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Socio-economic status, farm practices, and technology needs of selected coffee producer organizations in the CALABARZON region, Philippines

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Abstract The results of the study showed that 56.62% of the coffee farmers of the ten (10) selected Producer Organizations (POs) in the CALABARZON region are Male while 43.38% are Female mostly having more than 10 years of experience in coffee farming (63.23%). The average age of coffee farmers ranges between 61 to 70 years old (29%). Fifty-six-point ninety-nine percent (56.99%) of the respondents answered that only about 0 – 25% of their total household income represents the income they acquired from coffee farming. Farm practices such as propagation, land preparation, lay-outing and holing, fertilizer application, weed control, pruning, and rejuvenation were employed by more than 50% of the farmers. The technical needs of the coffee farmers in the region include training on the application of SMART technology intervention for coffee farming (69.70%), proper pruning and rejuvenation of old coffee trees (63.84%), harvesting and processing of produced coffee (63.10%), proper farm management and application of GAP/GMP, as well as seedling production and planting (59.04%). Furthermore, the result of the regression analysis revealed that the years of experience in farming, tenure status, farm size, nursery establishment, transplanting, shading of trees, pruning, and water management were significant in explaining variation in volume of coffee production at $\alpha = 0.1$ and above. Water management is the most significant predictor at a 5% level ($P = 0.027$) having a positive coefficient of $P = 0.545$.

Keywords: Coffee production, Farmers profile, Producer Organizations, Regression analysis

Introduction

The global value of coffee is estimated to be 77 billion US dollars (USD), with a trade amount of 66.5 billion USD in 2015 (Department of Trade and Industry [DTI], 2017). About 100 million families globally depend on the

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commodity for their living, with an estimated annual income of at least 220 billion USD (International Coffee Organization [ICO], 2019). Coffee is grown in a region called the "coffee belt" situated on both sides of the equator, between the tropics of Cancer and Capricorn, wherein the climate is humid and warm with a relatively constant temperature of about 27°C for the whole year (Schuchmann, 2007). The Philippines, lying in this region, is one of the few countries that cultivate three (3) commercially viable coffee: *Coffea arabica*, *Coffea canephora*, and *Coffea liberica* (Panaligan *et al.,* 2020). In the last four (4) years, the country's production in terms of thousand 60 kg bags of green coffee beans (GCB) were 203, 206, 307, and 250 for the years 2017, 2018, 2019, and 2020, respectively, with a percent change of -18.4% between 2019-2020 (ICO, 2020a). While the country's consumption in 2020/2021 is recorded at 3,312,000 bags of GCB (ICO, 2020b). This seen gap between production and consumption is mainly due to the increase in the number of coffee growers shifting to other crops, declining hectarage of land devoted to coffee due to land conversion to real estate and recreation areas and urbanization, and low productivity per tree and poor quality of beans which caused by the old age of trees, limited rejuvenation and, poor farm practices and management (Department of Agriculture [DA] and DTI (2017); Habaradas and Mia, 2021).

CALABARZON, formerly known as Southern Tagalog mainland, is situated in the southwestern part of Luzon Island with a total land area of 16,560 square kilometers and is considered the second most densely populated region in the Philippines (Mojares, 2013). It comprises five provinces: Cavite, Laguna, Batangas, Rizal, and Quezon. CALABARZON's major crops include coconut, corn, pineapples, palay, sugarcane, mango, banana, and coffee, with an estimated utilized agricultural land area of 764,381.16 hectares or 6.58% of the total land area in 2015 (National Economic and Development Authority [NEDA] Regional Office IV-A, 2017). In 2019, about 13,295.40 hectares of land in the region were devoted to coffee planting, with full-bearing trees of 10,336,630 and a total production of 1,496.34 metric tons of dried coffee berries (PSA, 2021a). Robusta is the predominant type of coffee planted, with a total production of 1,040.29 metric tons, while Excelsa and Liberica produced 387.78 and 58.82 metric tons of dried coffee berries in 2019, respectively (PSA, 2021a). However, the region's coffee production is constantly declining, with a recorded average annual decrease of 17.5% (PSA, 2021a). One of the primary reasons for this constant decrease is the rapid urbanization in CALABARZON due to its proximity to Metro Manila and its industrial and economic opportunities. Cavite, where the Municipality of Amadeo – the "Philippines' Coffee Capital" is situated, ranked first in terms of the number of land-use conversion applications between 1988 and 2000 (Mojares, 2013). In 2014 alone, Cavite's remaining area for coffee was

8,310 hectares from 8,335 hectares in 2010, 25 hectares decrease in just four years. Other provinces such as Batangas posed a decrease of land hectarage of 687, Laguna with 10, and Quezon with 179. In contrast, Rizal maintained its land area for coffee production at 60 hectares in 2014 (PSA, 2015).

Another significant reason for the decline is the aging coffee farmers in the region. It was revealed that the age of coffee farmers in the region ranges from 42 years old to above (Magcawas *et al*., 2015). The younger generation appears to be uninterested in farming which poses a threat to the agriculture sector in the coming years (Tañongon *et al.,* 2020) and may also significantly affect specifically the coffee industry. Moreover, lower farmgate price of dried coffee beans at Php 76.23 per kilogram for Robusta and Php 86.51 for Excelsa (PSA, 2021b), coffee farmers tend to shift to produce other cash crops for a higher income. Furthermore, a natural calamity, the Taal Volcano eruption, which happened on January 12, 2020, after 43 years of dormancy (Lagmay, 2021), significantly affected the coffee farm areas in Cavite, Laguna, and Batangas. The rise of the COVID-19 pandemic froze the economic activities of the region and the entire country due to the imposed stringent quarantine measures starting March 17, 2020 (The Guardian, 2020), which also contributed to the disruptions in the coffee value chain actors and activities. These enumerated gaps pose a risk to the sustainability of the coffee industry in the CALABARZON region.

While gaps and prospects of the coffee sector in CALABARZON are extensively eminent, there still needs to be more available updated and factual baseline data on coffee organizations and their profile in the region that could serve as a starting point when planning for a solution. Thus, this study aimed to assess the socio-economic, farm practices, and technology needs of the ten (10) selected coffee Producer Organizations (POs) in the CALABARZON region. Moreover, the study aimed to determine the POs' coffee farm management, harvest, post-harvest management, and the support services they received and are currently needed.

Materials and methods

Study sites and respondents

The study is based on profiling conducted on the randomly selected farmer-members of the ten (10) coffee producer organizations located in the five provinces of the CALABARZON region namely Cavite, Laguna, Batangas, Rizal, and Quezon (Figure 1). The researchers selected ten (10) coffee producer organizations (POs) as recommended by the DTI-CALABARZON. The survey was conducted from February to May 2021. Table 1 shows the list of POs and

their active members that served as the basis for determining the samples for the profiling. The list of members was obtained from the president of each organization and the Municipal Agriculture Office (MAO).

Source: https://www.google.com/maps/place/Calabarzon/

Figure 1. Map of the CALABARZON Region, Philippines

Table 1. List of coffee producer organizations involved in the study

Organization	Municipality and Province	No. of Active Members
Bailen Coffee Growers Association (BCGA)	General Emilio Aguinaldo, Cavite	500
Minantok East Coffee Farmer's Association (MECGA)	Amadeo, Cavite	21
Casile-Guinting Upland Marketing Cooperative (CGUMC)	Cabuyao, Laguna	197
Cueva Coffee Farmers Association (CCFA)	Sta. Maria, Laguna	40
Juan Santiago Agriculture Cooperative (JSAC)	Sta. Maria, Laguna	25
Kaylaway Farmers Association (KFA)	Nasugbu, Batangas	28
Aga Farmers Multi-Purpose Cooperative (AGFAMCO)	Nasugbu, Batangas	31
Samahan ng Magsasaka ng San Andres Tanay, Rizal Inc. (SMBC)	Tanay, Rizal	32
Guinyangan Coffee Growers Association & Farmer Entrepreneurs Inc. (G-CAFÉ)	Guinayangan, Quezon	23
Masalukot Farmers Association (MFA)	Candelaria, Quezon	42

Sample size computation

The percentage distribution was computed by dividing the entire population of 939 by each association's active members. The sample size was then computed using Equation 1,

$$n = \left(\frac{z^2 p(1-p)}{e^2}\right) \div \left(\frac{z^2 p(1-p)}{e^2 N}\right) \quad (1)$$

where: n= sample size; z= 1.96 for confidence level of 95%; p= 50% response distribution; e= 5% percent margin of error; and N= the population size (939)

The computed sample size is 272. 64 on a 5% margin of error and 95% confidence level, which was then equally divided among POs (Table 2). The values obtained were rounded off because 272 samples were obtained. Upon determining the recommended sample size for each group, purposive sampling was conducted for Bailen Coffee Growers Association because this cooperative has no available list of farmers. For the remaining 9 POs, the team utilized stratified random sampling to ensure that each subpopulation was well represented in the selection.

Table 2. Sample size of the respondents per PO

Organization	Percentage distribution (%)	Computed sample size
Bailen Coffee Growers Association (BCGA)	53.25	145
Minantok East Coffee Farmer's Association (MECGA)	2.24	6
Casile-Guinting Upland Marketing Cooperative (CGUMC)	20.98	57
Cueva Coffee Farmers Association (CCFA)	4.28	12
Juan Santiago Agriculture Cooperative (JSAC)	2.66	7
Kaylaway Farmers Association (KFA)	2.98	8
Aga Farmers Multi-Purpose Cooperative (AGFAMCO)	3.30	9
Samahan ng Magsasaka ng San Andres Tanay, Rizal Inc. (SMBC)	3.41	9
Guinyangan Coffee Growers Association & Farmer Entrepreneurs Inc. (G-CAFÉ)	2.45	7
Masalukot Farmers Association (MFA)	4.47	12
Total	**100.00**	**272**

Data collection

Information such as the farmers' socioeconomic and demographic profile, coffee farm management, harvest, and post-harvest management, and the support services that they received and even needed were identified during profiling since these are essential data that must be considered in ameliorating the coffee sector in the region. A questionnaire with a 0.755 reliability score was administered to determine this necessary information. The reliability score was obtained through the pilot testing of the developed questionnaire to the 30 farmers from one of the coffee producer organizations in Cavite.

The study also followed the action research concept wherein the implementers collaborated with the involved coffee stakeholders to determine the gaps in the region's coffee sector. The action research method was evident as the researchers and coffee stakeholders were working hand in hand in solving and mitigating the impacts of the identified gaps through the conduct of research-based extension activities and the introduction of various Science and Technology (S&T) programs and interventions that were focused on the problems identified during the conduct of research. On the other hand, the Microsoft Database was used to encode and store all the data gathered from the survey.

Statistical treatment of data

The IBM Statistical Package for the Social Sciences (SPSS) version 25 software was utilized for this study for the descriptive analysis of the survey results through the generation of frequency counts, percentages, and means. The multiple linear regression was employed through SPSS software to analyze how the farmers' socioeconomic profile and coffee technology adoption at the farm level affect the coffee productivity among the 10 POs involved in this study. This approach was adopted from the study conducted by Wambua *et al.* (2021), which tackles a clear understanding of how socio-economic factors and technological interventions ultimately affect coffee productivity among the smallholder coffee farmers in Embu County, Kenya (Wambua *et al.,* 2021). The result of this analysis would be significant for future policymakers who would wish to focus their interest on improving coffee productivity at the farm level by putting in place the right interventions or technologies.

Results

Socio-demographic profile

The descriptive result of the selected demographic profiles of the interviewed farmers is shown in Table 3. Out of the 272 surveyed farmers, 56.62% were male while 43.38% were female. A majority (89.3%) of them are aged between 41 – 80 years old and only 9.56% are below 40 years old. Meanwhile, 60.29% of the participants were married, 31.62% were widowed and the remaining 7.36% constituted the single, separated, and common-law population.

The household size of the farmers, on the other hand, mostly accounts for ranges 4 – 5 (46.32%) and 2 – 3 (19.49%). When asked about the number of their children, 31.99% said they have 2 – 3 children, and 30.51% have 4 – 5. It is also worth noting that 36.04% of them lacked formal education while 61.03% had attained secondary education and above. Lastly, 63.23% of the farmers had more than 10 years of coffee farming experience while 34.56% had 10 and below.

Table 3. Socio-demographic characteristics of the coffee farmers

Social Factors	Description	Frequency	Percentage (%)
Sex	Male	154	56.62
	Female	118	43.38
Age	21 – 30	5	1.84
	31 – 40	21	7.72
	41 – 50	49	18.0
	51-60	65	23.9
	61-70	79	29.0
	71-80	50	18.4
	81-90	3	1.1
Civil Status	Single	9	3.31
	Married	164	60.29
	Widow/er	86	31.62
	Separated/annulled	10	3.68
	Common Law/ Live in	1	0.37
	No/No answer	2	0.74
Household Size	0 – 1	33	12.13
	2 – 3	53	19.49
	4 – 5	126	46.32
	6 – 7	35	12.87
	8 – 9	8	2.94
	>10	17	6.25

Social Factors	Description	Frequency	Percentage (%)
No. of Children	0 – 1	55	20.22
	2 – 3	87	31.99
	4 – 5	83	30.51
	6 – 7	30	11.03
	8 – 9	7	2.57
	>10	6	2.21
	No answer	4	1.47
Educational Attainment	Elem Undergraduate	31	11.4
	Elem Graduate	23	8.46
	HS Undergraduate	44	16.18
	HS Graduate	73	26.84
	College Undergrad	28	10.29
	College Graduate	49	18.01
	Masters Graduate	2	0.74
	Doctorate	1	0.37
	Vocational /TVET	13	4.78
	No/No answer	2	0.74
Years of experience in coffee farming	0 – 10	94	34.56
	11 – 20	51	18.75
	21 – 30	72	26.47
	31 – 40	21	7.72
	41 – 50	20	7.35
	51-60	8	2.94
	No answer	6	2.21

Economic characteristics of the coffee farmers

Farmers' reasons for venturing into coffee farming or business were mainly to financially support their family (49.39%), to continue their family business (28.75%), and due to the product's high market demand (17.44%) (Table 4). However, it could be inferred that a significant percentage of interviewed coffee farmers only have an income ranging from PhP 0 – 10, 000 – quite alarming especially for most of them whose primary reason for engaging in coffee farming was to sustain their family's basic needs. Table 4 further delineated that significantly 56.99% of the respondents said that the income they get from coffee

farming only represents about 0 – 25% of their household income. Meanwhile, the survey results of the coffee farmers' sources of funds in sustaining their coffee farm operations showed that 96.32% of the coffee farmers interviewed were using their savings or personal money to fund their farm operations and only a very small portion (0.74%) of the respondents were given an opportunity for bank credits.

Table 4. Economic characteristics of coffee farmers

Economic characteristics	Description	Frequency	Percentage (%)
Reasons for venturing into coffee farming *(multiple response)*	To financially support the family	201	49.39
	To continue family business	117	28.75
	Due to product's high market demand	71	17.44
	Others	16	3.93
	No answer	2	0.49
Range of income from coffee farming/ processing (Php)	0-10,000	183	67.03
	11,000-20,000	58	21.32
	21,000-30,000	12	4.41
	31,000-40,000	2	0.74
	41,000-50,000	1	0.37
	51,000-60,000	2	0.74
	61,000-70,000	1	0.37
	No answer	13	4.78
Range of income aside from coffee farming/ processing (Php)	0-10,000	182	66.91
	11,000-20,000	27	9.93
	21,000-30,000	25	9.19
	31,000-40,000	4	1.47
	41,000-50,000	5	1.83
	51,000-60,000	2	0.74
	61,000-70,000	4	1.47
	No answer	21	7.72
Share of coffee production's income to the household income	0-25%	155	56.99
	26-50%	64	23.53
	51-75%	18	6.62
	76-100%	23	8.46
	No answer	12	4.41
Sources of funding	Personal savings	262	96.32
	Loan from relatives	3	1.10
	Loan from the bank	2	0.74
	Informal money lenders	1	0.37
	Others	2	0.74
	No answer	2	0.74

On the other hand, presents one of the most significant findings of the profiling conducted on the coffee farmers in CALABARZON – the evidence of family farming wherein the majority of the family members are engaged in arduous coffee farming to cut costs and compensate for farm's low productivity (Figure 2).

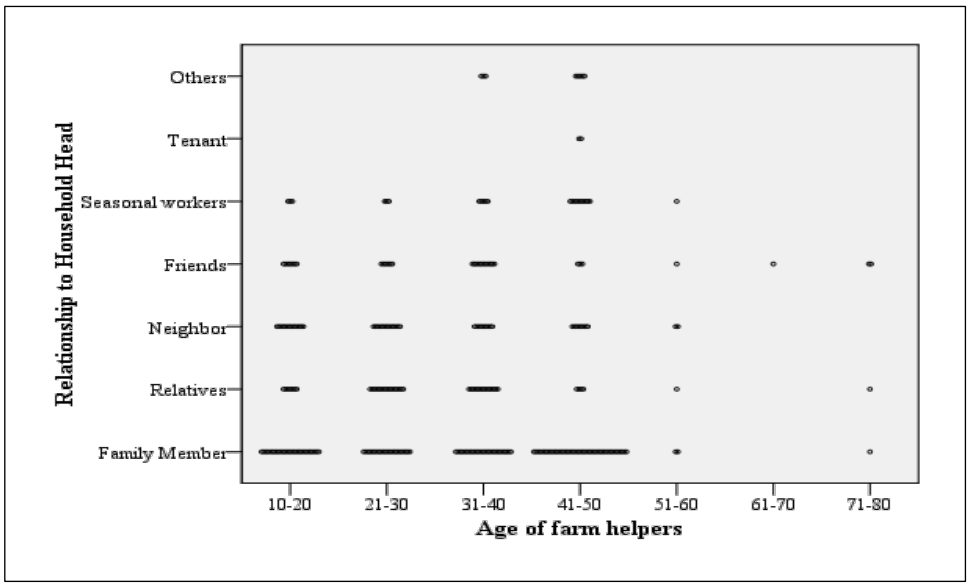

Figure 2. Age coffee farm workers and their relationship to household head

Farm-related economic factors

86.76% of the 272 respondents interviewed are reportedly the owner-operators of their lands, and 99.63% of them practice intercropping (Table 5). It was a good indicator of cost reduction at a farm level since almost all of them do not pay for land rentals. On the other hand, the same table denotes that the majority (76.5%) of the farmers interviewed were said to have land areas ranging between 0 – 2 has, and significantly 36.76% and 26.47% of the respondents said that they are allotting respectively 0 – 25% and 26 – 50% portions of their lands for coffee farming.

The top five crops are grown by the farmers aside from coffee which were banana (18.2%), coconut (18.2%), jackfruit (11.2%), papaya (10.2%), and calamansi (9.9%) as shown in Figure 3.

Table 5. Farm-related economic factors of the respondents

Farm-related factors	Description	Frequency	Percentage (%)
Land tenure status	Owner-operator	236	86.76
	Leasee	2	0.74
	Tenant	26	9.56
	Others	8	2.94
Farming system	Monocropping	1	0.37
	Intercropping	271	99.63
Farm size (ha)	0-0.5	78	28.68
	0.6-1.0	37	13.60
	1.1-1.5	61	22.43
	1.6-2.0	31	11.40
	2.1-2.5	5	1.84
	2.6-3.0	11	4.04
	3.1-3.5	2	0.74
	3.6-4.0	9	3.31
	>4.0	23	8.46
	No answer	16	5.88
Percentage of land planted with coffee	0-25%	100	36.76
	26-50%	74	27.21
	51-75%	43	15.81
	76-100%	14	5.15
	No answer	41	15.07

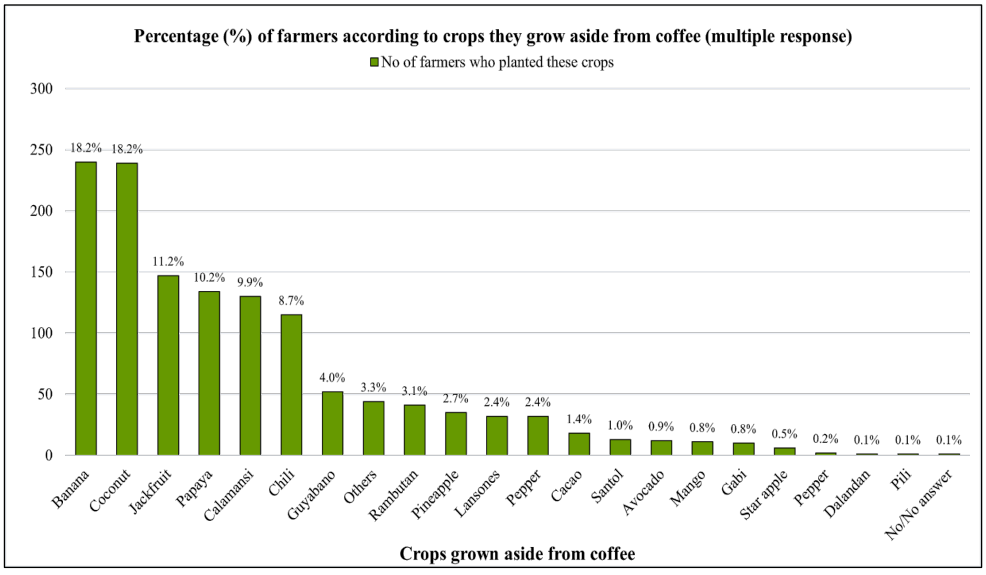

Figure 3. Other crops grown other than coffee

Coffee farm practices

The following figures below show the descriptive statistics among coffee farmers in CALABARZON who are practicing essential farm management techniques based on the results of the profiling conducted. The propagation, land preparation, lay-outing and holing, fertilizer application, weed control, pruning, and rejuvenation were the popular practices adopted by more than 50% of the farmers while nursery establishment, transplanting, shading of trees, replanting, control of pests and diseases, and water management were the agronomic practices that were not commonly practiced by more than 50% of the respondents (Figure 4).

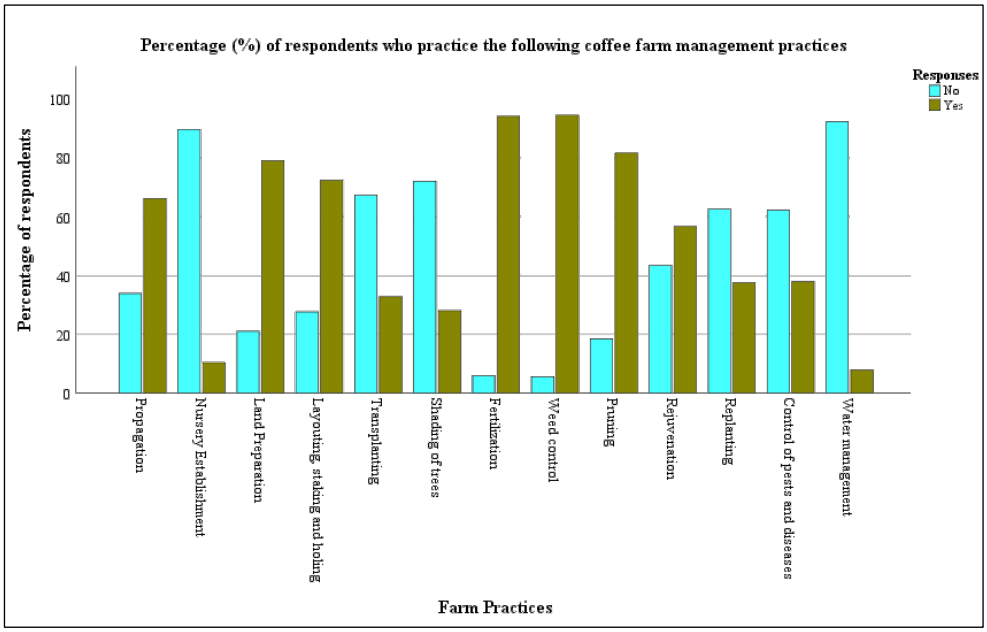

Figure 4. Farm practices of coffee farmers in CALABARZON

The result of the survey on the harvesting practices of the interviewed farmer-members is shown in Figure 5. As observed, some of the respondents still practice the stripping method (23.90%) despite the urge to utilize selective ripe picking to ensure the quality of the coffee beans. When it comes to the processing method (Figure 6) which was taken as a multiple response set, the result shows that all of the participants (100%) still rely on the traditional method (sun drying) of coffee processing and only a small percentage (5.54%) of them are aware or has the capability of using the wet processing method.

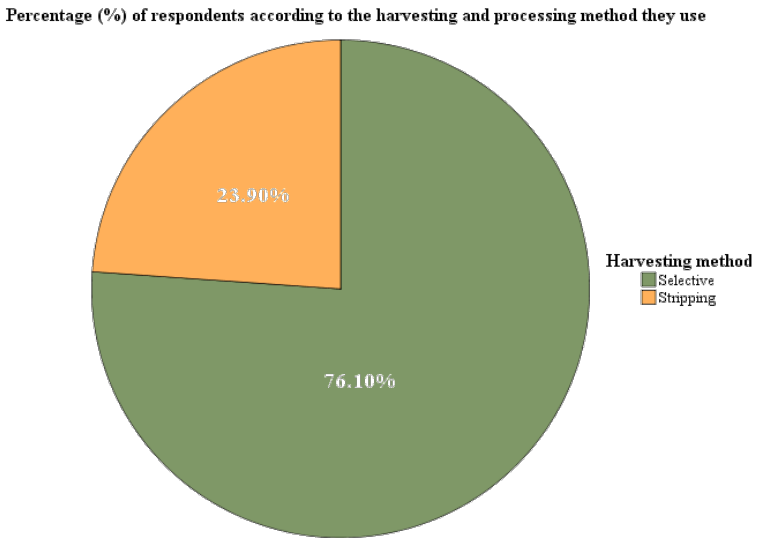

Figure 5. Harvesting method

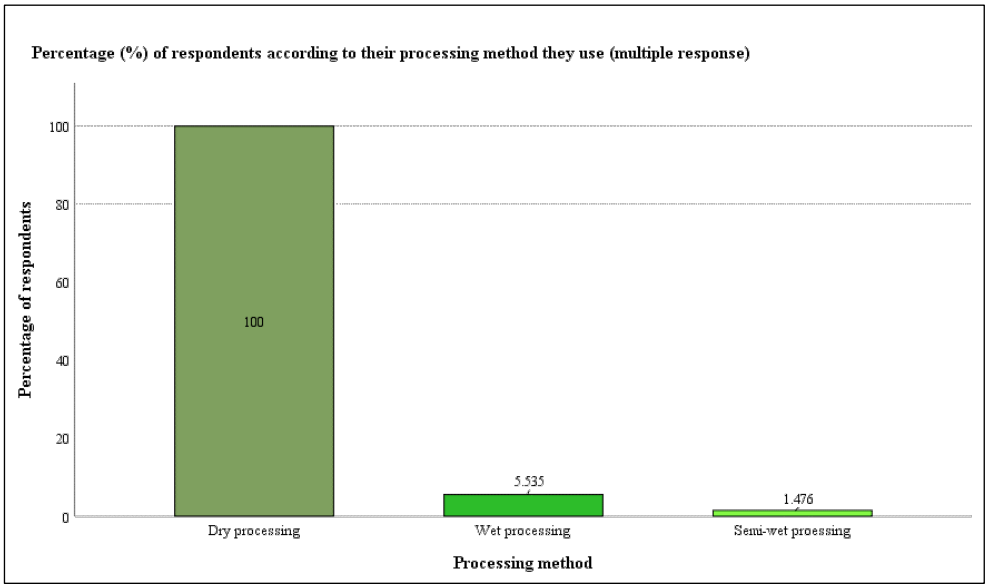

Figure 6. Coffee processing methods used

Market opportunity for coffee in the region

The majority of the farmer-members in CALABARZON were obtaining information about coffee, market, and technologies from the members of their family (54.04%), government (34.56%), and friends (15.81%) (Table 6).

Meanwhile, as for the volume of products sold by the farmers, it can be noticed that majority of the farmers can sell 0 – 50 cans of coffee (72.1%), where 1 can is equivalent to 10 kilograms. The types of products offered by POs are also presented in the same table. It was revealed that 72.73% of the coffee farmers sold their coffee produce as dried coffee berries while only 3.03% and 0.67% of the respondents answered that they are selling their products as ground coffee and green coffee beans, respectively. It was also revealed that the dried coffee berries were sold at a price range between Php 41 – 50/kg.

Table 6. Market-related data

Market-related factors	Description	Frequency	Percentage (%)
Sources of information about coffee production, market, and technologies *(multiple response)*	Family	148	43.02
	Government	43	12.50
	Friend	27	7.85
	Relative	94	27.33
	Television	7	2.03
	Social media	12	3.49
	Trader	5	1.45
	Others	3	0.87
	No Answer	5	1.45
Types of coffee products sold *(multiple response)*	Dried coffee berries	216	72.73
	Fresh coffee berries	31	10.44
	Ground coffee	9	3.03
	Green coffee beans	2	0.67
	None/No Answer	39	13.13
Volume of coffee products sold (cans; 1 can= 10kg)	0-50	188	69.18
	51-100	27	9.93
	101-150	3	1.10
	151-200	2	0.74
	201-250	1	0.37
	251-300	6	2.21
	>350	2	0.74
	None/No Answer	45	16.54
Price of coffee produce per kg (dried coffee berries)	0-10	2	0.74
	11-20	3	1.10
	21-30	3	1.10
	31-40	18	6.62
	41-50	174	63.97
	51-60	11	4.04
	91-100	2	0.74
	>100	18	6.62
	None/No Answer	41	15.07

The available market of coffee farmers in the region is shown in Figure 7. Majority (67.16%) of the coffee produced by the farmers of each organization is sold to their respective associations/cooperatives. Other markets include local

buyers, Nestle, middlemen, tourists, DA, markets, and so on. When asked about their average cost, majority of the respondents said that they usually incur about 0 – 10, 000 pesos while some have mentioned that it is more than 10,000 pesos and these variations occur due to the amount and type of their inputs, farm size and the number of farm helpers hire. As for the average net income, around 60% of the respondents said that about 0 – 10, 000 pesos is their net income from coffee (Figure 8).

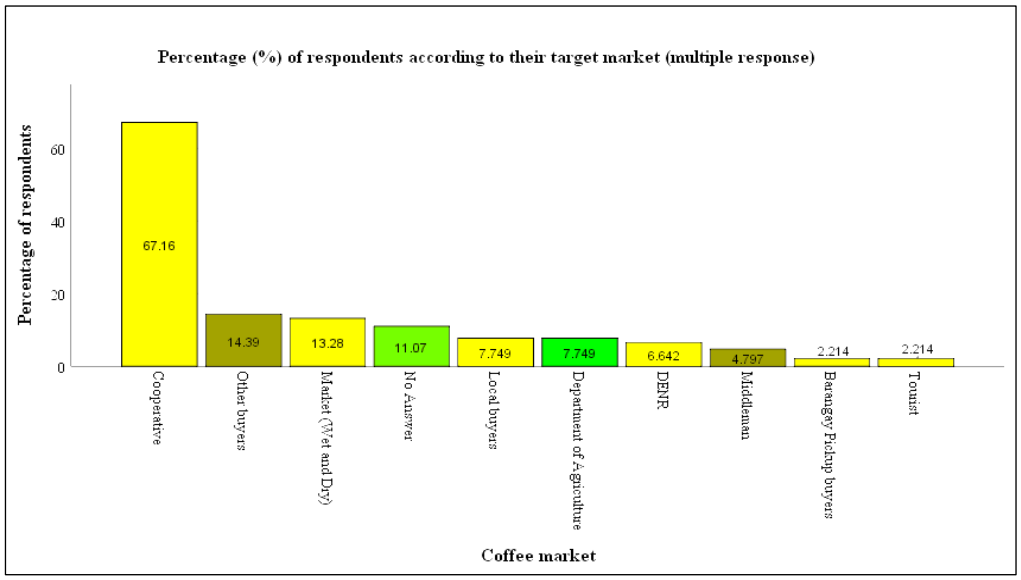

Figure 7. Coffee buyers/market in the region

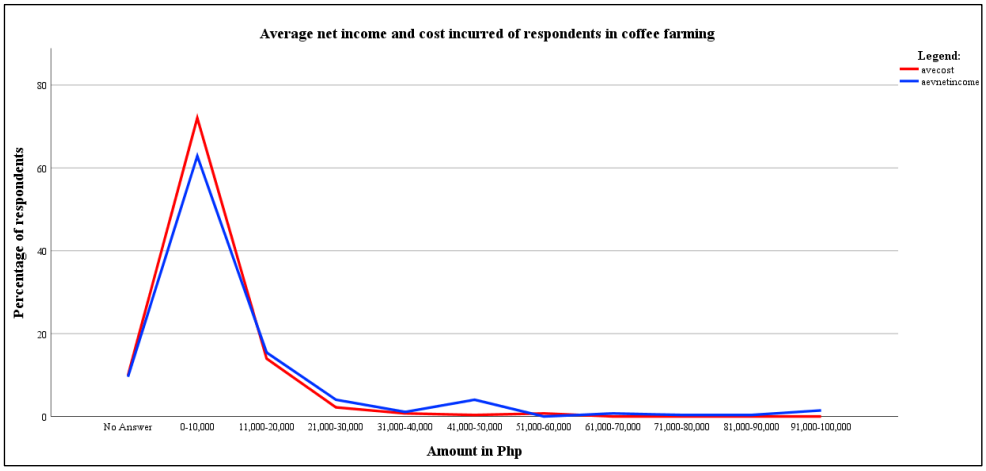

Figure 8. Estimated income and cost incurred in coffee farming

Technology needs of the coffee farmers and processors in CALABARZON

The ensuing figures below portray the support services needed by the POs in CALABARZON, the training needs of the farmer members, and the equipment that they think is needed for their respective organizations to operate at their full potential which were taken in multiple responses.

The support services needed by the POs (Figure 9). Education and training about coffee production and processing (66.79%), marketing/ buyer connections (63.84%), and the availability of quality planting materials are the three (3) most needed services answered by the farmers. As drawn from Figure 10, the technical needs of the coffee farmers in the region include training on the application of SMART technology intervention for coffee farming (69.70%), proper pruning and rejuvenation of old coffee trees (63.84%), harvesting and processing of produced coffee (63.10%), proper farm management and application of GAP/GMP, as well as seedling production and planting (59.04%). Lastly, it was found through the profiling conducted that the most needed coffee equipment by the farmer-members is a coffee dryer (40.96%), roaster (29.15%), and depulper (22.88%).

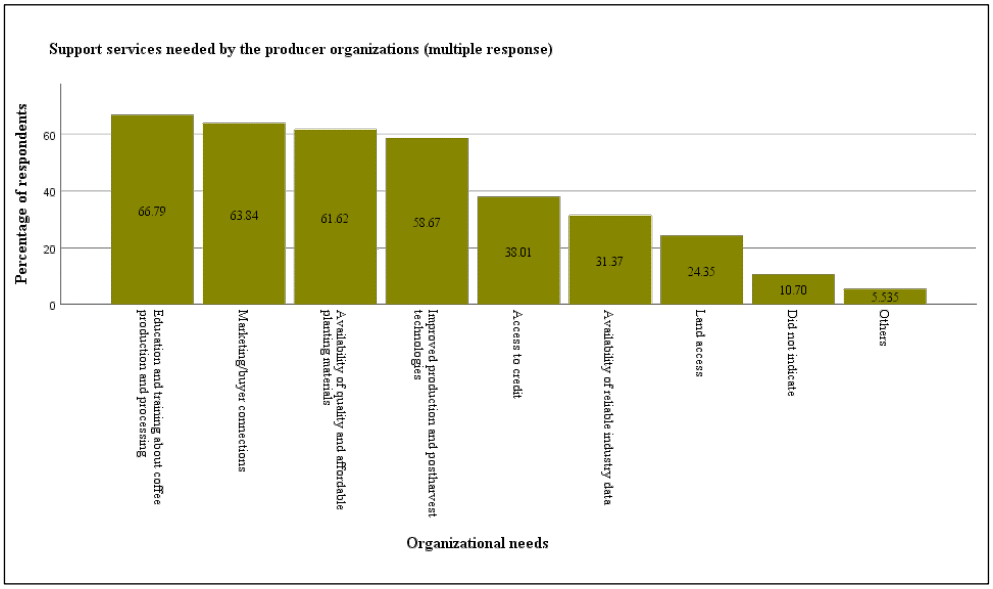

Figure 9. Support services needed by the POs in the region

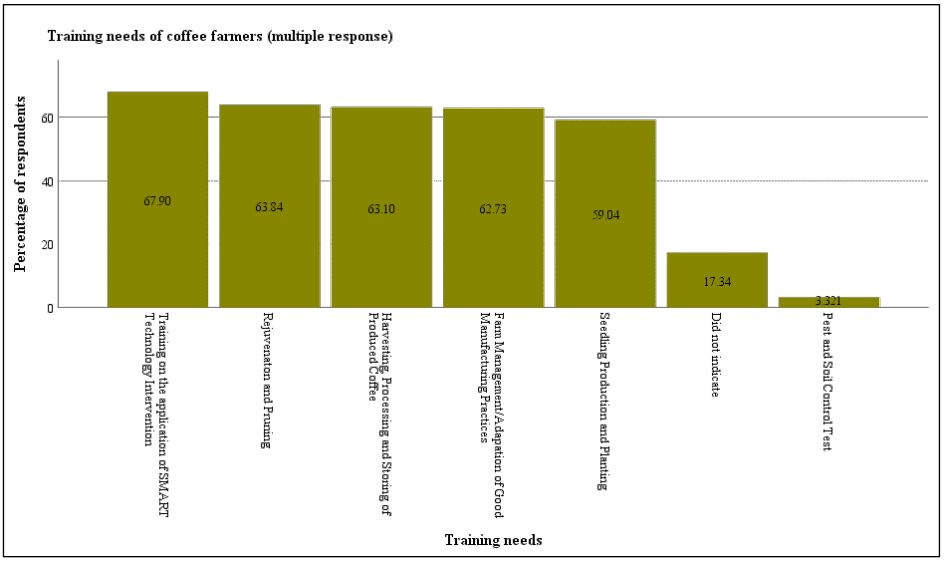

Figure 10. Identified training needs of the farmer-members

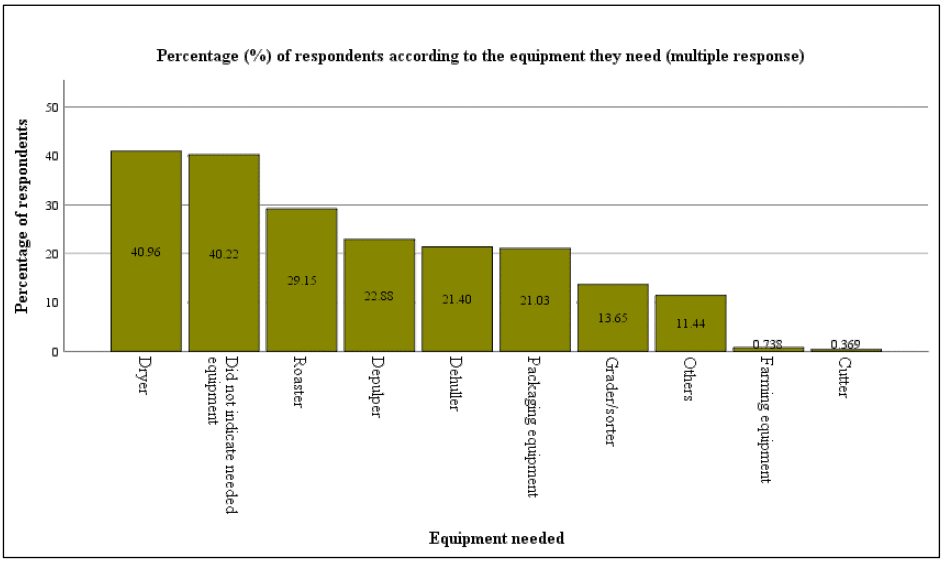

Figure 11. Equipment needed by the POs

Regression analysis results

R-squared was greater than zero (Table 7) and for it to be said significant, the sig value in the last column of the ANOVA table (Table 8) must be less than 0.05. Since the sig value in the last column is 0.001 which is way less than 0.05, then it can be inferred that the predictors or the set of independent variables are

able to account for a significant amount of variance. Hence, using the summary model and ANOVA table, it can be said that the overall regression model was statistically significant at F (20, 251) = 2. 50, $\rho < 0.001$, R2 = .166. This further tells that some of the predictors, when taken as a group, can predict its relationship with the volume of production significantly.

Table 7. Regression model summary table

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.408[a]	.166	.100	1.009

Meanwhile, the result of the regression analysis is shown in Table 9. This coefficient table specifically conveyed which among the predictors, on an individual level, is statistically significant and would account for a unique amount of variance in the given criterion or dependent variable. It revealed which among the set of socioeconomic and existing farm practices data of the farmer-members are significant in explaining variation in coffee production (Table 5).

Table 8. ANOVA table

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	50.966	20	2.548	2.501	.001b
Residual	255.736	251	1.019		
Total	**306.702**	**271**			

Those years of experience in farming, tenure status, farm size, nursery establishment, transplanting, shading of trees, pruning, and water management were significant in explaining variation in volume of coffee production at $\alpha = 0.1$ and above (Table 9). For a deeper analysis, water management is the most significant predictor at a 5% level (P = 0.027) having a positive coefficient of P = 0.545.

On the other hand, years of experience in farming (P = 0.097, B = 0.081), farm size (P = 0.090, B = 0.045), nursery establishment (P = 0.057, B = 0.428), transplanting (P = 0.078, B = 0.250) and pruning (P = 0.087, B = 0.318) were all significant predictors of coffee production volume at 10% level.

Tenure status (P = 0.062, B = -0.161) and shading of trees (P = 0.061, B = -0.288), on the other hand, are also significant predictors of the coffee production volume at 10% level.

Table 9. Multiple Regression table for participants' socioeconomic and existing farm practices affecting the volume of coffee production

Coefficients[a]								
	Unstandardized Coefficients		Standardized Coefficients				Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.	Remarks	Tolerance	VIF
(Constant)	.488	.534		.915	.361			
Age	.001	.053	.001	.019	.985		.705	1.418
Sex	.068	.132	.032	.514	.607		.881	1.135
Household Size	-.021	.054	-.023	-.394	.694		.937	1.067
Educational Attainment	-.009	.029	-.020	-.319	.750		.884	1.131
Years of Experience in Farming	**.081**	.048	.113	1.668	**.097**	*	.719	1.390
Tenure Status	**-.161**	.086	-.115	-1.875	**.062**	*	.888	1.127
Farm Size	**.045**	.027	.107	1.703	**.090**	*	.841	1.189
Propagation	.190	.145	.085	1.310	.191		.796	1.256
Nursery Establishment	**.428**	.223	.122	1.914	**.057**		.813	1.230
Land Preparation	-.271	.187	-.104	-1.448	.149		.645	1.550
Layouting, staking and holing	.043	.165	.018	.262	.794		.687	1.456
Transplanting	**.250**	.142	.111	1.767	**.078**	*	.849	1.178
Shading of trees	**-.288**	.153	-.122	-1.880	**.061**	*	.795	1.259
Fertilization	.189	.308	.042	.615	.539		.713	1.402
Weed control	.006	.307	.001	.019	.985		.764	1.309
Pruning	**.318**	.185	.116	1.721	**.087**	*	.732	1.366
Rejuvenation	-.062	.139	-.029	-.443	.658		.788	1.270
Replanting	.059	.148	.027	.400	.689		.733	1.363
Control of pests and diseases	.101	.145	.046	.697	.486		.757	1.321
Water management	**.545**	.245	.137	2.226	**.027**	**	.877	1.140

a. Dependent Variable: Volume Sold/Production Volume
*; **, significant at 0.1 and 0.05 levels respectively

Discussion

The study presents significant information describing the state of the coffee industry in the CALABARZON region, Philippines. Socio-demographic profiling conducted revealed that the coffee farmers in the region are aging, with an average age range of 51 to 90 years old (72.40%), and only about 27% are

below 50 years old which is considered a productive age (Sumarti and Falatehan, 2016). The findings were in agreement with the results of the study of Bamber *et al.* (2017) wherein the average age of coffee farmers in the Philippines is 57 years old. Aging coffee farmers can be one of the factors that contribute to the decline in the country's coffee production since aged farmers continue to produce coffee with outdated agricultural techniques (Bamber *et al.,* 2017; DA and DTI, 2017). This may be alarming to the coffee industry since new generations have little to no interest in agriculture and are hoping to pursue careers outside of farming (Tañongon *et al.,* 2020; Inso, 2028). According to PSA (2020), the total number of persons employed in agriculture continuously declined in a five-year reference period, and in the year 2019, about 9.70 million workers were reportedly employed in this sector. Further, about 22.9% was lessened to agriculture's contribution to the country's total employment rate. This indicator poses a great challenge in professionalizing coffee across the industry to encourage the young generations to get involved in farming. Moreover, household size and the number of children might have a profound effect on their productivity since family labor is widely reported in most coffee-producing countries mostly in small-holder or backyard farms due to the intensive manual work associated with coffee farming (Ngeywo *et al*., 2015; Luetchford, 2008; Pereira *et al.,* 2022). Meanwhile, the results of the assessment of the economic status of the farmers based on personal communications with some of the coffee organization leaders and municipal agriculturists in CALABARZON, are associated with interrelated factors such as lack of access to credit, fewer off-farm income opportunities, an array of marketing-related problems such as lack of access to viable market, low selling price, and lack of value-adding activities. These results were also seen in the studies of Sabroso and Tamayo (2022) and Rodolfo *et al.* (2016) on the assessment of the coffee industry in Davao City and Kalinga, Philippines, respectively. Furthermore, low productivity brought by devastating natural phenomena (typhoons, volcanic eruptions, etc.) was also one of the factors of the low economic status of coffee farmers in CALABARZON.

Coffee farmers in the region mostly employ the intercropping system in their farms in which cash crops such as banana, coconut, and citrus fruits are commonly planted which provides extra income to their household. The stripping method of harvesting and drying of coffee berries on a concrete pavement (traditional dry processing method) is mostly practiced in the region. These practices, when taken lightly, could seriously affect the whole value chain for coffee in CALABARZON. This is because several studies have already postulated that some of the common root causes of poor coffee productivity were mostly associated with the intrinsic factor within the farming section of the value chain. One of which was the study of Baybay (2012) which concluded that coffee

yields in Benguet continued to slip even though there was an increase in the number of coffee trees especially in the years 2009 and 2010. This technical argument was supported by Benguet State University (BSU) articulating that there is indeed a dire need for the rejuvenation of old coffee trees in the province, followed by tree trimming and proper fertilizer application. Relative to this was the decline in Tanzanian coffee yields in the 1990s and early 2000s, thus, requiring utmost efforts on the improvement of coffee's both quality and productivity. Evidence from several studies further delineated that the decline in Tanzanian coffee yield was associated with problems such as the presence of old coffee trees, poor husbandry being practiced by growers, high intensity of intercropping, and insufficient or lack of inputs (United States Agency for International Development [USAID], 2010). Thus, if the aim for the region's coffee sector is indeed to boost coffee production and improve its quality, the farm and post-harvest practices below should be properly followed and extension support among the coffee stakeholders should be.

A portion of the questionnaire used for this study was also devoted to taking the opportunity of gathering data about the farmers' source of information and market opportunities to lessen the educational gap in the region's coffee sector – especially that lack of information in rural areas was found to be one of the primary reasons that restrains farmers in improving their productivity and income (Yaseen *et al.*, 2016). A small percentage for television, social media, and other channels of information was only obtained. This result was paralleled by the significant findings of various studies such as the one conducted by Khan *et al.* (2010) which stipulated that the use of electronic media as a source of agricultural information was not that substantial. The result was further verified through the result of the study made by Irfan *et al.*, (2006) defining that neighbors, friends, relatives, and dealers of companies are some of the key sources of information in the rural areas. Meanwhile, a lower volume of sold coffee products was recorded compared to farmers' previous harvests which were mainly due to specific reasons like the existence of old coffee trees and the effects of the Taal volcanic eruption that happened in January 2020. While some farmers are now able to sell green coffee beans and roasted ground coffee, a significant 78.83% of the farmers who affirmed that they still sell their coffees in dried form is a challenge that should not be overlooked as this might be associated with the most pressing challenge by coffee farmers in the region – the lack of value addition at the processing level. This mirrors the findings shown in Table 6 wherein significantly 61.8% of the respondents said that their selling price for coffee only ranges between Php 41 – 50/kg. Indeed, coffee farmers in the region are facing challenges in securing enough share of the coffee market price. This might also be due to the lack of a lucrative market where farmers can sell their

coffee at a reasonable price, a problem common to almost all coffee organizations in the country, especially in the case of farmers who are forced to sell their products to the middleman – ore often at a very low price (Habaradas and Mia, 2021). What is clear, at this point, is that value addition should be prioritized by policymakers and other concerned agencies to transform the dried coffee beans into a more profitable product form.

The result of the study further revealed that the coffee organizations in the region are collectively in dire need of support services that will address the education gap in coffee farming which will be made possible through the provision of proper training on coffee production and processing. Aside from this, the POs also need assistance in looking for alternative markets or buyers where they can sell their harvests at a more reasonable price. Enhancing their market intelligence, providing them with training to leverage their market strategies, and giving them the assistance that will add value to their products are other concerns, that when addressed, would be a great leap for them to successfully penetrate and compete with the world coffee market. Availability of quality planting materials, improved post-harvest technologies, and access to credit, which are all found to be significant factors that affect the continuous drop of coffee production in the country (DA and DTI, 2017) were also said to be the primary needs of the coffee organizations in the region.

On the other hand, a significant result was obtained on the multiple linear regression employed that aims to analyze how the farmers' socioeconomic profile and coffee technology adoption at the farm level affect the coffee productivity among the 10 POs involved in this study. Water management was found to be the most significant predictor among others at a 5% level. This observation suggests that if the intervention is focused on water management, the volume of coffee production would increase with a probability of 54.5%. This finding is factual especially since the result of the pre-assessment survey revealed that only 8.46% of the 272 farmer-members interviewed have a water source in their coffee farms. Hence, there is a need for interventions in water management. Meanwhile, a positive beta value was observed on the predictors such as years of experience in farming, farm size, nursery establishment, transplanting, and pruning, thus, implying that the increase in effort in the aforesaid criteria would result in a notable increase in the volume of coffee production. However, predictors such as tenure status and shading of trees possessed negative beta values, implying a negative effect on the volume of production of coffee. An increase in the tenure status score would result in a negative effect on coffee production volume, because if more of the farmers are only leasing their land, then chances are they would need an extra source of income to pay for the rent and thus, they need to plant more trees other than coffee. Shading of trees is also

an issue of concern. If numerous trees were planted which would result in overshading, there's a probability that the volume of production would decrease by 28.8%. This factor was also attributed to the fact that some coffee farmers are losing interest in coffee farming and are now shifting to other cash crops. This issue was validated during the interview conducted where most of the respondents, especially in Bailen, Cavite are now planning to cut down their coffee trees and rather plant other crops such as pepper. Lastly, all the predictors in the regression analysis have a variance inflation factor (VIF) score of less than 5 which implies a significant multicollinearity among independent variables in the model (Wambua *et al.,* 2021).

The overall result of the needs assessments conducted on the 10 coffee producer organizations proves that the coffee sector in the CALABARZON region indeed faces challenges that need to be addressed with concentrated efforts from its various key stakeholders. Alarming problems such as the emerging gaps between the aging coffee farmers and the up-and-coming generation, low coffee profitability and productivity, lack of access to a lucrative market and credit, lack of extension support system, farmers slowly shifting to other cash crops and abandoning coffee farming, less value-adding activities for coffee, and unavailability of needed equipment and other technologies for coffee farming and processing were identified. Thus, the development of policies that are centered on increasing coffee producers' profit margin, coffee quality enhancement and value-adding activities for coffee, strengthening market linkages, and introduction of market opportunities for coffee farmers must be put in place.

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