Assessment of extension delivery services and Knowledge, Attitudes, and Practices (KAP) of corn farmers in Camotes Islands, Philippines

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ABSTRACT

This paper evaluated the extension delivery services and corn farmers' Knowledge, Attitudes, and Practices (KAP) toward corn production in Camotes Islands, Philippines. A sample of 232 corn farmers were interviewed for the primary data collection and analyzed using appropriate statistical tools such as descriptive metrics and correlation analysis. Results revealed that most (79.74%) of the corn farmers exhibited a moderate knowledge of corn production methods, suggesting room for educational initiatives to optimize yields. Although most farmers displayed positive attitudes (52.16%) and good practices (76.73%), concerns about environmental vulnerability, particularly drought, underscored the challenges posed by climate change. Areas like irrigation and pest control require further attention, and only the other sources of income had positively correlated (p-value < 0.05) to the level of knowledge. Demographics had minimal influence (not significant correlation; p-value > 0.05) on attitudes, while age showed a negative correlation (p-value < 0.05) with practices, and education (p-value < 0.05), farm size (p-value < 0.05), and landownership (p-value < 0.01) positively influenced practices. Conclusively, extension services must prioritize middle-aged farmers, those with larger farms or higher incomes, as they may be more receptive to new practices. The need for collaborative efforts between lead agencies was recommended to improve farmers' access to resources, financial aid, and training opportunities and revisit policies. Equally important was empowering corn farmers' KAP to change the agricultural landscape successfully. Policy changes like input subsidies, irrigation infrastructure, and the promotion of sustainable pest management were also suggested solutions.

1. Introduction

Corn is the Philippines' second most important crop and the country's most widely produced grain; millions of Filipinos consume corn as a primary food source (Parreño & Anter, 2024). Corn is a center of several strategic value chains in the food area, feed, and multi-industries sectors that involve corn products (Painagan & Ella, 2022). Corn significantly impacts the market and food sector because it has developed community resilience and food

security. The government has recently created programs to improve corn production and offered extension delivery services to enhance corn cultivation and develop local farmers' output capacity, particularly in smallholder systems (Casinillo, 2022; Hernando-Valdez & Cecilia, 2021). In addition, agricultural extension services provided farmers with important information such as pricing patterns, innovative seed varieties, crop cultivation and marketing management, and training in new technologies (Anderson & Feder, 2007; Ozor & Nnaji, 2011). In that case, extension services used various strategies to increase farmers' knowledge bases, such as field days, agricultural exhibits, individual farm visits, model farms, specialized training, and group gatherings. It is hoped that by exposing farmers to these kinds of activities through farmer field school or other training programs, their capacity to maximize their resource utilization and ultimately boost crop production will be maximized (Red et al., 2021).

The study of Ozor and Nnaji (2011) demonstrated the value of extension services in facilitating the exchange of information, technologies, and knowledge among farmers and connecting them with other economic participants. The extension services are, therefore, one of the agents needed to transform subsistence farming into modern and commercial agriculture. Irawan (2023) portrayed the need for agricultural extension officers to stay in constant contact with farmers, providing them with information such as how to adapt to climate change, build effective irrigation schemes, make economical use of farm equipment and procedures, and maximize farmland utilization, among others. According to Kauky (2024), an extension delivery service is a program responsible for farmers' needs with limited resources and information about the production system.

The study by Red et al. (2021) mentions that understanding farmers' Knowledge, Attitudes, and Practices (KAP) towards farm production and their interactions with extension delivery services is vital for ensuring sustainability and enhancing farmers' livelihoods. The corn production in Camotes Islands, Philippines, has been going through some agricultural problems, especially in the production system and economic yield, according to their Municipal Agriculture Office (MAO). In addition, Camotes Islands has not yet seen any studies of the KAP model, which aids corn farmers in their production, and research about extension delivery services in the municipality is scarce. Hence, this study on farmers' knowledge, attitudes, and practices towards corn production and extension delivery services in the four towns, namely Pilar, Poro, San Francisco, and Tudela, was conducted to provide utmost significance for several compelling reasons. Firstly, understanding farmers' knowledge and practices identified gaps and areas for improvement in corn production techniques. This knowledge allows extension services to provide targeted training and information, enhancing agricultural productivity (Mbesa et al., 2024). Secondly, assessing farmers' attitudes towards extension delivery services helped extension officers tailor their programs to meet farmers' needs better. Aside from the practical implications of the study's findings to corn production and extension delivery services, this study may help Local Government Units (LGU), MAO, and farmers' associations contribute to the development of agricultural policy and programs that give more attention to the needs of corn farmers which shall eventually enhance their farm productivity, economic yield, as well as standard of living. Furthermore, the study may suggest some viable ways to address the issues and concerns regarding the production of corn not only in the Camotes Islands and the neighboring towns and cities.

However, assisting corn farmers should not stop at increasing corn yield; instead, we should look at the value chain and determine how farmers can participate in the production

process - inspiring other researchers to include KAP studies on similar commodities or other crops in their research programs for a deeper understanding of the needs of local farmers. Hence, given the research gap, this study is realized. The study's general objective was to conduct an in-depth assessment of corn farmers' knowledge, attitudes, and practices towards corn production and extension delivery services in the Camotes Islands. This study specifically aimed to (1) determine the socio-demographic and socio-economic profile and other related characteristics of the respondents; (2) examine the extension delivery services on corn production of agriculture Offices; (3) find out respondents' knowledge and attitudes towards corn production; (4) analyze the corn production practices adapted by the respondents; and (5) investigate the relationship (by correlation analysis) between the farmer's socio-demographic and economic characteristics and their knowledge, attitudes, and practices on corn production and extension delivery services.

2. Framework of the study

Anchored in the principles of the KAP Model theory (Hasan et al., 2022; Liao et al., 2022), the study conceptualized farmers' knowledge, attitudes, and practices concerning corn production and extension delivery services. Thus, the study emphasized understanding and analyzing the relationships between farmers' knowledge, attitudes, practices, and distinctive characteristics, which is anchored in the current research by Casinillo and Seriño (2022). These include socio-demographic traits such as age, gender, marital status, and educational attainment, as well as economic indicators like primary source and other sources of income, tenure duration, monthly income, farm size, and land ownership status (Adiputra & Bilang, 2020; Casinillo, 2020; Casinillo & Seriño, 2022). Moreover, the study's analysis has integrated the role of extension delivery services. In the study by Casinillo (2022), agricultural extension services are programs and services by the government that provide support, information, and education to farmers in enhancing their production and promoting sustainability. Moreover, the study also considered variables such as farmers' knowledge about farm production, their attitudes toward it, and their practices in its cultivation (Koo et al., 2016). Red et al. (2021) emphasized that the KAP model in farming is a type of framework employed to understand and change the behavior of a farmer to improve their agricultural techniques in developing their production process and economic profitability. These variables collectively indicated that farmers' understanding and actions in corn production may shaped by the dynamic interplay of multiple influencing factors. Hence, the conceptual framework of this study is to correlate the farmer's socio-demographic and economic characteristics and their knowledge, attitudes, and practices on corn production and extension delivery services to determine its relationship that provides decision-making strategies and policies in corn production activities.

3. Research method

3.1. Research design

The methodology and research design used in conducting any research were critically important and deserve careful consideration. Appropriate methodology enables the researcher to collect valid and reliable information regarding research instruments and to analyze the information correctly to arrive at valid results. In that case, a descriptive-correlational quantitative research design was employed using a structured interview schedule with a cross-sectional approach. This research design aims to articulate the description of variables and capture their association, which might give helpful information for policy purposes.

3.2. Research locale, sampling, and respondents

The study was conducted in the Camotes Islands and comprised four municipalities: Poro, Tudela, San Francisco, and Pilar. This study area was selected because most farmers had engaged in corn farming as their primary source of living and livelihood for several years. Consequently, this area offered convenient accessibility and ensured the researcher's safety. The corn farmers of four municipalities under the Camotes Islands were considered the study's respondents. Lists of corn farmers in these municipalities' respective Farmers Associations (FAs) were prepared with the help of Municipal Agriculture Officers (MAO). Given that the study covered four municipalities, Cochran's (1977) formula was employed to get the total sample size of the respondents with a reasonable margin of error (e = 6.25%). Since there is limited information about the corn farmers, it was assumed that the proportion would be p = 0.5. It is worth noting that the said proportion is a worst-case assumption, while a close to 1 proportion is considered a best-case assumption. This study used a 95% confidence interval, which, in Statistics, the established Z-value is equal to 1.96. Hence, the estimated sample size (n_0) is computed as follows:

$$n_0 = \frac{Z_{\alpha/2}^2 p(1-p)}{e^2} \quad (1)$$

Since the population is known to be finite (N = 4,089), then the adjusted sample size (n) is computed by the following formula:

$$n = \frac{n_0}{1+\frac{n_0}{N}} \quad (2)$$

Hence, among 4,089 corn farmers from the four (04) municipalities mentioned above, the sample size of 232 farmers was selected randomly as the actual respondents of the study, considering some constraints in the researchers' resources. The 232 samples are large enough to give statistically sound results based on the sample size guideline for the correlation method by Bujang and Baharum (2016). The respondents were selected proportionally from the list in each municipality as the sample by following the proportional stratified sampling method. The distribution of the respondents in each city is indicated in Table 1.

Table 1

Distribution of Samples

Municipality	Population	Sample size	%
PILAR	1,309	74	17.69
PORO	1,284	73	17.59
TUDELA	161	9	17.89
SAN FRANCISCO	1,335	76	17.57
TOTAL	**4,089**	**232**	**17.63**

Note. Authors' calculation (2024)

3.3. Research instrument and data collection process

Since this study was based on KAP, a survey method was employed to collect quantitative data. The study adopted a research instrument or structured interview schedule by Ntawuruhunga et al. (2020) by making some modifications suitable for the current research

situation. The structured interview schedule was subjected to a pre-testing process to assess its applicability and verify that the questions were framed in a comprehensible manner to the farmers. A reliability test was performed on the instrument of study to evaluate its validity and reliability for data collection, and it was found valid and reliable to use. The test for the instruments' reliability was calculated using the Ordinal Alpha. The research instrument contains four (04) major parts: Part I dealt with the socio-demographic and economic characteristics (actual response) of the respondents; Part II dealt with the extension delivery services (Likert scale; 5-point rating) on corn production given by the municipal agriculture offices; Part III dealt with the farmers' knowledge (Likert scale; 5-point rating) and attitudes towards corn production (Likert scale; 5-point rating) and the practices they adapted (Likert scale; 5-point rating); Part IV focused on the problems encountered (actual response) and possible coping (actual response) strategies they employed to address the problems. Secondary data on the complete list of corn farmers in each municipality were obtained through the Municipal Agriculture Office secretary. The researcher conducted personal interviews in the respondents' residences through a structured interview schedule, which was kept confidential to protect their privacy. The issuance of permits to conduct the study was coordinated with the various offices in the respective areas where farmers were situated after the data had been collected. The Cebuano dialect was used during the interview to elicit responses. The gathering of data took place from March to April of 2024. Moreover, the conversation was captured using a recording tool, including a mobile phone and handwritten notes. Important variables (related to corn production) needed for the interview (actual response) are the following: (1) training exposure for corn production (Mbesa et al., 2024); (2) extension contacts (Casinillo, 2022); (3) extension delivery services (Casinillo, 2022); (4) knowledge of farmers towards corn production (Centino & Vista, 2018; Hasan et al., 2022; Red et al., 2021); (5) the attitude of farmers towards corn production (Centino & Vista, 2018; Hasan et al., 2022; Red et al., 2021); and (6) practices of farmers towards corn production (Centino & Vista, 2018; Hernando-Valdez & Cecilia, 2021).

3.4. Data analysis

Statistical Package for Social Sciences version 20 (SPSS v.20) was used in coding and analyzing the data. Descriptive statistics such as frequency, percentages, means, and ranges were established, and the data gathered were summarized and analyzed. All computations were presented in statistical tables. Moreover, since the variables involve categorical and ordinal data, then the Chi-Square test (X^2), Spearman's rho correlation (r_s), and Rank-biserial correlation (r_{rb}) were used to determine the relationship between the respondents' socio-demographic and economic characteristics on the knowledge, attitudes, practices, and extension delivery services. Statistical calculations were presented in descriptive forms and tables. Necessary interpretations were derived, and essential insights were discussed.

4. Results and discussion

4.1. Socio-demographic characteristics

Table 1 shows the socio-demographic profile of the respondents. Middle-aged farmers (48.71%) were highly involved in farming, followed by old-aged (40.95%) and young-aged farmers (10.34%), respectively. On average, the age of the respondents was 54.76 years. Most respondents were male (57.33%), and 42.67% were female. Regarding civil status, almost all of the respondents were married (85.34%), followed by widowed (11.64%), and few were

single (2.59%). The results also revealed that less than one-half (45.69%) of respondents were elementary undergraduates, while 14.22% graduated their elementary level. On the other hand, 11.64% of the respondents were high school undergraduates, 24.14% had finished their secondary education, and only 2.59% had earned their college degree. This indicates that a higher percentage of lower-level education respondents engaged in farming operations because they believed farming does not require considerable knowledge. This result is consistent with the study of Casinillo and Seriño (2022), which indicated that most of the farmers have a lower level of educational attainment.

Table 2

Socio-demographic Profile of the Respondents

Variables	Frequency	Percentage (%)
Age		
Young (28 - 35)	24	10.34
Middle (36 - 55)	113	48.71
Old (56 above)	95	40.95
TOTAL	232	100.00
MEAN	54.76	
RANGE	28 - 83	
Sex		
Female	99	42.67
Male	133	57.33
TOTAL	232	100.00
Civil status		
Single	6	2.59
Married	198	85.34
Widowed	27	11.64
Separated	1	0.43
TOTAL	232	100.00
Educational attainment		
Elementary undergraduate	106	45.69
Elementary graduate	33	14.22
High school undergraduate	27	11.64
High school graduate	56	24.14
College undergraduate	4	1.72
College graduate	6	2.59
TOTAL	232	100.00

Note. Authors' calculation (2024)

4.2. Socio-economic characteristics

Data on socio-economic characteristics revealed that corn farming (96.12%) was the respondents' primary income source, as shown in Table 3. However, apart from corn farming, the respondents also earned money through raising poultry and livestock (1.72%) animals; they also served as government employees (1.29%) and other sources of income such as in the food business and lending collector (0.86%). In that case, Table 3 shows that farmers have different sources of income to protect from economic downturns, which implies that financial gain diversification can help with efforts to reduce poverty, increase economic activity, and promote sustainable development (Agyeman et al., 2014; Casinillo, 2023). Moreover, data also revealed that fishing (35.78%) topped the other sources of income of the respondents. It also included livestock raising (23.71%), vending (14.66%), sari-sari stores (13.36%), and construction workers (4.74%). Hence, the result indicates that whatever income they derived from other non-farming work, they still determined to continue corn farming, which was their primary source of income (Alvarez et al., 2021; Centino & Vista, 2018). Additionally, data given in Table 3 provided that one-fourth of the respondents (25%) had years in farming ranging to 38 - 48 years, and fewer portions of farmers (8.19%) had high years in farming ranging to 49 - 58 years. Generally, the respondents had an average farming experience of 28.54 years. Our findings roughly agreed with Casinillo and Seriño's (2022) observation that the respondents' mean farming experience exceeded 20 years, and high expertise in farming leads to higher profitability. Moreover, it is validated from the study of Red et al. (2021) and Parreño and Anter (2024) that farmers have gained sufficient farming experience to effectively employ new farming techniques and be more responsive to sustainable conservation practices, which can have a meaningful and significant impact on agricultural production and increase profitability. Moreover, the majority (97.41%) of the respondents had a monthly income of Php 10,000 below, and a low (2.59%) number of respondents had Php 10,000 above monthly income. Additionally, data showed that 93.97% of the farmers had one hectare and below of land in the study area, and 6.03% of the respondents had 1.1 - 5.0 hectares of land. In addition, on the tenurial status of the respondents, three categories were used to group the respondents: Owners, tenants, and both (owner and tenant). Data on the respondents' tenurial status depicted that out of a total of 232 respondents, a majority (65.09%) of the respondents were tenant cultivators, followed by owner (27.59%) and both tenant and owner (7.33%), respectively. These findings were consistent with those of Casinillo and Seriño (2022), who reported that tenant cultivators comprised the majority of respondents (71%) in their study.

Table 3

Socio-economic Profile of the Respondents

Variables	Frequency (n = 232)	Percentage (%)
The primary source of income		
Corn farming	223	96.12
Poultry and livestock raising	4	1.72
Government employed	3	1.29
Others (*Food business, lending collector*)	2	0.86
TOTAL	232	100.00

Variables	Frequency (n = 232)	Percentage (%)
Other sources of income		
Vending	34	14.66
Fishing	83	35.78
Sari-sari store	31	13.36
Livestock raising	55	23.71
Furniture making	3	1.29
Government worker	6	2.59
Copra making	9	3.88
Construction worker	11	4.74
TOTAL	232	100.00
Years in farming		
05 - 15	54	23.28
16 - 26	49	21.12
. 27 - 37	52	22.41
38 - 48	58	25.00
49 - 58	19	8.19
TOTAL	232	
MEAN	28.54	100.00
RANGE	5-56	
Monthly income		
High (Php 10,000 above)	6	2.59
Low (Php 10,000 below)	226	97.41
TOTAL	232	100.00
Farm size		
Small (1 hectare and below)	218	93.97
Medium (1.1 - 5.0 hectares)	14	6.03
Large (5.1 hectares and above)	0	0
TOTAL	232	100.00
Tenurial Status		
Tenant	151	65.09
Owner	64	27.59
Both	17	7.33
TOTAL	232	100.00

Note. Authors' calculation (2024)

4.3. Training participation variables

Table 4 provides a breakdown of training exposure, training attended, and the number of days spent in training among 232 individuals. The first key observation was that the majority (85.34%) of the participants did not receive training, indicating a potential gap in agricultural education and support for this group. Among those who did receive training (14.66%), the most common type of training was the Farmers Scientist Training Program (9.91%). It is mentioned in the study by Cayabyab et al. (2024) that the said training aimed to equip participants with the necessary skills to serve as resource speakers and facilitators in implementing the Farmer Scientist Training Program (FSTP). Other training attended by the respondents was the Training of Trainers (3.45%). It is worth noting that agricultural training can enhance the skills and capabilities of farmers toward greater productivity and sustainability (Red et al., 2021); hence, respondents who have undergone training are more advantaged in farming decision-making than traditional farmers. However, it was notable that only a small percentage (0.86%) attended specific training on land preparation, soil analysis, and cultural and physical management of corn. This suggests that training programs may not provide comprehensive or intensive education, which could limit their effectiveness in improving agricultural practices and productivity; however, they improve their farming techniques (Red et al., 2021). Additionally, a considerable portion of participants (85.34%) reported not acquiring training days, highlighting a substantial segment of the farming population that may be underserved or lacking access to training opportunities altogether. Training on fertilizer application and land management where widespread knowledge gaps currently exist must be addressed (Parreño & Anter, 2024; Red et al., 2021). The research study by Ali et al. (2012) and Casinillo (2022) stated that farmers with more training and agricultural extension experiences were better equipped to operate agrarian implements.

Table 4

Respondents' Exposure and Participation in Various Training Programs

Variables	Frequency (n = 232)	Percentage (%)
Training exposure		
With training	34	14.66
Without training	198	85.34
TOTAL	232	100
Training attended		
Training on land preparation, soil analysis, cultural and physical management of corn	3	1.29
Training of Trainers (Corn-based program)	8	3.45
Farmers' scientist training program	23	9.91
No training attended	198	85.34
TOTAL	232	100
No. of days		
01 - 15 days	4	1.72
16 - 30 days	7	3.02
31 - 45 days	23	9.91
No days acquired	198	85.34
TOTAL	232	100

Note. Authors' calculation (2024)

4.4. Extension contacts

The data shown in Table 5 reveals that the majority (67.67%) of the farmers had low extension contact, while almost one-fourth (24.14%) had medium extension contact, and few (8.19%) of the respondents had high extension contact. Consequently, most (91.81%) farmers had low to medium extension contact. On average, the extension contact of the respondents was 27.09, with a standard deviation of 5.25. It is worth noting that farmers with high exposure to agricultural extension believed that they possess a greater understanding of whom to go with and what to use in times circumstances on corn production arise (Casinillo, 2022; Red et al., 2021). Interactions with agricultural professionals contributed to keeping individuals updated on modern practices (Irawan, 2023).

Table 5

Distribution of the Corn Farmers According to Their Extension Contact

Categories	Basis of categorization (score)	Frequency (n = 232)	Percentage (%)
Low contact	Below 20	157	67.67
Medium contact	20 - 30	56	24.14
High contact	Above 30	19	8.19
TOTAL:		232	100
MEAN:		27.09 (Medium Contact)	
SD:		5.25	

Note. Authors' calculation (2024)

Table 6 provides further information on extension contacts, including their weighted average with adjectival rating. The weighted mean adjectival rating for each contact varied; farmers had occasional contacts with meetings (m = 3.12) and through group discussion (m = 2.89). On the other hand, farmers were rarely contacted through television programs (m = 2.42), radio (m = 2.31), municipal agriculturists (m = 2.30), resource speakers in the training (m = 1.91), and publications (m = 1.86), respectively. This suggests that specific channels, particularly mass media and formal publications, must be utilized to disseminate information related to corn production. Subsequently, farmers had never been contacted by any sub-assistant agriculture officer (m = 1.71), agricultural input dealer (m = 1.64), field technician (m = 1.50), NGO worker (m = 1.41), and field technician (m = 1.26), respectively. It is worth noting that these extension agents play an essential role in closing the gap between research institutes and farmers (Casinillo, 2022). Hence, it needs to be strengthened to reach out to more farmers. Furthermore, the low average (M = 1.93) rating from respondents who rarely interacted with extension services highlighted the limited information access for many farmers. The study of Irawan (2023) shows that information on agricultural extension delivery services needs to be improved, and appropriate strategies must be applied to reach out to farmers, especially in remote areas.

Table 6

Respondents' Contact to Extension

Extension contacts	Weighted mean	Adjectival rating*
Meetings	3.12	Occasionally
Group discussion	2.89	Occasionally
Television program	2.42	Rarely
Radio	2.31	Rarely
Municipal agriculturists	2.30	Rarely
Resource speaker in a training	1.91	Rarely
Publications *(newspaper, poster, leaflet, journals, research paper, etc.)*	1.86	Rarely
Sub-assistant agriculture officer	1.71	Never at all
Agricultural input dealer	1.64	Never at all
Field technician	1.50	Never at all
NGO worker	1.41	Never at all
Extension agents/officers	1.39	Never at all
Science research assistant	1.35	Never at all
Model farmers	1.26	Never at all
Grand weighted mean	**1.93**	**Rarely**

***Interval for Weighed Mean: 1 - 1.75 = Never at all, 1.76 - 2.5 = Rarely, 2.52 - 3.25 = Occasionally, 3.26 - 4.00 = Regularly*

Note. Authors' calculation (2024)

4.5. Extension delivery services

Data in Table 7 shows that the mean analysis on the extent of services to corn farmers rendered by the different agriculture offices in the Camotes Islands was at a "low extent" (M = 2.48). This means the agency's services extended to corn farmers in the different municipalities were minimal. For the services on training and information delivery that include disseminating information on farm mechanization (m = 2.6), conducting a seminar and training on corn management including the preparation of farm plan and budget (m = 2.4), establishing of demonstration plots as show window to farmers (m = 2.4); disseminating information on socialized credit program (m = 2.4); and distributing of brochures and other reading materials (m = 2.3) had minimal implementation to the farmers resulting to a low extent. The low extent of dissemination of information on farm mechanization and socialized credit programs underscored missed opportunities for improving efficiency and access to resources among corn farmers (Red et al., 2021). Moreover, in terms of the services on field support and monitoring also take account of the low extent of dissemination, such as conducting regular consultations and/or field visits (m = 2.6), assessing damage after the occurrence of natural calamities (m = 2.5); assisting in the gathering of soil samples for

analysis (m = 2.4), monitoring and gathering data on production/yield estimate at farm level regularly (m = 2.4); conducting regular monitoring/survey on the incident of pest and diseases (m = 2.4). On the part of resource and production support services such as advocating for farmers to re-plant the missing hill to maximize production (m = 2.5), assisting farmers in the computation of fertilizers to be applied based on the result of the soil analysis (m = 2.4); guiding farmers in the application of lime for acidic soil (m = 2.4); assisting in the preparation of documents for any related projects and scholarships to corn farmers (m = 2.2); establishment of nursery and distribution of planting material (m = 2.2); and conducting of brix reading on the field during harvesting period (m = 2.1) had low extent of dissemination to the farmers which highlighted to where extension efforts may need to be strengthened. Without proper guidance on soil analysis, farmers were more susceptible to crop failure due to nutrient deficiencies. However, a "moderate extent" rating on the extent of services to corn farmers in environmental practices, such as encouraging the farmers to continuously advocate for using organic fertilizers/inputs (m = 2.9). The study results implied that when corn farmers increase the adoption of organic fertilizers, they could lead to improved soil health, reduced reliance on synthetic chemicals, potentially lower pollution risks, and adapt to climate change (Centino & Vista, 2018).

Table 7

Respondents' Extension Delivery Services on Corn Production of Agriculture Offices

Extension services	Weighted mean	Adjectival rating*
Environmental practices		
Continuous advocacy on the use of organic fertilizers/inputs	2.9	Moderate extent
Encourage farmers to practice environmentally friendly methods of farming, non-burning of trash after harvest	2.6	Low extent
Sub-mean:	2.75	
Training and information delivery		
Disseminate information on farm mechanization	2.6	Low extent
Conduct a seminar and training on corn management, including the preparation of a farm plan and budget	2.4	Low extent
Establishment of demonstration plots as a show window to farmers	2.4	Low extent
Disseminate information on socialized credit program	2.4	Low extent
Distribution of brochures and other reading materials	2.3	Low extent
Sub-mean:	2.42	
Field support and monitoring		
Conduct regular consultations and/or field visits	2.6	Low extent
Conduct an assessment of damage after the occurrence of natural calamities	2.5	Low extent

Extension services	Weighted mean	Adjectival rating*
Assist in the gathering of soil samples for analysis	2.4	Low extent
Monitor and gather data on production/yield estimates at the farm level regularly	2.4	Low extent
Conduct regular monitoring/surveys on the incidents of pests and diseases	2.4	Low extent
Sub-mean:	2.46	
Resource and production support		
Advocate farmers to re-plant the missing hill to maximize production	2.5	Low extent
Assist farmers in the computation of fertilizers to be applied based on the result of the soil analysis	2.4	Low extent
Guide farmers in the application of lime for acidic soil	2.4	Low extent
Assist in the preparation of documents for any related projects and scholarships to corn farmers	2.2	Low extent
Establishment of nursery and distribution of planting material	2.2	Low extent
Conduct brix reading on the field during the harvesting period	2.1	Low extent
Sub-mean:	2.3	
Grand Weighted Mean	**2.48**	**Low extent**

***** *Interval for Weighted Mean: 1 - 1.08 = Very low extent, 1.09 - 2.6 = Low extent, 2.7 - 3.4 = Moderate extent, 3.5 - 4.2 = High extent, 4.3 - 5.0 = Very high extent*

Note. Authors' calculation (2024)

4.6. Knowledge of farmers on corn production

Observed knowledge scores ranged from 17 to 36, with a mean of 29.89 and a standard deviation of 2.37. Based on the observed scores, the farmers were classified into three categories: "low knowledge," "medium knowledge," and "high knowledge". Table 8 displays the distribution of farmers according to their knowledge level. An analysis shows that nearly 80% of farmers had moderate corn production knowledge. While a small percentage (around 15.09%) demonstrated a high level of expertise, and over 5.17% had limited or low understanding. This indicates that most farmers (over 84.91%) descended within the low to medium knowledge range. With the proper training, farmers were likely to farm corn properly, produce good yields, and contribute to the overall agricultural output in the country. Henceforth, a medium knowledge base shows that corn farmers may be open to new farm information and technology from extension agencies or other sources (Casinillo, 2022; Irawan, 2023; Miiro et al., 2014).

Table 8

Distribution of the Corn Farmers according to Their Knowledge of Corn Production

Categories	Basis of categorization (score)	Frequency (n = 232)	Percentage (%)
Low knowledge	< 28.41	12	5.17
Medium knowledge	28.41 - 32.63	185	79.74
High knowledge	> 32.63	35	15.09
TOTAL:		232	100
MEAN:		29.89 (Medium knowledge)	
SD:		2.37	

Note. Authors' calculation (2024)

4.7. The attitude of corn farmers on corn production

Attitude scores of the corn farmers ranged from 21 to 63, within a possible range of 0 to 70, with an average score of 50.44 and a standard deviation of 6.43. Based on these observed attitude scores, the respondents were categorized into four categories: unfavorable, neutral attitude, low favorable, and high favorable. The distribution of respondents across each category was presented in Table 9, indicating approximately 52.16% of the respondents exhibited a highly favorable attitude toward corn production. In comparison, 45.69% held low favorable, 1.72%, and 0.43% held neutral and unfavorable attitudes, respectively.

Table 9

Distribution of the Corn Farmers according to Their Attitude toward Corn Production

Categories	Basis of categorization (score)	Frequency (n = 232)	Percentage (%)
Unfavorable	< 30	1	0.43
Neutral	30	4	1.72
Low favorable	31 - 50	106	45.69
High favorable	> 50	121	52.16
TOTAL:		232	100
MEAN:		50.44 (High Favorable)	
SD:		6.43	

Note. Authors' calculation (2024)

Table 10 shows that these indicators' grand weighted mean adjectival rating was (M = 3.65), indicating a general agreement among respondents. These indicators have significant implications for research in corn production. Farmers strongly agreed that less yield of corn during the dry compared to wet season (m = 4.5) and also with heavy rainfall and high temperatures are injurious for corn plan (m = 4.3) getting with a sub-mean of 4.4 indicating that farmers strongly agreed on the environmental factors towards corn production. Thus, it suggests the vulnerability of corn production to climate variability. Research has shown climate change poses significant risks to agricultural productivity, particularly in rainfed cropping systems (Centino & Vista, 2018). Farmer respondents agreed that they would

continue corn production because it was more profitable than other crops (m = 4.0); they also continued corn cultivation because its marketing facilities were available and good (m = 3.8); and, of course, interested in corn production because the demand of it is very high most especially in food industries (m = 3.8). This aligns with research indicating the importance of market access in influencing farmers' decisions to continue or discontinue production by Red et al. (2021). Zhou et al.'s (2018) research has shown that profitability was a key determinant of crop choice and investment decisions among farmers. The attitude towards production challenges and costs received varied responses indicating that farmers were undecided (m = 3.38) with the statements. Farmers in the islands agreed that poor farmers could not cultivate corn due to lack of money (m = 3.6). However, they were undecided on the statement that they were losing their interest in cultivating corn because of a very high cost of production (m = 3.4). Also, the complexity of corn production (m = 3.2) indicates that some farmers find corn production complex, potentially leading to inefficiencies or mistakes. Lastly, its difficulty in maintaining the quality of seeds (m = 3.3) suggests that some farmers struggle to maintain seed quality, resulting in lower yields and higher production costs. Farmers agreed that pests and diseases of corn can be controlled by clean cultivation (m = 3.8); also agreed sometimes they lose their motivation to produce corn due to severe insect attacks (m = 3.5); disagreed with the statement that less infestation of diseases occurs (m = 2.5). These findings suggest that the importance of clean cultivation for pest and disease control underscored the role of agronomic practices in mitigating crop losses, according to Red et al. (2021).

Table 10

Attitudes of Farmers toward Corn Production

Indicators	Weighted mean	Adjectival rating*
Attitude towards environmental and climatic factors		
Less yield of corn during the dry compared to the wet season	4.5	Strongly agree
Heavy rainfall and high temperatures are injurious to the corn plant	4.3	Strongly agree
Sub-mean:	4.4	
Attitude towards market and profitability		
I will continue corn production because it is more profitable than other crops	4.0	Agree
I will continue corn cultivation because its marketing facilities are available and good.	3.8	Agree
I'm interested in corn production because the demand for it is very high, especially in the food industries	3.8	Agree
Sub-mean:	3.87	
Attitude towards production challenges and costs		
Poor farmers can't cultivate corn due to lack of money	3.6	Agree
I sometimes lose my interest in corn cultivation because the cost of production is very high	3.4	Undecided
Corn production is complex	3.2	Undecided

Indicators	Weighted mean	Adjectival rating*
It isn't easy to maintain the quality of seeds	3.3	Undecided
Sub-mean:	3.38	
Attitude towards pests and diseases		
I think pests and diseases of corn can be controlled by clean cultivation	3.8	Agree
Due to severe insect attacks, I sometimes lose my motivation to produce corn	3.5	Agree
Less infestation of diseases occurs	2.5	Disagree
Sub-mean:	3.27	
Attitude towards farmers' interest		
Young and educated farmers are interested in producing corn	3.5	Agree
In small areas, corn can be cultivated	3.2	Undecided
Sub-mean:	3.35	
Grand weighted mean	**3.65**	**Agree**

***Interval for Weighted Mean: 1 - 1.08 = Strongly disagree, 1.09 - 2.6 = Disagree, 2.7 - 3.4 = Undecided, 3.5 - 4.2 = Agree, 4.3 - 5.0 = Strongly agree*

Note. Authors' calculation (2024)

4.8. Practices of corn production on corn production

The practice scores of corn farmers could range from 0 to 52, but the observed practice scores ranged from 21 to 47, with a mean of 38.83 and a standard deviation of 4.87. Based on these practice scores, corn farmers were categorized into three groups, as detailed in Table 11. The findings indicated that 21.55% of the corn farmers demonstrated medium practice, 76.73% exhibited high practice, and 1.72% showed low practice in corn production. This suggests that the overwhelming majority (98.28%) of the farmers had medium to high practice levels in corn production. Effective production of corn necessitates regular land preparation, irrigation, fertilizer application, insecticide use, and weeding (Hernando-Valdez & Cecilia, 2021).

Table 11

Distribution of the Corn Farmers according to Their Practices in Corn Production

Categories	Basis of categorization (score)	Frequency (n = 232)	Percentage (%)
Low practice	< 22	4	1.72
Medium practice	22 - 30	50	21.55
High practice	> 30	178	76.73
TOTAL:		232	100
MEAN:		38.83 (High Practice)	
SD:		4.87	

Note. Authors' calculation (2024)

Table 12 depicted that the overall weighted mean adjectival rating for these indicators was 2.99, indicating that, on average, they are implemented occasionally. These indicators have important implications for research in corn production. Farmers had regularly practiced grading corn (m = 3.72), applying fertilizers (m = 3.67), preparing the land (m = 3.53), carefully loading corn (4.53), storage corn (m = 3.41), considering plant reproduction and propagation (m = 3.33), weeding and thinning (m = 3.28), and selecting the appropriate corn variety that suits the area (m = 3.26). Research by Wang and Hu (2020) supports the importance of these practices in optimizing yield and quality in corn production. The findings were also supported by Centino and Vista (2018), who highlight the importance of these practices in maximizing both the quantity (yield) and quality of corn production. However, farmers had occasionally practiced counting the seeds before planting in the field (m = 2.63) and safe transportation of corn (m = 2.62). Research findings of Adiputra and Bilang (2020) support the idea that corn farmers should focus on improving post-harvest technologies and practices to minimize losses and maintain grain quality throughout the storage and marketing process. Additionally, farmers rarely practiced when it comes to considering the soil fertility of the field (m = 2.48) and using insect and disease control (m = 1.95), which could highlight areas where improvement was needed. Research has shown that soil fertility and pest management are critical for ensuring optimal growth and yield in corn crops (Alvarez et al., 2021).

Table 12

Practices of Farmers towards Corn Production

Indicators	Weighted mean	Adjectival rating*
Grading of corn	3.72	Regularly
Applying fertilizer (organic and synthetic)	3.67	Regularly
Preparing the land (plowing, harrowing, furrowing)	3.53	Regularly
Carefully loading corn	3.47	Regularly
Storage of corn	3.41	Regularly
Consider plant reproduction and propagation	3.33	Regularly
Weeding and thinning	3.28	Regularly
Selecting the appropriate corn variety that suits the area	3.26	Regularly
Counting the seeds before planting in the field (seed establishment)	2.63	Occasionally
Safe transportation of corn	2.62	Occasionally
Consider the soil fertility of the field	2.48	Rarely
Using insect and disease control	1.95	Rarely
Proper irrigation in the field	1.48	Never at all
Grand weighted mean	**2.99**	**Occasionally**

***Interval for Mean (Overall response): 1 - 1.75 = Never at all, 1.76 - 2.5 = Rarely, 2.52 - 3.25 = Occasionally, 3.26 - 4.00 = Regularly*

Note. Authors' calculation (2024)

4.9. Correlation analysis

Table 13 showed a significant negative correlation (p-value = 0.0108) at a 5% level between the farmers' age and the practice level, suggesting that middle-aged farmers tend to have a higher level of practice. Middle-aged farmers had access to more recent education and training programs that emphasized improved practices and were more comfortable adopting new technologies and techniques that could improve efficiency and yield. Research by Casinillo and Seriño (2022) supports this notion, suggesting that middle-aged generations may be more willing to tackle challenges. Moreover, the highest educational attainment of the farmer respondents was positively correlated (p-value = 0.0279) at a 5% level with practice, implying that as the highest educational attainment increases, so does the level of practice. Courses in agriculture or related fields equipped them with information on improved planting techniques, effective pest and disease control methods, proper use of fertilizers and irrigation practices, and new technologies and advancements in corn production (Hernando-Valdez & Cecilia, 2021; Red et al., 2021).

The other source of income was found to be significantly related (p-value = 0.0242) at a 5% level to the farmers' knowledge. This indicates that farmers with income from other sources had more disposable income to invest in themselves and their farms, allowing them to attend workshops or training programs on improved corn production practices. This corroborates with the findings of Casinillo (2023), who stated that income from various sources may enable farmers to invest in formal or informal education related to agriculture. This could involve participating in extension programs offered by agricultural agencies and seeking out knowledge from other farmers or experts in the field (Casinillo, 2022; Casinillo & Seriño, 2022).

Additionally, another significant positive correlation (p-value < 0.0001) at 0.1% level with monthly income and the level of extension delivery services implies a higher level of extension delivery services being rendered to the farmers tends to have higher monthly income to acquire. This claim was supported by Kauky's findings (2024), which showed a positive correlation between the effectiveness of extension services and farmers' income. Lastly, the primary source of income was found to be significantly related (p-value = 0.0072) at a 1% level with the level of extension contacts. Farmers with corn as their primary source of income might be highly motivated to seek extension services on their own to improve their production and livelihoods (Adiputra & Bilang, 2020; Centino & Vista, 2018). Other socio-economic characteristics were independent of knowledge, attitude, practices, extension contacts, and extension delivery services.

Additionally, Table 13 seemingly displays the relationship of KAP, Extension Contact, and Extension delivery services with the other farming-related variables. Analysis showed that the farm size and level of practice were positively related (p-value = 0.0148) at a 5% level. This positive relationship between farm size and the level of agricultural practices suggests that farmers who have larger farms are more likely to adopt and implement advanced farming practices and tend to have a higher level of practice. The findings of Wang and Hu (2021) posited that larger farms tend to adopt more intensive farming practices due to their ability to invest more in technology and inputs. Furthermore, a significant positive correlation (p-value = 0.0085) at a 1% level was also observed between farm size and the level of extension delivery services. This means that larger farms tend to have a higher level of extension delivery. Supported from the research findings of Anderson and Feder (2007) emphasized that larger farms were more likely to benefit from extension services due to their greater capacity to implement the recommendations provided. Moreover, a significant relationship (p-value = 0.0024) at a 1% level between type of tenure and level of practice was found. This indicates that land tenure influences farmers' decisions to invest in and adopt improved agricultural practices.

On the other hand, attendance at training was significant (p-value = 0.0047) at a 1% significance level with the level of extension contacts. With better understanding through the various trainings, farmers can make more informed decisions about their crops, potentially leading to improved yields and profitability (Casinillo, 2023). Also, training programs expose farmers to new and improved practices in corn production, which they are more likely to adopt if they have frequent contact with extension services (Casinillo, 2022; Red et al., 2021). However, other variables were found to be independent of the level of extension contacts. Lastly, attendance to training was also positively correlated (p-value < 0.0001) at a 0.1% significance level with the level of extension delivery, suggesting that higher attendance to training was associated with a higher level of extension delivery. In other words, farmers who attended training sessions more frequently performed better in delivering extension services. Furthermore, the attitude of the respondents was found to be independent of all the variables considered. Moreover, the other farming-related variables were independent of knowledge, attitude, and practices.

Table 13

Correlation Analysis for the Variables Involved in the Study

Factor	Correlation analysis	Farming variables				
		Knowledge	**Attitude**	**Practices**	**Extension contacts**	**Extension delivery services**
Age	r_s	0.0897	0.0388	-0.1671*	0.1072	0.0182
	p-value	0.1733	0.5570	0.0108	0.1035	0.7814
Sex	r_{rb}	-0.0650	-0.0273	0.0865	-0.0606	-0.0679
	P-value	0.3245	0.6791	0.1890	0.3579	0.3032
Civil status	χ^2	27.2441	56.7359	36.5976	41.1387	92.1307
	p-value	0.2021	0.5958	0.8378	0.9316	0.8909
Educational attainment	r_s	0.0146	-0.0476	0.1444*	0.1038	0.0290
	p-value	0.8254	0.4708	0.0279	0.1148	0.6599
The primary source of income	χ^2	1.6899	0.6502	1.3450	9.8654**	3.6990
	p-value	0.1936	0.7224	0.2462	0.0072	0.4483
Another source of income	χ^2	19.1214*	15.4041	15.5120	17.5118	36.2561
	p-value	0.0242	0.6341	0.0778	0.4882	0.4567
Monthly income	r_s	0.0530	0.0154	0.0275	-0.0040	0.2540***
	p-value	0.4219	0.8152	0.6766	0.9514	<0.0001
Years of farming	r_s	0.0804	0.0504	-0.0877	0.0948	0.0647
	p-value	0.2223	0.4444	0.1830	0.1501	0.3267
Farm size	r_s	0.0412	0.1138	0.1599*	0.0003	0.1723**
	p-value	0.5322	0.0838	0.0148	0.9966	0.0085
Tenurial status	χ^2	1.2133	8.4935	12.0406**	0.7350	10.4730
	p-value	0.5452	0.0751	0.0024	0.9469	0.2334
Attendance to training	r_{rb}	-0.0543	0.0946	0.0753	0.1851**	0.2832***
	p-value	0.4107	0.1511	0.2532	0.0047	<0.0001

Note. *Significant at 5% level

**Significant at 1% level

***Significant at 0.1% level. Authors' calculation (2024)

5. Conclusion and policy recommendations

The study highlights a significant gap in extension delivery services to corn farmers, indicating limited access across various municipalities. Corn farmers possessed medium knowledge of corn production, highlighting a need for educational improvements to optimize yields. The study identified major problems like limited resources, pest issues, and lack of support services. Coping strategies include exploring intercropping, microfinancing, and providing training for farmers. A positive attitude among farmers, exhibiting medium to high practice levels in corn production techniques, was revealed, indicating a strong foundation for efficiency and yield. The study suggests focusing extension services on corn farmers and those with larger farms or higher incomes, as these groups demonstrated a stronger connection to extension services and potentially more excellent receptiveness to new practices.

Additionally, the government must subsidize costly inputs like pesticides, herbicides, fertilizers, and other modern agricultural machinery for the farming community. Extension staff were needed to make frequent visits to ensure the dissemination of information and the latest farming practices to the farming community to avoid environmental and human health risks. Future research should explore the interconnections between knowledge, attitude, and practices and their impact on the success of farmers in corn production to enhance the present findings of this study further.

SCIENTIFIC CONTRIBUTION

The manuscript clearly identifies a research gap; the manuscript opens new directions for further research; the conceptual framework of the study is to correlate the farmers socio-demographic and economic characteristics and their knowledge, attitudes, and practices on corn production and extension delivery services to determine its relationship that provides decision-making strategies and policies in corn production activities.

AUTHOR CONTRIBUTIONS

CRediT: **Alberto Jimenez Colminas, Jr.**: Conceptualization, Framework, Methodology, Writing-original draft, Formatting; **Karen Luz Pacetes Yap**: Supervision, Investigation, Proofreading, Correcting Errors; ; **Leomarich Fortugaliza Casinillo**: Writing - Review & Editing, Software, Formal and Data Analysis, Proofreading, Corresponding author.

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All authors declare that they have no conflict of interest.

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