radio. Education level was significantly related to participation in study tours, with farmers having secondary level education and above being more likely to have a higher interest in participation. Lastly, changes in production costs were found to influence the farmers' participation in training, with those experiencing a decrease in costs exhibiting greater participation in the activity. Based on the findings herein, we suggest that agricultural extension service methods should be customized to meet the needs of farmers in consideration of their socioeconomic contexts.

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