International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

http://ijpsat.ijsht-journals.org

Vol. 8 No. 2 May 2018, pp. 302-311

Determinant Variable of Net income of Two Cobs Hybrid Corn Farm: Panel Data Analysis of Three Districts in South Sulawesi, Indonesia

Basir Paly

Department of Animal Science, Faculty of Science and Technology
Alauddin Makassar State Islamic University, Indonesia

Abstract - This study aimed to analyze the net income variables of 2 cobs hybrid corn farm using panel data. The study was implemented in three districts of corn production center of 2 cobs hybrids corn in South Sulawesi. Using survey method on 75 farm samples with three period of times (2015-2017). Observations were made on each sample with two cropping indexes, so that the total observation data was 450. There were 19 variables observed; total area of farming (X_1); soil processing (X_2), productivity (X_3), seed price (X_6), fertilizer price (X_7), pesticide price (X_8), labor cost (X_9), cost of living (X_{10}), post-harvest cost (X_{11}), irrigation cost (X_{12}), equipment and machine maintenance cost ($X_{13)}$ and depreciation cost (X_{14}). The data were analyzed by harvest data regression using Eviews 7. The analysis showed the determinant (R2) 0.563. That was, 56.30% net income was determined by 14 variables, while the remaining 43.70% was determined by other variables not included in the model. Out of the 14 variables, there were 9 significant variables ($p < 0.05$) and can be categorized as determinant variable. That was; X_1, X_3, X_4, X_5, X_9, X_{10}, X_{11}, X_{12} and X_{14}. While 5 not-significant variables ($p > 0.05$) were categorized as not-determinant; the X_2, X_6, X_7, X_8, and X_{13}. These 5 variables directly affect the productivity, not the net income. Without ignoring the 5 not-determinant variables, it is suggested that farmers should prioritize the 9 determinant variables in the increase of net income 2 cobs hybrid corn farm.

Keyword - Deciding Variable; Longitudinal Data; Net Earning; Hybrid Maize; Two Cobs.

I. Introduction

In Indonesia, corn commodity plays an important role as raw material for animal feed industry and household food industry. Approximately 67% of domestic corn production is used for raw materials for animal feed and fish industry, 25% for small scale of households industry, and 8% was consumed by the population (CADIS, 2017). The total of corn cultivation area in Indonesia is about 3.3 million ha, 96% is owned by the farmer's and 4% by the company (Nuryati, 2016). Thus means, corn also acts as a productive field for the increasing income and prosperity of rural farm households. The capability of corn farming to provide prosperity to the farmer depends on the net income (Yorobe and Smale 2012, Mathengeet al 2014). Therefore, the improvement of net income of corn farming is an issue that is always interesting to be studied.

The previous hybrid corn net income studies have been done by; Otunaiya et al, 2013; Banerjee et al, 2014; Miladis et al., 2014; Zalkuwi et al, 2014; Dhakal et al, 2015; Koondhar et al, 2016; Garba et al, 2017; Surhano and Rusdi, 2017; Wang et al, 2017; Choudhri et al., 2018. However, the researchers are still focused on cross-section data, not using panel data (combined cross-section and time data) yet. The use of panel data in agricultural research is highly recommended because agricultural production has quality variation, seasonal variability, and varying cost of production (Baylis et al., 2011; Platoni et al., 2012; Olatunji and Matthew, 2016). The advantages of using panel data include providing more observation data so that the distribution of data is closer to normal, increasing the degree of freedom (degree of freedom) and minimizing errors (Gujarati, 2011). Accommodate the individual heterogeneity to obtain more accurate estimation models (Ekananda, 2014 and Widarjono, 2016).

The next problem is that previous studies related to the net income have not explicitly analyzed the 2 cobs hybrid corn farming. In South Sulawesi, especially in this study area, the 2 cobs hybrid corn variety is enthused by the farmers (Arsyad, 2016).

Accordingly, this study aimed to analyze the net income variables of 2 cobs hybrid corn farming with panel data in the three center districts of hybrid corn production in South Sulawesi (Gowa, Takalar and Jeneponto). The results of this study are expected to be additional information for previous studies that have not take into account the 2 cobs hybrid corn and or have not used panel data. Also, can be an additional knowledge for farmers in improving their net income. If the price of corn decreases and/or input cost increases, the farmers can manage the input cost by reduce it based on their best-practice experience.

II. Material And Methods

1. Study area

The research was conducted in December 2016 until March 2017 in three districts (Gowa, Takalar and Jeneponto) in South Sulawesi Province (Figure 1). These three districts were hybrid corn production centers in South Sulawesi since 2008 with the total area 1473 ha (Taufik et al, 2015). This 2 cobs hybrid corn (Figure 2), belong to single cross hybrid group with the characteristics; the height of stems about 223 cm with an average yield potential of 7-9 tons of dry corn kernels per ha (Subagyo, 2018). The plantation index of hybrid corn farming in the study area takes place twice a year. Which are, March-August and September-December every year.

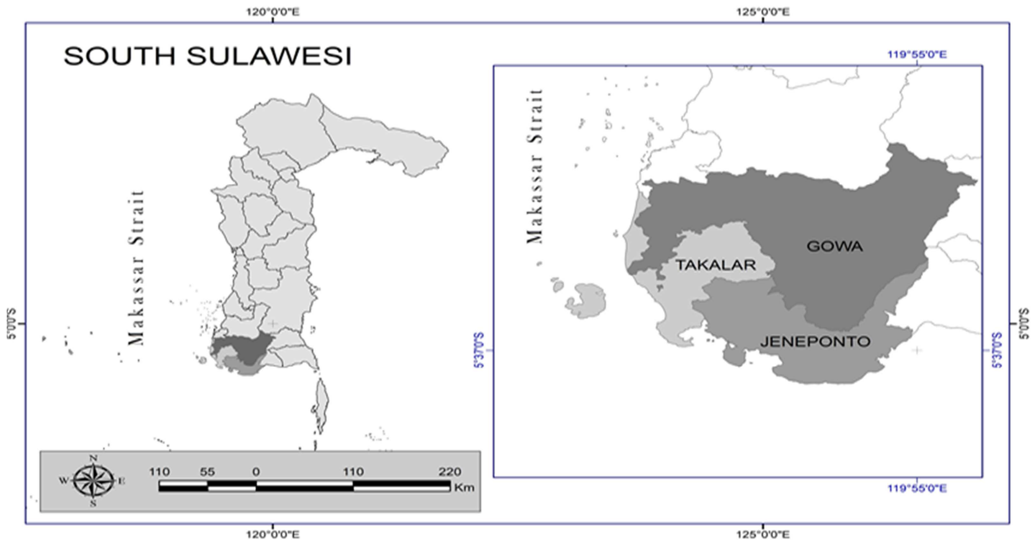

Figure 1. Study area (the picture will be replaced by the author)

Figure 2. The 2 cobs hybrid corn (photo was taken in the study area)

2. Data and Research Variables

The data used in this study was panel data, the combination of cross-section data with times-series. The cross-section data consisted of 25 random samples taken in each district so that the sample amounted to 75. Each sample was observed on 2 cropping index, so the cross-sectional observation sample was 150 (75 sample x 2 index of cropping). The time-series data used was the last 3 years period (2014-2016), so that 450 (150 cross-section x 3 time-series) observation data were obtained.

There were 19 variables which estimated as net income determinant (Table 1). These variables were identified and adapted from the objective conditions of farming in the study area and the findings of previous studies (Otunaiya et al, 2013, Ntabakirabose et al, 2015; Wang et al, 2017). As shown on the Table 1, in addition to the area of land (X1) and productivity (X3), the other 17 variables use price concept or terminology. This refers to (Gittinger 2008 and Bidzakinet al, 2014) which defined cost as the price of goods or services paid by farmers in their farms.

Table 1. Define Net income Determinant Variable.

No	Determinant Variable (units)	Symbol	Define variable
1	Net income (IDR)	Net income	Net income after deducting all expenses
2	Total Area (ha)	X_1	The total area of 2 cobs hybrid corn farm
3	Soil Processing (IDR)	X_2	The cost paid for the processing of the land
4	Productivity (ton/ha)	X_3	Production rate of dried kernel corn per hectare
5	Output Price (IDR)	X_4	The amount of price received by farmers for the sale of dried kernel corn.
6	Investment Cost (IDR)	X_5	Total cost paid by farmers for investment goods such as equipment and machinery
7	Seed Price (IDR)	X_6	The cost paid by farmers for the seed needed in the production process
8	Fertilizers Price (IDR)	X_7	Total cost paid by farmers for all types of fertilizers used in the production process
9	Pesticides Price (IDR)	X_8	Total cost paid by farmers for all types of pesticides used in the production process
10	The Cost of Labor (IDR)	X_9	Labor costs paid by farmers outside the family labor during the production and harvesting process (outside post harvest)
11	Cost of living (IDR)	X_{10}	The living cost of farmers for daily consumption during the production and post-harvest process
12	Post Harvest Cost (IDR)	X_{12}	Total cost paid by farmers in the post-harvest process, for

			transportation of crop yield, corn processing, drying and packaging
13	Irrigation Cost (IDR)	X_{12}	Total cost paid by farmers for crop irrigation during the production process
14	Equipment Maintenance Cost (IDR)	X_{13}	Total cost paid by farmers for equipment and machinery maintenance
15	Depreciation Cost (IDR)	X_{14}	Total cost paid by farmers for the depreciation of equipment and machinery, calculated on the straight-line method (Straight Line Method)

3. Collection of Data

The collection of data was done through observation and interview techniques. Observations were conducted on farming area along with recorded net income determinant informed by farmers. As for the historical data (times-series) that were not recorded by farmers, researchers tried to help them to recall. The interviews and data collection were conducted using a questioner.

4. Statistical Analysis of the Data

4.1. Model estimation

The data were analyzed by panel data regression using software-eviews 8 based on Widarjono's guidance (2016). Panel data regression has the same objective as multiple linear regression, i.e. predicting the value of intercept/constant (β_0) and coefficient (β_i; 1,2,3, ... n). The equation model used for (β_0) and (β_i) estimation as follows.

$$Income_{it} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14} X_{14} + €_{it} \quad \text{(1)}$$

Where:

$\beta_{0.}$ = Intercept

$\beta_{i;1,2,3,..n}$ = Variable coefficient X_i; *i:* 1, 2, 3….n

$X_{1,2,3,....n}$ = Determinant Variable

$€_{it\,it}$ = Residual/error, *i*; 1,2,3…n,*ti*, the period observation (year) 1,2,3

Equation (1) is transformed into natural logarithm (Ln) to normalize the units of different variables (Gujarati, 2011). The transformation of Ln also serves to make the estimation model linear; the data distribution is nearly normal and free from the problem of heteroscedasticity (Ekananda, 2014; Widarjono, 2016). The model of natural logarithmic equation (Ln) is as follows (2).

$$Ln\ Income_{it} = Ln\beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + \beta_6 LnX_6 + \beta_7 LnX_7 + \beta_8 LnX_8 + \beta_9 LnX_9 + \beta_{10} LnX_{10} + \beta_{11} LnX_{11} + \beta_{12} LnX_{12} + \beta_{13} LnX_{13} + \beta_{14} LnX_{14} + €_{it} \quad \text{(2)}$$

Estimation (β_0) and (βi) are done through 3 (three) approach models, namely Common Effect (CE), Fixed Effect (FE), and Random Effect (RE). The CE model, equation (2), assumes that data between individuals are equal throughout the observation, thus ignoring the existence of individual or time dimensional differences. The FE model, assuming the intercept value of each district region is different (β_{0i}), the coefficient (β_i) between regions is same, and the intercept distinction is denoted by (β_{0i}), not (β_0), equation (3).

$$Ln\ Income_{it} = \boldsymbol{Ln\beta_{0i}} + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + \beta_6 LnX_6 + \beta_7 LnX_7 + \beta_8 LnX_8 + \beta_9 LnX_9 + \beta_{10} LnX_{10} + \beta_{11} LnX_{11} + \beta_{12} LnX_{12} + \beta_{13} LnX_{13} + \beta_{14} LnX_{14} + €_{it} \quad \text{(3)}$$

The RE model assumes that each region has different intercept (β_{0i}), as a random variable, and takes into account random error ($€_{it} + \mu_{it}$) that may occur along the cross section and time series data, equation (4).

$$Ln\ Income_{it} = \boldsymbol{Ln\beta_{0i}} + \beta_1\ LnX_1 + \beta_2\ LnX_2 + \beta_3\ LnX_3 + \beta_4\ LnX_4 + \beta_5\ LnX_5 + \beta_6\ LnX_6 + \beta_7\ LnX_7 + \beta_8\ LnX_8 + \beta_9\ LnX_9 + \beta_{10}\ LnX_{10} + \beta_{11}\ LnX_{11} + \beta_{12}\ LnX_{12} + \beta_{13}\ LnX_{13} + \beta_{14}\ LnX_{14} + (€_{it} + +\mu_{\ it}) \quad (4)$$

4.2. Model Accuracy Test and Classic Assumption

To know the best model of the three models (CE, FE, RE), the Chow, Hausman and Langrangge Multiplier (LM) test are conducted (Ekananda, 2014 and Widarjono, 2016). The Chow test is used to select the best model between CE or FE by comparing the F-count value. Criteria, if F>0.05 then the accurate model is FE, and if F<0.05 then the right model is CE. Hausman test is used to select the best model between FE or RE. Criteria, if the value of chi-squared >0.05 then the exact model is RE, if the value <0.05 then the selected model is FE. The Langrangge Multiplier (LM) test is used to select the best model between CE and RE. Criteria, if the value of LM (arithmetic) > chi-squared at the confident level (α) 0.05, then the selected model is RE, if LM < chi-squared then the selected model is CE. The model selected should proceed with classic assumption test such as linearity test, normality test, multicollinearity test, heterochemicality, and autocorrelation, in order to obtain the Best Linear Unbiased Estimator (BLUE) estimation model or free from violation of classical assumptions (Gujarati, 2011; Ekananda, 2014; Widarjono , 2016).

III. RESULT

1. Estimation Model

Table 2. Regression results of panel data model of CE, FE and RE

Regression statistic	Model					
	CE		FE		RE	
	Coef	Prob	Coef	Prob	Coef	Prob
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept (β_o)	6,388	0.062	7,090	0.013	6.663	0.027
Total Area (X_1)	0.112	0.000	0.037	0.000	0.122	0.000
Soil Processing (X_2)	0.004	0.057	0.047	0.606	0.016	0.901
Productivity (X_3)	0.340	0.000	0.520	0.031	0.488	0.000
Output Price (X_4)	0.442	0.000	0.339	0.019	0.397	0.031
Investment (X_5)	0.155	0.017	0.313	0.000	0.423	0.021
Seed Price (X_6)	0.012	0.506	0.107	0.136	0.045	0.707
Fertilizer Price (X_7)	0.041	0.005	0.022	0.120	0.026	0.051
Pesticides Price (X_8)	0.007	0.092	0.023	0.071	0.013	0.062
Labor Cost (X_9)	0.217	0.041	0.312	0.077	0.523	0.017
The Cost of living (X_{10})	0.122	0.000	0.176	0.013	0.318	0.010
Post Harvest Cost (X_{11})	0.141	0.057	0.522	0.120	0.226	0.011
Irrigation Cost (X_{12})	0.077	0.012	0.023	0.071	0.413	0.022
Equipment Maintenance Cost (X_{13})	0.001	0.064	0.012	0.077	0.023	0.074
Depreciation Cost (X_{14})	0.016	0.000	-0.076	0.033	-0.118	0.010
F-Statistic	112.79	-	137.27	-	126.60	-
Prob (F-Statistic)	0.027	-	0.031	-	0.020	-
R-squared R^2 (Determinant)	0.523	-	0.472	-	0.563	-

Sources: Created by the authors based on the result of regression analysis of panel data using software Eviews 7

From Table 2, the columns 2 and 3 show the coefficient and probability values of the regression static column 1. Columns 4 and 5 are coefficient and probability values of the FE model, whereas columns 6 and 7 are coefficient and probability values of RE models. The probability used in this analysis was (α = 0.05), with significant criteria if p < 0.05, and not-significant if p > 0.05. F-Statistics is the value of F Test or the simultaneous test of panel data regression. Prob (F-Statistics) is p-value of F test to assess significance level of simultaneous influence of determinant variable $X_{1,1,3......14}$ against net income. Table 2 shows that the Prob (F-Statistic) CE model was 0.027; FE model 0.031 and CE model 0.020; they were at a significant level (p <0.05). This indicated that these three models can be used to estimate the net income of the farm.

2. Model Accuracy Test

To find an appropriate estimation model, whether the CE, FE, or RE models need to proceed with the Chow test, Hausman test, and ML test (Table 3).

Table 3. Model Accuracy Test

Test	Value	Prob	Results based on criteria
Chow-test	149.005	0.0000	The FE model was more precise than the CE model
Hausman-test	210.0182	0.6003	The RE model was more precise than the FE model
LM-test	394.722	0.0100	The RE model was more precise than the CE model

Source: Created by the authors based on the test model data panel regression estimation using Eviews 7 software
.

The value of Chow-test showed F value 149.005 (p<0.05), based on the criteria, it means FE model was more precise than the CE model. Hausman-test obtained value 210.0182 (p > 0.6003), according to applicable criteria, it means RE model was more precise than FE model. Furthermore, Lagrange Multiplier (ML) test obtained value LM 394.722 (p<0.05), according to criteria, it means RE model was more appropriate than model CE. The whole test results revealed that RE model was more precise than CE and FE model. Based on thus result the RE model was the most suitable as model estimation Table 4.

Table 4. Selected model estimation (Model RE) and determinant value

Determinant Variable	Coefficient	Std. Error	t-statistic	Prob.
(1)	(2)	(3)	(4)	(5)
Intercept (β_o)	6.663	2.054	3.244	0.027*
Total Area (X_1)	0.122	0.021	5.810	0.000*
Soil processing (X_2)	0.016	0.007	0.941	0.901^{Ns}
Productivity (X_3)	0.488	0.063	7.746	0.000*
Output Price (X_4)	0.397	0.015	26.467	0.031*
Investment (X_5)	0.423	0.037	11.432	0.021*
Seed Price (X_6)	0.045	0.016	1.250	0.707^{Ns}
Fertilizer Price (X_7)	0.026	0.009	1.238	0.051^{Ns}
Pesticides Price (X_8)	0.013	0.007	0.183	0.062^{Ns}
Labor Cost (X_9)	0.523	0.181	2.890	0.017*
The Cost of living (X_{10})	0.318	0.052	6.115	0.010*
Post Harvest Cost (X_{11})	0.226	0.041	5.512	0.011*
Irrigation Cost (X_{12})	0.413	0.026	15.885	0.022*
Equipment Maintenance Cost (X_{13})	0.023	0.011	0.742	0.074^{Ns}
Depreciation Cost (X_{14})	-0.118	0.023	-5.130	0.010*

F-Statistic	126.60	-	-	-
Prob (F-Statistic)	0.021	-	-	-
R-squared (R^2) atau Determinant	0.563	-	-	-

Source: Created by the author based on regression analysis of panel data using software Eviews 7;
Note: * Sign means significant at level 5% ($p < 0.05$), Ns = Not significant

This selected model (RE) automatically complied the classical assumption because it use the general least square (GLS) technique, rather than the ordinary least square (OLS) technique (Gujarati and Porter, 2011; Ekananda, 2014 and Widarjono, 2016). Thus, RE model is a Best Linear Unbiased Estimator (BLUE) estimation model or free of basic violation assumptions. Furthermore, R-squared (R2) in Table 4 was used as a result of determinative measurements to show how well this regression model approximates the value of the original data. The value of R2 was 0.563 indicating that 56.30% of net income was determined by the 14 variables (Table 4), while the remaining 43.70% was determined by other factors not specified in this model.

The value of F-statistics (Prob = 0.021) implied that simultaneously the $X_{i\ldots\ 1,\ 2,\ 3\ \ldots\ .14}$ variable has significant effect ($p < 0.05$) on net income. However, partially (t-test) showed that only 9 determinant variables that have significant effect ($p < 0.05$). That was, the area of farming (X_1);), productivity (X_3), output price (X_4), investment (X_5), labor cost (X_9), cost of living (X_{10}), post-harvest cost (X_{11}), irrigation cost (X_{12}), and depreciation cost (X_{14}). Other five variables that were not-significant ($p > 0.05$), soil processing (X_2), seed price (X_6), fertilizer price (X_7), pesticide price (X_8) and equipment maintenance cost X_{13}.Regretional equations of RE model can be written as follows.

$$\text{Net income} = 6.663 + 0.122X_1 + 0.016X_2 + 0.488X_3 + 0.397X_4 + 0.423X_5 + 0.045X_6 + 0.026X_7 + 0.013X_8 + 0.523X_9 + 0.318X_{10} + 0.226X_{11} + 0.413X_{12} + 0.023X_{13} - 0.118X_{14} \ldots\ldots\ldots (5)$$

From equation (5), the intercept value of 6,663 (million IDR) was defined as the average net income value of the 2 cobs hybrid corn farm contributed by the 14 variables ($X_{i;\ 1,2,3\ \ldots\ .14}$) assuming other variables outside the model were constant. Total area of farming (X_1) contributed positively and significantly ($p < 0.05$) to net income with coefficient of 0.122. It means that every 1% increase of X_1 will give an additional net income of its coefficient value (0.122). Vice versa, every 1% decrease will reduce net income by X_1 coefficient. Soil processing (X_2) also contributed positively to coefficient 0.016 but not-significant ($p > 0.05$) so that statistically its contribution to net income questionable.

Productivity (X_3), output price (X_4) and investment (X_5) contributed positively and significantly ($p < 0.05$) to net income with coefficients of 0.488, 0.397 and 0.423, respectively. It can be interpreted that every 1% increase of each of these variables will provide an additional net income of the coefficient value, vice versa. Variable of seed price (X_6); fertilizer price (X_7) and pesticide price (X_8) had positive contraction on net income with coefficient of 0.045; 0.226; and 0.013. However, the effects of these three variables were not significant so that its contribution to net income was not convincing.

The cost of labor (X9), cost of living (X10), the post-harvest cost (X_{11}) and irrigation cost (X_{12}) also contributed positively and significantly ($p < 0.05$) to net income with their respective coefficients; 0.523; 0.318; 0.226 and 0.413. Each 1% increase of each of these variables will provide an increase in net income by their respective coefficients, vice versa. The maintenance tool (X_{13}) also gave positive coefficient 0.023 to net income but not-significant, so its contribution was doubtful. Further depreciation cost (X_{14}) contributed negatively -0.118 and significant ($p < 0.05$) to net income. It can be interpreted that every 1% increase in depreciation will decrease net income by its coefficient value (0.118), vice versa.

IV. DISCUSSION

1. Determinant Variable

The findings of this study introduce 14 determinants of variables that contribute to net income of 2 cobs hybrid corn in the study area. Out of these 14 variables, 9 were significant ($p < 0.05$), while the other 5 variables were not significant ($p > 0.05$). Significant can be interpreted as a determinant variable that can be accepted, believed and can be generalized (Sudjana, 2005, Gujarati, 2011) in 2 cobs hybrid corn farming population. At least, in the three districts (centers) the development of the study site was implemented. Thus the 9 significant variables can be categorized as net income determinant, while the 5 not-significant variables are categorized as not-determinant or not the deciding variable.

The 9 determinant variables were; total area of farming (X_1); productivity (X_3), output selling price (X_4); investment (X_5); cost of living (X_{10}), post-harvest cost (X_{11}), irrigation cost (X_{12}) and depreciation cost (X_{14}). The results of this study correspond to some other findings (Otunaiya et al, 2013; Banerjee at al, 2014; Mbamalu and Yigezu 2016, Wang et al, 2017, Harendra et al, 2018).

The five authors reported that net income determinants of corn farming is the area of farmland (X_1) where the medium size of farm (1.5-2.0 ha) provides net income higher than the small farm (0.75-1.5 ha). Selling price of output (X_4); where 2-3% increase in selling prices from the previous selling price significantly ($p <0.05$) gives additional net income. Investment of machinery and equipment (X_5); where machine and equipment investments have a very significant effect ($p <0.01$) on net income through cost efficiency and quality improvement. As for the Labor cost (X_9); the higher the work hours, the higher the workforce production and net income. The living cost of farmers and their families during the production process (X_{10}) is relatively a determinant of productivity and net income, while the limitations of the cost of living encourage farmers to do other jobs; therefore they ignore their own corn farms. Irrigation (X_{12}); where the regular irrigation schedule significantly ($p <0.05$) increases the production and net income of the corn.

Unfortunately, the five authors did not include productivity (X_3), post-harvest cost (X_{11}) and depreciation cost (X_{14}) into his estimation model. However, separately reported the productivity, post-harvest cost (Abass et al, 2014) and depreciation cost (Kozlovska, 2015) significantly ($p <0.05$) affect the net income of corn farm. Furthermore Abass et al (2014) reported that there was a loss of 5-15% of production without a good post-harvest. The depreciation of tools and machinery was reported by Kozlovska (2015) stated that the Straight Line Method (used in this study) has a negative and significant ($p <0.05$) effect on net income.

2. Not-determinant (not the deciding) variable

There were five variables that are categorized as not-determinant because it shows a not-significant effect ($p> 0.05$). The five variables were soil processing (X_2); seed cost (X_6), fertilizer cost (X_7); pesticide cost (X_8) and equipment and machine maintenance cost (X_{13}). These results are inconsistent with previous studies of soil processing (Mafongoya et al, 2017), seed use (Dhakal et al 2015, and pesticide as a variable determinant of net income in hybrid corn farming.

The five variables were productivity determinants, not net income determinants (Esham, 2014, Ibrahim et al., 2014). The study of Soenartiningsih (2015) and Daryono et al (2017) that compared the local varieties and hybrid corn varieties revealed that hybrid corn was more resistant to stalk rot disease (caused by *gibberella* and *diplodia*), therefore the effect of pesticide was not significant ($p> 0.05$). As for the cost of machine and tool maintenance (X13), the greater amount of investment of machinery and equipment, the greater amount of maintenance costs (Bonhee et al, 2016). Tools and machinery used by farmers in this study area consisted of pest and disease sprayer (hand sprayer), water pump machine, and corn sheller machine. The value of these three equipments ranges from 3-4 million IDR ($ US 220-295), which is relatively small maintenance cost and gives a not-significant effect ($p> 0.05$).

V. CONCLUSION

The results of this study identified 14 determinants variables on net income of 2 cobs hybrid-corn farm in the study areas. Out of the 14 variables, 9 were significant variables ($p <0.05$), and 5 other were not-significant variables ($p> 0.05$). Significant variable ($p <0.05$) is categorized as a determinant variable in 2 cobs hybrid corn farm, whereas the not-significant ($p> 0.05$) is categorized as not-determinant or not the deciding variable. The 9 significant variables were the total area of farming (X_1); productivity (X_3), output selling price (X_4); investment cost (X_5); labor cost (X_9), cost of living (X_{10}), post-harvest cost (X_{11}), irrigation cost (X_{12}) and depreciation cost (X_{14}). While the 5 not-significant variables ($p> 0.05$) or not the deciding variable were the soil processing (X_2); seed price (X_6), fertilizer price (X_7); pesticide price (X_8) and equipment and machine maintenance cost (X_{13}).

ACKNOWLEDGEMENT

The authors would like to thank the Agriculture and Food Security Agency of Gowa, Takalar and Jeneponto Regencies, and all the farmer groups as respondents, who have spent the time in this research.

REFERENCES

[1] CADIS (Center for Agricultural Data and Information System). 2017. Agricultural Statistics 2017. Ministry of Agriculture Republic of Indonesiac Jakarta, Indonesia. Available onlinre: http://epublikasi.setjen.pertanian.go.id/download/file/390-statistik-pertanian-2017 (accessed on 12 March 2018), ISBN : 979-8958-65-9.

[2] Nuryati L, Waryanto B, Akbar, Widaningsih R. 2016. Outlook Komoditas Pertanian Tanaman Pangan, Jagung. Jakarta, Pusat Data dan Sistem Informasi Pertanian Kementerian Pertanian. ISBN : 1907 –1507

[3] Yorobe J.M.J, Smale M. 2012. Impacts of Bt Maize on Smallholder Income in the Philippines. AgBioForum, 15:152-16.

[4] Mathenge M.K, Smale M, Olwande J. 2014. The impacts of hybrid maize seed on the welfare of farming households in Kenya. Food Policy, 44:262–271. https://doi.org/10.1016/j.foodpol.2013.09.013

[5] Otunaiya A.O, Ologbon O.A.C and Oyebanjo O. 2013.Determinants of Financial Performance of Maize Farms in Egba Division of Ogun State, Nigeria. IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS), 4: 27-30. www.iosrjournals.org

[6] Banerjee H, Goswami R, Chakraborty S, Dutta S, Majumdar K, Satyanarayana T, Jat M.L, Zingor S. 2014. Understanding biophysical and socio-economic determinants of maize (Zea maysL.) yield variability in eastern India. NJAS-Wageningen Journal of Life Sciences, 70:79–93. https://doi.org/10.1016/j.njas.2014.08.001. www.elsevier.com/locate/njas

[7] Miladis M, Afidchao, Musters C.J.M, Wossink A,.Balderama O.F, de Snoo G.R. 2014. Analysing the farm level economic impact of GM corn in the Philippines. NJAS - Wageningen Journal of Life Sciences, 70:113–121 . https://doi.org/10.1016/j.njas.2014.05.008

[8] Zalkuwi J, Ibrahim A, Kwakanapwa E. 2014. Analysis of Cost and Return of Maize Production in Numan Local Government Area of Adamawa State, Nigeria. International journal of innovative research, 3:62-68. www.ijird.com

[9] Dhakal S.C, Regmi P.P, Thapa R.B, Kumar S.S, Khatri-Chhetri D.B. 2015. Productivity and profitability of maize-pumpkin mix cropping in Chitwan, Nepal. Journal of Maize Research and Development,1:112-122. DOI: http://dx.doi.org/10.5281/zenodo.34290.

[10] Koondhar M, HeGe, Chandio A, Abbas, Xaio X, Koondhar A.M. 2016. Economic Analysis of Hybrid Maize Cultivation in Distt. Journal of Poverty, Investment and Developmen, 18:56-62. Available online: https://www.researchgate.net/publication/289389535_Economic_Analysis_of_HybridMaize_Cultivation_in_Distt (accessed on 12 Juni 2017).

[11] Garba Y, Ahmed B,Katung M.D, Lawal A.F, Abubakar H.N. 2017. Profitability of striga tolerant maize variety (SAMMAZ 17) amongst smallholder farmers in Lapai, Niger State, Nigeria. S Afr. Jnl. Agric. Ext., 45:1-9. http://dx.doi.org/10.17159/2413-3221/2017/v45n1a400.

[12] Surhano and Rusdi, 2017.Kelayakan Usahatani Jagung Hibrida di Kabupaten Muna, Provinsi Sulawesi Tenggara. Jurnal Pengkajian dan Pengembangan Teknologi Pertanian, 20:36-46. Availabe online: http://www.bbp2tp.litbang.pertanian.go.id (accessed on 12 December 2017). b/c rasio hibrida lebih tinggi (1.7) dan local (1.5)

[13] Wang Y, Vitale J, Park P, Adams B, Agesa B and Korir M. 2017.Socioeconomic determinants of hybrid maize adoption in Kenya. African Journal of Agricultural Research, 12: 617-631. DOI: https://doi.org/10.5897/AJAR2016.11958. http://www.academicjournals.org/AJAR

[14] Baylis, K., Paulson, N., & Piras, G. 2011. Spatial Approaches to Panel Data in Agricultural Economics: A Climate Change Application. Journal of Agricultural and Applied Economics, 43:325-338. doi:10.1017/S1074070800004326.

[15] Platoni, Sckokai P, Moro D; Panel. 2012. Data Estimation Techniques and Farm-level Data Models. American Journal of Agricultural Economics, 94:1202–1217, https://doi.org/10.1093/ajae/aas072

[16] Olatunji T.A and Matthew I.E. 2016. Food Production Modelling Using Fixed Effect Panel Data for Nigeria and Other 14 West African Countries (1990-2013). American Journal of Theoretical and Applied Statistics, 5: 208-218. doi: 10.11648/j.ajtas.20160504.17

[17] Gujarati D.N, Porter D.C. 2011. Dasar-Dasar Ekonometrika (Book 2), (5-ed). Salemba Empat, Jakarta. ISBN 9789790610668.

[18] Ekanandan M. 2014. Analisis Ekonometrika Data Panel. Jakarta-Indonesia: Mitra Wacana Media. ISBN 978-602-1353-99-8

[19] Widarjono A. 2016. Ekonometrika; Pengantar dan Aplikasi Disertai Panduan Eviews, Yogyakarta-Indonesia: UPT STIM YKPN. ISBN 978-979-5332-10-1

[20] Arsyad Biba, M. (2016).Preferensi Petani terhadap Jagung Hibrida Berdasarkan Karakter Agronomik, Produktivitas, dan Keuntungan Usahatani. Jurnal Penelitian Pertanian Tanaman Pangan, 35:81-88. DOI:10.21082/jpptp.v35n1.2016.p81-88.

[21] Taufik M, Maintang, and Nappu M.B. 2015. Feasibility Analysis of Maize Farming System in South Sulawesi Province. Jurnal Pengkajian dan Pengembangan Teknologi Pertanian Vol. 18, No.1, Maret 2015 : 67-80.DOI: http://dx.doi.org/10.21082/jpptp.v18n1.2015.p%25p.Website : http://www.bbp2tp.litbang.pertanian.go.id

[22] Subagyo, 2018.Balitbang Pertanian lepas 39 varietas jagung hibrida. Available online: https://www.antaranews.com/berita/686489/balitbang-

pertanian-lepas-39-varietas-jagung-hibrida (accessed on 3 March 2018).

[23] Ntabakirabose G, Mbabazize M, Shukla J. 2015. An Analytical Study of the Factors Influencing Maize Production in Rwanda: A Case Study of Gatsibo District. The International Journal Of Business & Management, 3:146-181. www.theijbm.com. Available online: http://www.theijbm.com/force_download.php?file_path=wp-content/uploads/2015/10/16.-BM1509-054.pdf&id=1995 (accessed on 20 Mey 2017).

[24] Gittinger J. P. 2008. Analisa ekonomi proyek-proyek pertanian (Economic analysis of agriculture project). Jakarta, Universitas Indonesian (UI-Press), ISBN: 9798034287 9789798034282 1986 ,

[25] Bidzakin J.K, Fialor S.C, and Asuming-Brempong D. 2014. Small Scale Maize Production In Northern Ghana: Stochastic Profit Frontier Analysis. ARPN Journal of Agricultural and Biological Science, 9: 76-83. www.arpnjournals.com

[26] Sudjana. 2005. Metoda Statistika. Tarsito, Bandung. ISBN 9799185378.

[27] Mbamalu M.B.Y and Yigezu T.T. 2016. Determination of Optimal Irrigation Scheduling for Maize (Zea Mays) at Teppi, Southwest of Ethiopia. Irrigat Drainage Sys Eng 5:173. doi: 10.4172/2168-9768.1000173

[28] Harendra P.S.C, Singh G.P, Singh R, Kushwaha P, Kumar R and Ranjan A.K. 2018. Costs and Income Analysis of Maize Cultivation in Bahraich District of Uttar Pradesh.Int.J.Curr.Microbiol.App.Sci. 7(2): 1060-1065. doi: https://doi.org/10.20546/ijcmas.2018.702.131n

[29] Abass A.B, Ndunguru G, Mamiro P, Alenkhe B, Mlingi N, Bekunda M. 2014. Post-harvest food losses in a maize-based farming system of semi-arid savannah area of Tanzania. Journal of Stored Products Research, 57: 49-57. https://doi.org/10.1016/j.jspr.2013.12.004. ournal homepage: www.elsevier.com/locate/jsp.

[30] Kozlovska I. 2015.The impact of long-lived non-financial assets depreciation/ amortization method on financial statements. Copernican Journal of Finance & Accounting, 4:91–108. http://dx.doi.org/10.12775/CJFA.2015.018

[31] Mafongoya P, Obert J, Phophi M. 2016. Evaluation of Tillage Practices for Maize (Zea mays) Grown on Different Land-Use Systems in Eastern Zambia.Sustainable Agriculture Research. 5:10-23. doi:10.5539/sar.v5n1p10 URL: http://dx.doi.org/10.5539/sar.v5n1p10.

[32] Esham M. 2014. Technical Efficiency and Determinants of Maize Production by Smallholder Farmers in the Moneragala District of Sri Lanka. Mediterranean Journal of Social Sciences, 5:416-422. Doi:10.5901/mjss.2014.v5n27p416.

[33] Ibrahim K, Shamsudin M.N, Yacob R and Radam A.B. 2014. Technical Efficiency in Maize Production and its Determinants: A Survey of Farms Across Agro Ecological Zones in Northern Nigeria. Trends in Agricultural Economics, 7: 57-68. DOI:10.3923/tae.2014.57.68URL:https://scialert.net/abstract/?doi=tae.2014.57.68

[34] Soenartiningsih S. 2015. Uji Ketahanan beberapa Varietas Unggul Jagung terhadap Penyakit Gibberella dan Diplodia. Biosfera 32 :103 – 109. Available online: https://journal.bio.unsoed.ac.id/index.php/biosfera/article/view/301 (accessed on 20 April, 2016).

[35] Daryono B.S, Purnomo, Parazulfa A. 2017. Uji Ketahanan Tujuh Kultivar Jagung (Zea mays L.) Terhadap Penyakit Bulai (Peronosclerospora spp.). Biogenesis, 6: 11-17. DOI https://doi.org/10.24252/bio.v6i1.4175. 7

[36] Bonhee C, Arshad F.M, Kusairi M.N, Sidique S.F. 2016. Cost analysis of rice milling: a case study of 7 rice mills in Malaysia. Journal of Agribusiness in Developing and Emerging Economies, 6: 173-190, https://doi.org/10.1108/JADEE-05-2014-0019.