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Abstract. Sustainable agriculture becomes crucial issue in economic development and cocoa production is one of the important pillars. The research deals with determinants of cocoa production using Path Analysis. The results show that, first, the larger cultivated land area with farm equipment, the much higher increase in cocoa productions of smallholders will be. Therefore, we may argue that the variable Cultivated Land Area with Farm Equipment (X_{22}) is the most important variable to be considered in increasing production. Second, the more difficult access to public health center is, the less cocoa production of smallholders will gain. This implies that providing public health center closer to the smallholder residence could be considered to encourage cocoa production as a smallholders income source.

1. Introduction

Sustainable agriculture becomes crucial issue in economic development (the importance of sustainable agriculture for global development) [1] and cocoa production is one of the important pillars. Cocoa is one of Indonesia's important estate crops. Ministry of Agriculture show that, the total area of Indonesian cocoa crops (2017) has reached 1 730,002 ha of which 97% is cocoa smallholders. The area of Indonesia's cocoa production center is on the Sulawesi Island, one of them is South Sulawesi Province. Indonesian cocoa production in 2017 reached 659,776 tons, with the development of cocoa production from 2013 to 2017 which continued to decline so that the productivity obtained was only 756 kg/ha. Indonesia is a world cocoa producer; however, Indonesian cocoa bean production continues to experience a significant decline until the position is increasingly shifted [2,3]. At the same time,

Indonesia is facing highly demand for global cocoa beans (see for example, Joachim et al. [4] shows that demand for cocoa products continues to increase significantly with an average growth of 20% per year and it is projected that demand for cocoa beans will continue to increase by 2.2% mainly from the United States and Western European countries as food producers that use cocoa as the main ingredient [5]. Therefore, it is important to note that, in meeting global market demand needs the sustainable development paradigm of increasing awareness, concern and product quality [6]. Program of income increasing and ability of farming and agribusiness management towards Good Farming Practices (GFP), science and technology application, and concern for the conservation of resources both physical and genetic and environment become the main priority agenda [7] in getting sustainable agriculture.

Some problems appear in cocoa smallholders in Indonesia. It has impact on low productivity and decrease amount of cocoa production due to cocoa trees aging and pests disease in plantaton [8]. It also will affects socio-economic situation of cocoa smallholders [9], including cocoa land conversion [10] become crucial issue in the country (see also "peasant problem") [11] . In order to avoid tremendously decreasing of cocoa production, Indonesian government has an effort to increase productivity and ensure that cocoa production practices from upstream to downstream have taken economic, social and environmental aspects into account by implementing various government policies like the National Movement Program (called 'Gernas Kakao') [12]; in selected provinces.

In a global economy, cocoa smallholders are facing a difficult access to public health center. It affects farming production input even indirectly. The hypothesis is that, if smallholders are far from public helath center, they need high cost to travel in order to get the center. Smallholders reduced purchasing input in agriculture for accessing public health center. It means farmers reduce input availability for agricultural farming. In turn, it will affects cocoa production (farmers welfare in other words). Given the situtation above, the research deals with determinants of cocoa production and explaining how the public health access affects cocoa production.

2. Analysis

The research employed our previous model of Path Analysis to explain different issue. The general model of Path Analysis below;

$Y_t = \beta_1 X_{1t} + \beta_2 X_{2t} + ... + \beta_k X_{kt} + E_t$, for Y_t, X_{it} is standardized and t = 1, 2,…, n yields the following equations:

$Y_t = \left(\sum_{q=1}^{K} \beta_q X_{qt} \right) + E_t$ in which the direct impact of exogenous variables on each of its respective endogenous can be estimated by path equations:

$X_1 = E_1$ (Path Equation 1, PE 1)

$X_2 = E_2$ (PE 2)

$X_3 = E_3$ (PE 3)

$X_4 = E_4$ (PE 4)

$X_5 = P_{51}X_1 + P_{52}X_2 + P_{53}X_3 + P_{54}X_4 + E_5$ (PE 5)

$X_6 = P_{61}X_1 + P_{62}X_2 + P_{63}X_3 + E_6$ (PE 6)

$X_7 = P_{71}X_1 + P_{72}X_2 + P_{74}X_4 + P_{76}X_6 + P_{75}X_5 + E_7$ (PE 7)

The above equations yield a general form, $X_j = \left(\sum_{q=1}^{k} P_{jq} X_q \right) + E_j$ for (k < j); where P_{jq} is a path coefficient of the independent variables, and E_j is disturbance terms. The estimated values in each one of the above path equations can be obtained (from PE 5 to PE 7) by the formula

$\hat{X}j = \sum_{q=1}^{k} \hat{P}jqXq, (k < j)$; where a hat (^) indicates an estimated value. Thus, a path coefficient P_{jq} is a standardized path coefficient, which is $b_{jq}*(S_{xj}/S_{xq})$. In this case, b_{jq} is an unstandardized path coefficient, while S_{xj} and S_{xq} are, respectively, the standard deviation of X_j and X_q. This solution leads us to test a Null Hypothesis (H_0) that "there is no significant impact of independent variables on dependent".

3. Results and discussion

3.1. Determinants of cocoa production

As clearly shown in Figure 1, dependent variable in the model is Cocoa Production (X_{53}). Of those five variables, the variable Cocoa Production (X_{53}) receives nine causal effects directly from independent variables. They are "Cultivated Land Area with Farm Equipment (X_{21}), Total Paddy Field and Estate Crop Area with Farm Equipment (X_{22}), Paddy Upland Area with Farm Equipment (X_{23}), Clove Area with Farm Equipment (X_{24}), Access to Public Health Center (X_{32}), Distance to Secondary School and Primary Public Health (X_{34}), Primary and Auxiliary Health Center (X_{35}), Agriculture and Non-Agriculture Extension (X_{41}) and Agricultural Marketing (X_{42})".

Four out of nine variables send their direct effects positively on the variable Cocoa Production (X_{53}). These variables are; Cultivated Land Area with Farm Equipment (X_{21}, β= .851), Total Paddy Field and Estate Crop Area with Farm Equipment (X_{22}, β= .165), Distance to Secondary School and Primary Public Health (X_{34}, β= .282) and Agriculture and Non-Agriculture Extension (X_{41}, β= .177). Of those four variables that have positive effects, the variable Cultivated Land Area with Farm Equipment (X_{21}) has very strong βweight meaning very strong effect (β= .851) than the latter three variables {(Total Paddy Field and Estate Crop Area with Farm Equipment (X_{22}), Distance to Secondary School and Primary Public Health (X_{34}), and Agriculture and Non-Agriculture Extension (X_{41})}, or 3-5 times higher than the effect of the latter ones.

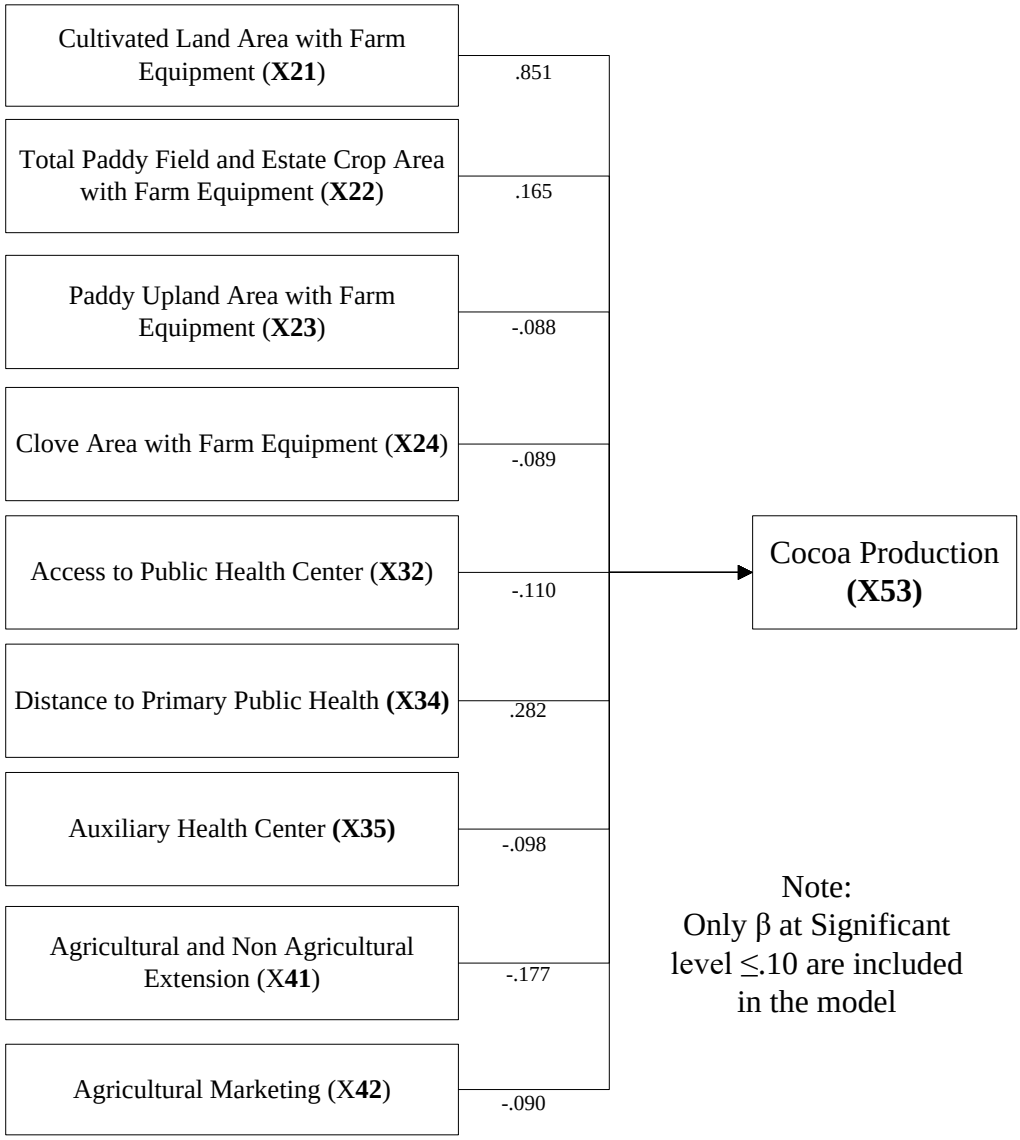

Figure 1. Determinants of cocoa production

Based on these results, we may say that the larger the cultivated land area with farm equipment, the much higher the increase in cocoa productions of smallholders will be. Therefore, we may argue that the variable Cultivated Land Area with Farm Equipment (X_{22}) is the most important variable to be considered in increasing cocoa production. This then, implies that it is considerably important to expand the cultivated land area with farm equipment in order to increase the cocoa production as a source of income for smallholders. However, this finding should not be interpreted to mean that the other variable does not have a contribution in explaining the cocoa production; although they have weaker standardized path coefficients (βweights). It is generally true that the weaker βweights, the smaller influences or effects. However, it is also true that even if the βweights are relatively weaker, the variables give us the important information to understand the nature of cocoa production as a whole. Let us takes the variable Agriculture and Non-Agriculture Extension (X_{41}, β= .177 meaning weaker effect) for instance. This index was derived from four original variables. These variables are; CRED_AMOUNT, FRE_INF_AGREX, FRE_INF_NOAGR, and FRE_INF_PRICE (we do not display all original variables in this paper). The interpretation of these results could be that the higher

credit amount for agriculture, the higher cocoa production will be. This is a true phenomenon. It was found through the survey, that the smallholders who have the possibility to finance their farming through credit from the banks, have higher production. Unfortunately, only few smallholders can get the credit, mainly because they have no or lack the access to credit information (84.70% respondents), inavailability of collateral (6.8%), complicated procedures (3.40%) and high interest rates (5.10%). Now clearly, how important is the role of the variable in completing information, even though it has smaller βweights.

Another possible interpretation dealing with the variable Cocoa Production (X_{53}) as one of the intermediate variables is that the higher the frequency of getting the information of technology/agricultural extension, non-agricultural jobs information and price information for input-output in agriculture, the higher the cocoa productions will be gained. This is also an understandable phenomenon. In the research site, as we observed during the survey, the smallholders who have better access to information in agriculture such as network to the Local Farmers Group, in which the local government officers for agriculture introduce newer technology, have better agricultural production as well as better daily lives than the others. All of these indicate that besides expanding cultivated land area, access to information such as credit information, agricultural extension (including input-output price), non-agricultural business/jobs information can also be expected to improve cocoa production as a source of income for smallholders.

3.2. Access to public health center and cocoa production

Then, the other five remaining variables send their direct effect on the variable Cocoa Production (X_{53}) negatively. These variables are Paddy Upland Area with Farm Equipment (X_{23}, β= -.088), Clove Area with Farm Equipment (X_{24}, β= -.089), Access to Public Health Center (X_{32}, β= -.110), Primary and Auxiliary Health Center (X_{35}, β= -.098) and Agricultural Marketing (X_{42}, β= -.090). Even if all of these five variables have standardized path coefficient (βweights) relatively weak in the intervals, (ranging between .090 and .110) it means smaller effects, some possible interpretations could be concretized. Firstly, just like their effect on the coffee and orange productions occurred. Paddy upland area is rice farming cultivated by the smallholders on the dry land (e.g. called *ladang*), while paddy field area is on the wet land (called *sawah*). In the research site, generally the cocoa crops are planted on the dry land in which *ladang* is no exception. At the same time, it is also necessary for the smallholders to choose which kind crop they will plant (paddy upland or estate crop such as cocoa and clove) on the same dry land. Clearly, the paddy upland and clove crops compete with cocoa in terms of agricultural land utilization. Thereby, it is also a possible result that the larger paddy upland and clove area, the less cocoa area will be cultivated and in turn it will also reduces cocoa productions itself. Secondly, the difficult access to public health center, meaning further distance, the less the cocoa production will be. In the research area, primary and auxiliary public health centers are more often used by the smallholders' families. Thus, if the primary and auxiliary public health centers are further, the more time and money will be spent to travel, then the more household income at hand will be lost. In turn, smallholders will be difficult to finance their input for cocoa productions such as a higher quality of seed, fertilizer, etc as well as farm equipments needed. In other words, distance appears to be a crucial part of this interpretation. Therefore, it is reasonable to say that the more difficult the access to public health center is, the less cocoa production of smallholders will be. This implies that providing public health center closer to the smallholder residence could be considered to encourage cocoa production as a smallholders income source.

However, an interesting point is that the index "Access to Public Health Center (X_{32}, β= -.110)", which is one of them was derived from the original variable DISTN_HEALT2 (distance to auxiliary public health center, so called PUSTU) has different effect from the index "Primary and Auxiliary Health Center (X_{35}, β= -.098)" which was also one of them derived from the original variable DISTN_HEALT3 (distance to primary public health center, so called PUSKESMAS). Their different effects can be traced carefully based on the size (not magnitude) of standardized path coefficient or

βweights in which "DISTN_HEALT2" is higher than "DISTN_HEALT3". An important point from this finding is that, even if these two indices are the same in terms of public health center facility, but βweights shows that the distance to PUSTU slightly higher (β= -.110) than PUSKESMAS (β= -.098). This is a true phenomenon. In the research site, PUSTU is located nearer to the smallholder community than to PUSKESMAS. Therefore, we may say that the degree of PUSTU utilization is, however, more important than PUSKESMAS itself, meaning that smallholders often used PUSTU than PUSKESMAS, or PUSTU is potentially important to provide for the rural smallholders.

4. Conclusion

Two important conclusions can be explored. First, the larger the cultivated land area with farm equipment, the much higher the increase in cocoa productions of smallholders will be. Therefore, we may argue that the variable Cultivated Land Area with Farm Equipment (X_{22}) is the most important variable to be considered in increasing cocoa production. This then, implies that it is considerably important to expand the cultivated land area with farm equipment in order to increase cocoa production. Second, the more difficult the access to public health center is, the less cocoa production of smallholders will be. This implies that providing public health center closer to the smallholder residence could be considered to encourage cocoa production as a source of income of smallholders. Both provement of expanding cultivated land with farm equipement and better access to public health centers will help sustainable agriculture in the country.

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References

[1] Janker J, Mann S and Rist S 2018 What is Sustainable Agriculture ? Critical Analysis of the International Political Discourse *J. Sustain. 2018*, **10** 1–19
[2] ICCO 2019 *[ICCO] International Cocoa Organization. 2019 Quarterly Bulletin of Cocoa Statistic. London (GB): ICCO Anual Report*
[3] Langkong J, Mahendradatta M, Tahir M M and Abdullah N 2019 Utilization Of Cocono Seed Skin (Theobroma Cacao L) Become Chocolate Cookies Products *Canrea J. Food Technology, Nutr. Culin. J.* **2** 44–50
[4] Joachim, Regine, Nurheni, Afwdani and Terhorst 2016 Sustainable management of cocoa plantations. [Internet]
[5] FAO 2010 *Medium-term prospects for agricultural commodities: 2012 projections to the year. Rome (IT): FAO*
[6] Zhen L and Routray J K 2003 Operational indicators for measuring agricultural sustainability in developing countries *Environ. Manage.* **32** 34–46
[7] Jumiyati S, Arsyad M, Palubuhu D A T and Hadid A 2018 Cocoa based agroforestry: An economic perspective in resource scarcity conflict era *IOP Conference Series: Earth and Environmental Science* vol 157 (IOP Publishing) p 12009
[8] Hidayanto, Yahya and Amien 2009 Analysis of the sustainability of cocoa plantation communities in the border region of Sebatik Island, Nunukan Regency, East Kalimantan Province. *Agro Econ. J.* **27** 213–29
[9] Hariyadi, U S and IW W 2009 Identification of problems and solutions for developing cocoa plantation communities in North Luwu Regency, South Sulawesi Province. *Proc. Semin. IPB*

Res. Results
[10] Kumala 2016 *Design a sustainable cocoa agro-industry supply chain model using smart systems* (Bogor (ID): Institute Bogor Agriculture.)
[11] Neilson 2008 National movement program to accelerate national cocoa revitalization (Gernas). [Internet]. [downloaded 2018 August 15]
[12] Bernstein H 2018 The ‘ peasant problem ’ in the Russian revolution (s), 1905 – 1929 *J. Peasant Stud. ISSN* **45** 1127–50