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Hypothesis Testing in The Study of The Characteristics of Pagaralam Coffee Farmers as Herbicide Reductant Users

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Abstract. The use of herbicides in weed control must be done wisely so that negative impacts on land and cultivated plants can be minimized. Herbicide reductants were introduced to Pagaralam coffee farmers through an educational process. This study aims to analyze the characteristics of Pagaralam coffee farmers who are users of herbicide reductants. Comparison of the characteristics of users and non-users of reductants was carried out using the mean test, variance test, and independence test. The selection of respondents was using purposive sampling. The variables studied include the identity of the respondent, the identity of the land, and the culture of coffee farming. There were 125 respondents consisting of 55 users and 70 non-users of herbicide reductants. In the mean test results, only the average planting area per 1 tree, age of tree, maximum selling price of green beans, and number of workers are not the same between the two categories of respondents. While the results of the variance test, only five variables result H_0 rejection, namely the number of trees, planting area per 1 tree, age of tree, average price of green beans, and the use of female workers outside the family. The independence test showed that there was a relationship between the respondent's category and every categories variable, that education, land conditions, frequency of herbicide use, impact of chemical herbicides (no reductants) on coffee production, positive impact (good) reductant in coffee plants, the role of relevant agency, the impact after using reductants on the amount of production, the impact after using reductants on net income, number of workers, and length of harvest period.

INTRODUCTION

The coffee industry is one of the priority sectors set by the Ministry of Industry in accordance with the National Industrial Development Master Plan (RIPIN) 2015-2035. It is the focus of the development commodity of the Ministry of Industry, especially the Directorate General of Small and Medium Enterprises (IKM) [1]. Coffee is one of Indonesia's leading export commodities, which ranks 8th. Coffee is the fourth largest foreign exchange earner after palm oil, rubber and cocoa [2].

South Sumatra Province is the largest robusta coffee producer in Indonesia [3]. The area of smallholder plantations of South Sumatra is 19.9% of the national coffee area. South Sumatra's contribution to the total national coffee production in 2018 was 25% [4]. Pagaralam City is famous for its plantation and horticultural crop production. The smallholder plantation crops are mainly coffee. Most of the population in this area make a living as coffee farmers. In 2020, Pagaralam's plantation crop production was dominated by coffee with 12,782 tons, tea 3,240 tons and rubber 515 tons [5]. Based on data from the Directorate General of Plantation [3], there were 6,914 heads of families' coffee farmers in Pagaralam.

Based on a survey in 2019 ([6] - [10]), the majority of Pagaralam coffee farmers are their main livelihood and their gardens were inherited from generation to generation, traditional gardening knowledge, and the majority of them use herbicides in weed control in coffee fields. Herbicide use and land productivity were 2 of 13 factors that affect farmers' income. Several socio-economic variables including coffee yields and farm inputs, management regimes, labor requirements, farm-gate prices, labor use, the effect of using compost were examined by [11]. These variables have a significant effect on coffee production in Uganda.

Weeds are unwanted plants because they can interfere with growth, can reduce the productivity and quality of other cultivated plants, and compete for nutrients (nutrients), water, and light. The presence of weeds around coffee plants will indicate plant morphological abnormalities, including yellowing leaves, stunted or thin plants, dead plagiotrope branches, smaller fruit, low production and symptoms of nutrient deficiency [12]. The selection of the use of the type and active ingredients of the herbicide determines the cost, effectiveness, and amount of labor [13].

Chemical weed control in coffee plantations is considered quite efficient and effective by using herbicides with the active ingredient glyphosate. But the application of the use of this herbicide must be done properly so as not to poison the coffee plant [14].

The use of herbicides is used by coffee farmers to control weeds. Pagaralam coffee farmers rarely control weeds mechanically and manually, because it requires high costs and is less effective, the grass grows back quickly, and the control time is longer, and requires a lot of labor. Based on [6], the frequency of use of pesticides (i.e. herbicides) of respondents to Pagaralam coffee farmers is quite high (1 to 3 times a year). Only 20% of respondents do not use herbicides. If the land has a high potential for overgrown weeds, it will require extra care and high costs for weed control. Herbicide applications are often mixed with fertilizers (by 53%). Some coffee fields, the land is damaged and the coffee plants become less or even not producing. Based on [7], using bivariate analysis, frequency of fertilization and use of pesticides are two variables that are related to land productivity. In this study, Pagaralam coffee farmers who are considered a population are defined as farmers who own and operate their own coffee farming in Pagaralam, starting from land and plant maintenance to post-harvest process to green bean production. In land maintenance, farmers sometimes involve workers both from within their families and workers outside the family. Likewise, during the harvest process, farmers sometimes also involve workers, both men and women.

Herbicide reductant is a product made from organic as herbicide reducer, so it can reduce herbicide residue in agricultural areas as well as more economical because it can reduce herbicide used costs. A mixture of reductants in herbicides can save agricultural or plantation maintenance costs by at least 10 percent to 40 percent [15]. Based on information from herbicide distributors and field assistant of private companies in Pagaralam on early year 2021, there were around 600 – 1,000 users of herbicide reductants during the last 3 years. However, there were around 500 farmers who are loyal to using reductants for more than 1 year. In this study, coffee farmers in Pagaralam were divided into 2 categories, namely reductant users (who were loyal to using more than 1 year) and non-users (i. e. farmers who had just started as users and also farmers who had never used herbicides). Coffee fields of reductant users are spread over 4 sub-districts in Pagaralam.

Hypothesis is a temporary answer to a research problem that is theoretically considered the highest and most likely level of truth. According to [16], the hypothesis is based on the existence of a relationship between variables where there are assumptions or temporary conclusions that need to be proven true. A statistical hypothesis is a statement or conjecture about one or more populations [17]. Hypothesis testing is a procedure based on samples and probability theory to determine whether the hypothesis is reasonable and verifiable [18]. The F test can be used to determine whether two populations have different variations or not. While the Z test can be used to test the mean of two independent populations on a large sample. The chi squares test is a test for data on a nominal scale and does not require assumptions about the normal distribution of the population.

The introduction of the reductant requires an educational process for farmers to be wise, in the right way, on target, and on time in weed control. The farming culture (behavior) of coffee farmers who use reductants is farmers who are willing to learn, willing to accept new innovations in plant care, discussing issues related to fertilization and the use of pesticides, so that their coffee plants can produce optimally. In this case, it is necessary to examine the hypothesis that farmers who use herbicide reductants have different characteristics from farmers who do not use reductants.

The purpose of this study was to analyze the comparison of characteristics between farmers who used herbicide reductants and those who did not, using the mean test, variance test, and independence test. The mean test was carried out on a large sample and the samples taken were assumed to come from two independent populations. The variance test was carried out on a large sample and the sample taken was assumed to come from a normally distribution population. The research variables tested were the characteristics of the farmers including the identity of the farmers, the state of the land, and the farming culture of the Pagaralam coffee farmers. Furthermore, the results of this study can be a reference for related institutions regarding the state of Pagaralam coffee farming, so that it can be input regarding sustainable agriculture.

RESEARCH METHODS

This research was a case study, which the object of research is Pagaralam coffee farmers who own and did a coffee farming. Respondents were selected as research samples using purposive sampling technique. In this research, 125 respondents were taken. After the respondents were classified, 55 respondents were reductant users and 70 respondents were not reductant users.

Questionnaire questions filled out by respondents include the identity of the respondent, the identity of the land, the culture of coffee land management, the production and income of the respondent, as well as the state of the respondent's perception of sustainable agriculture. The observed characteristics of the population elements are called variables. In this paper, not all questionnaire questions become research variables. Previously, the questionnaire questions were modified through validity and reliability tests.

The steps in this research are:

1. Conduct descriptive statistics based on 2 categories of respondents, namely farmers who use herbicide reductants and non-users (including farmers who are just starting to use). In this step, a description of the variables with histograms or boxplots is carried out in each category of respondents. In this case, it is assumed that there are two samples obtained from two populations.
2. Perform mean test on several variables with a ratio scale by using the *Z* test, namely the equation:

$$Z = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad (1)$$

   where $\overline{x_1}$ = mean of sample taken from population 1; $\overline{x_2}$ = mean of samples taken from population 2; s_1^2 = variance of sample 1; s_2^2 = variance of sample 2; n_1 = number of samples taken from population 1; dan n_2 = number of samples taken from population 2.
3. Perform variance test on several variables with a ratio scale, using the *F* test, namely the equation:

$$F = \frac{s_1^2}{s_2^2} \quad (2)$$

   where s_1^2 and s_2^2 respectively represent the variances of sample 1 and sample 2. The larger sample variance is placed in the numerator, while the smaller sample variance is placed in the denominator.
4. Compile a two-way contingency table on several variables with nominal and ordinal scales, or categorizable ratio-scale variables. Each of these variables is divided into categories to become row variables. While the column variables are categories of reductant users and non-reductant users.
5. Perform the independence test, using chi squares test (χ^2) on the relationship of each row and column variables in Step 4.
6. Interpretation of results.

Stages of data processing with the help of Minitab 19 and SPSS 24 software.

RESULTS AND DISCUSSION

The assumption in this study is that Pagaralam coffee farmers have homogeneous characteristics. This was based on literature from BPS and field surveys. The respondents were divided into 2 categories, namely reductant users and non-users (including those who had just started trying to use). For reductant users, on average, they have used 2.3 times in 1 year, which ranges from 1 to 3 times. The number of respondents who are not users are 70 persons. While the respondents who are users are 55 persons. Comparison of the characteristics of the categories of respondents can be seen in Table 1. Comparison of the characteristics of the two categories of respondents does not include variables related to the production and income of respondents. The variables in question are estimated yields, land maintenance costs, gross income (in 1 year), net income (in 1 year), harvested production in the form of green beans (in quintals), and total production (in quintals).

Comparison of the characteristics of the two categories of respondents was carried out using the mean test to test the significance of the difference in the mean scores and the test of the difference between the two variances (with the *F* test). The *F* distribution provides a tool for testing the variance of two normally distributed populations. In other words, the *F* test can be used to determine whether two populations have different variations or not. The characteristics of respondents in testing this hypothesis are based on continuous variables.

TABLE 1. Descriptive Statistics, *Z* Test, and *F* Test of Several Variables in Both Categories of Respondents

No.	Variables	Users/ Non users	Mean	StDev	Min	Med	Max	Z_{count}	F_{count}	Description
1	Age	0	44.47	11.58	23	46	76	0.76	1.28	Accept H_0
		1	42.98	10.22	25	42	69			

2	Education	0	10.87	3.36	4	12	17	2.02	1.33	Accept H_0
		1	9.55	3.87	4	9	17			
3	Number of dependent children	0	1.34	1.24	0	1	6	-0.10	1.46	Accept H_0
		1	1.36	1.03	0	1	4			
4	Number of family members helping	0	1.60	1.00	0	1	5	0.18	1.40	Accept H_0
		1	1.56	1.18	0	1	6			
5	Long time in coffee farming	0	21.93	3.83	15	20	36	0.56	2.38	Accept H_0
		1	21.42	5.90	11	20	40			
6	Land area (in hectares)	0	1.20	0.63	0	1	4	-1.37	1.72	Accept H_0
		1	1.39	0.83	0	1	5			
7	Number of trees	0	3910	1868	800	3600	10K	-0.11	1.89	**Accept H_0
		1	3955	2567	1000	3500	15K			
8	Average planting distance (in *m*)	0	2.23	0.72	1	2	6	-1.53	1.66	Accept H_0
		1	2.41	0.56	1	2	4			
9	Planted area (m^2)/1 tree	0	3.12	0.83	1	3	8	-3.21	3.44	Reject H_0
		1	3.86	1.55	1	3	13			
10	Age of tree (in years)	0	15.94	0.86	15	4	40	-35.4	2.44	Reject H_0
		1	23.41	1.35	20.5	3	50			
11	Frequency of herbicide use	0	2.10	0.74	1	2	4	-2.07	1.21	Accept H_0
		1	2.36	0.68	1	2	4			
12	Herbicide use interval	0	5.71	2.22	3	6	12	1.29	1.32	Accept H_0
		1	5.24	1.93	3	4	12			
13	Frequency of chemical fertilizer use	0	0.84	0.76	0	1	2	-0.727	1.80	Accept H_0
		1	0.96	1.02	0	1	4			
14	Frequency of using Organic fertilizer	0	0.34	0.54	0	0	2	-1.65	1.88	Accept H_0
		1	0.54	0.73	0	0	2			
15	Minimum selling price of green beans (IDR)	0	17824	987	15K	18000	20K	1.72	1.22	Accept H_0
		1	17500	1089	15K	18000	19K			
16	The maximum selling price of green beans	0	20033	1077	17K	20000	25.5K	3.40	1.24	* Reject H_0
		1	19410	967	17K	20000	21K			
17	Average price of green beans	0	18758	1504	8K	19000	20.2K	1.38	2.73	**Accept H_0
		1	18457	911	16.5K	19000	20K			
18	Number of workers in the family (TD)***	0	2.2	0.79	0	2	4	2.57	1.22	*Reject H_0
		1	1.8	0.87	0	2	4			
19	Male (TDL) ***	0	1.4	0.72	0	1	3	3.54	1.30	* Reject H_0
		1	0.9	0.63	0	1	2			
20	Female (TDW) ***	0	0.9	0.43	0	1	2	-1.38	1.01	Accept H_0
		1	1.0	0.43	0	1	2			
21	Number of Workers outside the family (TL) ***	0	2.4	2.33	0	2	6	-1.23	1.39	Accept H_0
		1	2.9	2.74	0	3	6			
22	Male (TLL) ***	0	1.8	1.88	0	2	6	-0.72	1.26	Accept H_0
		1	2.1	2.11	0	2	6			
23	Female (TLW)***	0	0.8	1.50	0	0	6	-3.13	2.63	**Reject H_0**
		1	2.0	2.43	0	0	6			

Description: Not a reductant user is denoted by 0.
The user of the reductant is denoted by 1. The critical Z value for $\alpha/2$ is 2.33; the critical F value is for $\alpha = 1\%$. ***Mean and standard deviation (StDev) values in descriptive statistics are assumed not to be rounded off. Notation of * means that the mean test results reject H_0, but the variance test results accept H_0. Notation of ** means that the mean test result is accepted H_0, but the variance test result rejects H_0.

Suppose the respondents are defined as non-reductant users as in sample-1 and respondents using reductant as in sample-2. The values of Z_{count} based on Eq. (1), F_{count} based on Eq. (2), and $\alpha = 1\%$. For the value of F_{count}, the larger sample variance is placed in the numerator, while the smaller sample variance is placed in the denominator. Table 1 presents the results of the mean and variance tests for the other variables in the two categories of respondents. The value of the variable is on a ratio scale and there is also an interval.

Based on Table 1, the variable values of respondent identity, land identity, and culture on land care can be characteristics of both categories of reductant users and non-reductant users. The values of mean and standard deviation of several variables in reductant users were higher than non-users. The difference in the mean and standard deviation values between the two categories of respondents was respectively tested with the Z test and the F test, so that it can be analyzed whether the difference in values is significant or not.

In the comparison of the mean values of variable, if the value of $Z_{count} < Z_{critical}$, then it fails to reject the null hypothesis (notated by H_0). In this case, the sample (respondents) is not sufficient to provide evidence that the characteristics of users and non-users of reductants based on the mean of the variable are not the same. In the same thing for the results of the F test, if the value of $F_{count} < F_{critical}$, then it fails to reject H_0, so there is no evidence that the variable variation in respondents using reductants is more stable than variable variations in respondents not using reductants. In this case, there is no difference in variance between the two populations. So, there is no difference in the character of the two categories of respondents on the variable.

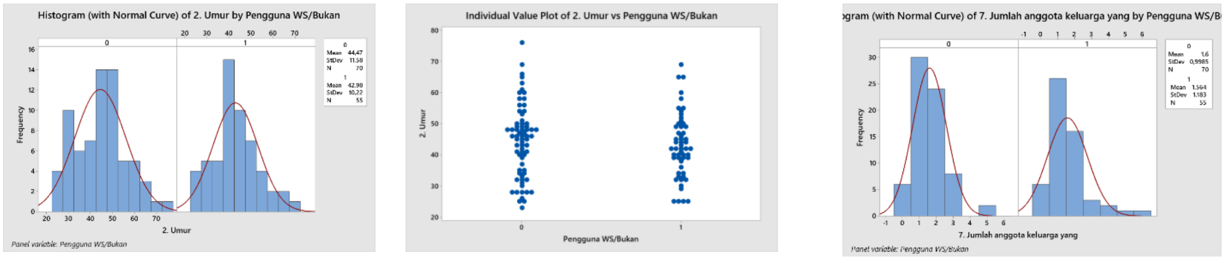
The comparison of almost every mean variable in the two categories of respondents resulted in $Z_{count} < Z_{critical}$, meaning that it failed to reject the null hypothesis. In this case, the sample (respondents) is not sufficient to provide evidence that the user and non-constructing reductant characters based on these variables are not the same. So, the two categories of respondents have the same mean on these variables. There are only six variables whose mean value test results in H_0 rejection, namely planting area per 1 tree, age of tree, maximum selling price of green beans, and 3 variables related to the labor used. This means that the average of planting area per 1 tree, age of tree, maximum selling price of green beans, TD, TDL, and TLW of the two categories of respondents are not the same.

The category of non-user respondents had a lower average planting area per 1 tree and age of tree than respondents using reductants. However, the non-user respondents have a higher average maximum selling price of green beans. Especially for the variable of labor use, the category of non-user respondents has an average of worker in the family (TD) and also has male workers (TDL) which is higher than respondents using reductants. The opposite side for the average of female workers outside the family (TLW).

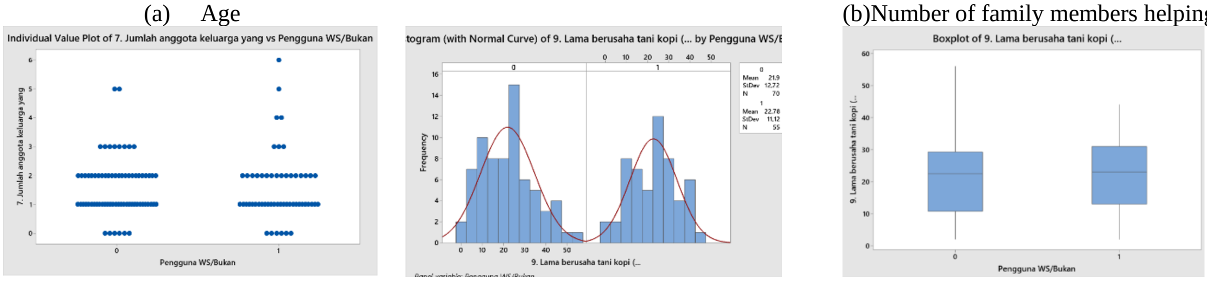
In the same case for the results of the F test, it fails to reject H_0, except for 5 variables. The test results accept H_0, meaning there is no evidence that the variable variation in respondents using reductants is more stable than variable variations in respondents not using reductants. So, there is no difference in variance between the two categories of respondents in the variance of the variables in Table 3, except for the number of trees, planted area per 1 tree, age of tree, average price of green beans, and the use of female worker outside the family. For example, in the variance test of the average price of green beans, the value of $F_{count} > F_{critical}$, which means that the variation in the average price of green beans for reductant users is more stable than the variation in non-reductant users. On the other hand, in the other four variables, variations in the number of trees, planting area per 1 tree, age of tree, and the use of female worker outside the family, non-reductant users were more stable (or lower) than the variation in reductant users.

Figure 1 represents the histogram, value plot, and boxplot of several variables. In the figure for each of these variables, the plots of the two categories of respondents are distinguished. If seen from Table 1 and Figure 1, it can be seen that the interpretation of the range of values for each variable in the two categories of respondents tends to differ not too much. In some variables, there are 1 to 3 respondent data that have variable values that differs greatly from other respondent data. These respondent's data have the potential to become outliers, such as the variables of land area, planted area per 1 tree, frequency of herbicide use, frequency of use of chemical and organic fertilizers, and selling price of coffee. There are data that have the potential as outliers only in the category of reductant users (i.e. frequency of herbicide use and frequency of use of chemical fertilizers) and some are only in the category of non-reductant users (i.e. frequency of use of organic fertilizers, maximum selling price of green beans, and average price of green beans), as well as in both categories of respondents (i.e. land area, planted area per 1 tree, and age of tree). In the histogram with normal curves and standard deviation values, each variable in the user category mostly has a higher variance than the non-user category.

Based on the histogram, boxplot or value plot for each variable in the two categories of respondents, it can be interpreted that the majority of respondents are 40 to 50 years old, the number of families who help are 1 to 2 persons, have started coffee farming since the age of 18 to 20 years, have started farming coffee for 10 to 30 years, owning 1 to 2 hectares of land, planting area 3 m^2/1 tree, coffee trees aged 15 to 25 years, using herbicides 2 times a year (or every 6 months), using chemical fertilizers 0 and 1 time, do not use organic fertilizers, minimum selling price of green beans is IDR 18,000 and maximum IDR 20,000, the number of TD is 2 persons for non-user respondents and 1 person for user respondents, each TDL and TDW is 1 person, TL is 0 person for non-user respondents users and 0 (and 6 people) for user respondents, each TLL and TLW for both categories of respondents is 0 person.



(a) Age (b)Number of family members helping



(c) Long time in coffee farming

FIGURE 1. Histogram, Plot of values, and Boxplot of Several Variables

Bivariate analysis on the relationship (or independence test) between the values of several variables on a nominal or ordinal scale with respondents' categories was carried out by using the chi squares test (χ^2). In some contingency tables, the relationship between row variables and column variables, there are cells that are less than 5, so the contingency table is rearranged by combining categories in row variables. Column variables consist of 2 categories of respondents. The Minitab output from the χ^2 tests on two variables with an ordinal scale can be seen in Figure 2. In the invalid test results, the initial step of the correspondence analysis is carried out. Table 2 is a recapitulation of Minitab's results from the χ^2 tests.

Education vs. Users and non-users

	0	1	All
Under graduate	8	7	15
Elementary School	16	24	40
Senior High School	39	15	54
Junior High School	7	9	16
All	70	55	125

Chi-Square Test

	Chi-Square	DF	P-Value
Pearson	10,941	3	0,012
Likelihood Ratio	11,173	3	0,011

(a)

Coffee plant condition vs. Users and non-users

	0	1	All
Good	5	9	14
Less good	4	2	6
Moderate	61	42	103
All	70	53	123

Chi-Square Test

	Chi-Square	DF	P-Value
Pearson	3,023	2	0,221
Likelihood Ratio	3,006	2	0,222

2 cell(s) with expected counts less than 5.

(b)

FIGURE 2. Minitab Output on The χ^2 Test

The recapitulation of interpretation of Figure 2 and the other variables are presented in Table 2. If the value of $\chi^2_{count} > \chi^2_{table\ (\alpha\ =\ 0{,}05;\ df)}$, then it will reject H_0, meaning that there is a relationship between row variables (i.e. variables that characterize the users and non-users of reductants) with categories of respondents. The χ^2 test is only carried out on variables whose values are nominal and ordinal scales, or also variables whose values are ratio scale, but whose values can be divided into a number of categories.

Based on Table 2, rejecting H_0 means that the variables have a relationship with the categorization of respondents, or in this case the variables that characterize the two categories of respondents are different. These variables are education, land conditions, frequency of herbicide use, impact of chemical herbicides (no reductants) on coffee production, *positive (good) impact of reductants on coffee plants, role of relevant agency, impact after using reductant on production amount, impact after using reductant to net income, number of workers in the family (TD), male TD (TDL), number of workers outside the family (TL), female TD (TDW), and length of harvest period (months). On the other hand, if it fails to reject H_0 (in this case, it accepts H_0), it means that there is no relationship between the variables that become characters of the two respondent categories.

TABLE 2. Recapitulation of Bivariate Analysis Results with The χ^2 Test

Variables	χ^2_{count}	*df*	*p*-value	Test results
Education	10.941	3	0.012	**Reject H_0**
Side job	0.114	1	0.736	Accept H_0
The role of the wife in coffee farming	0.615	2	0.735	Accept H_0
Land condition	6.764	1	0.009	**Reject H_0**
Coffee land condition	1.920	2	0.383	Accept H_0
Coffee plant condition	3.023	2	0.221	Accept H_0
Frequency of herbicide use in 1 year	8.030	3	0.045	**Reject H_0**
Frequency of using chemical fertilizers in 1 year	3.763	2		Accept H_0
Frequency of using organic fertilizer in 1 year	5.027	2	0.081	Accept H_0
Herbicide and fertilization applications	1.460	1	0.227	Accept H_0
Impact of chemical fertilizers (without reductants) on coffee plant	0.782	2		Accept H_0
If 'Yes', the impact of chemical herbicides (without reductants) on **coffee plants**	0.557	1	0.456	Accept H_0
Impact of chemical herbicides (without reductants) on coffee production	14.962	2	0.001	**Reject H_0**
If 'Yes', The impact of chemical herbicides (without reductants) on **coffee production**	0.557	1	0.456	Accept H_0
General assessment of **herbicide reductants** in the long term	3.450	2		Accept H_0
* Positive (good) impact of herbicide reductants on coffee plants	12.737	2	0.002	**Reject H_0**
* Positive (good) impact of herbicide reductants on **coffee production**	1.920	2	0.383	Accept H_0
Grading of coffee (post-harvest): pick red	0.012	2	0.994	Accept H_0
Premium coffee market link (price of red picks)	2.383	1	0.123	Accept H_0
Drying treatment on the para-para	0.934	1	0.334	Accept H_0
The role of relevant agency	14.267	2	0.001	**Reject H_0**
The role of formulator	3.073	3		Accept H_0
The role of Field Assistant from PAI	5.446	3		Accept H_0
Mentoring/assistance in field	0.665	2	0.721	Accept H_0
The impact after using reductants on the amount of production	8.382	2		***Reject H_0**
Impact after using reductants on production costs (maintenance and harvest)	0.341	2	0.843	Accept H_0
Impact after using reductant on gross income	3.831	2		Accept H_0
Impact after using reductant on net income	7.557	1	0.006	**Reject H_0**
Number of workers in the family (TD)	17.768	4	0.001	**Reject H_0**
Male TD (TDL)	11.769	3	0.008	**Reject H_0**
Female TD (TDW)	2.095	2	0.351	Accept H_0
Number of Workers outside the family (TL)	11.153	5	0.048	**Reject H_0**
Male TL (TLL)	3.009	6	0.808	Accept H_0
Female TL (TLW)	13.329	6	0.038	**Reject H_0**
Length of harvest period (in months)	4.375	1	0.036	**Reject H_0**

Note: *The value of $\chi^2_{count} > \chi^2_{table}$. The test result is invalid, because there are cells whose frequencies are less than 5. But, if we use correspondence analysis, the test results are H_0 rejected.

CONCLUSION

Based on the mean test, only the variables of the average planting area per 1 tree, age of tree, maximum selling price of green beans, TD, TDL, and TLW were not the same between the two categories of respondents. Based on the results of the *F* test, there is no difference in the variance of the variables studied between the two categories of respondents, except for the number of trees, planting area per 1 tree, age of tree, average price of green beans, and the use of female workers outside the family. In these five variables, variations in the number of trees, planting area per tree, age of trees, and the use of female workers outside the family, in non-reductant users were more stable (lower) than the variation in respondents using reductants.

Based on the chi squares test, the variables that have a relationship with the categorization of respondents (or in this case the variables that characterize the two categories of respondents are different) are education, land conditions, frequency of herbicide use, impact of chemical herbicides (No reductants) on coffee production, positive impact (good) reductant in coffee plants, the role of relevant agency, the impact after using reductants on the amount of production, the impact after using reductants on net income, number of workers in the family (TD), male TD (TDL), number of outside workers family (TL), female TL (TDW), and length of harvest period (in months).

This study only used 125 respondents. For further research, it is necessary to examine how the comparison of two categories of respondents based on production and income variables with linear regression models and logistic regression models for a larger number of respondents.

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