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IMPACT OF CLIMATE CHANGE ON MACRO-ECONOMY OF CENTRAL SULAWESI PROVINCE INDONESIA: CASE OF COCOA BEANS COMMODITY

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ABSTRACT

Central Sulawesi is the first rank of cocoa beans supplier in Indonesia. Unfortunately, climate change resulted on emerging of cacao pests and diseases that causes continuously decreasing productivity of cacao farm. Consequently, farmers have been converted their cocoa farm to others farm. This has been impacted on macro-economy of Central Sulawesi. Generally, the aim of this study is to analyze impact of climate change on macro-economy of Central Sulawesi for case cocoa beans commodity. Particularly, the aim of this study is (i) to analyze impact of climate change on productivity of cacao farm; (ii) to estimate effect of the productivity on GDRP of cocoa beans; (iii) to estimate effect of the GDRP of cocoa beans on macro-economy of Central Sulawesi; and (iv) to estimate trends of macro-economy of Central Sulawesi. Analyze method was econometric simultaneous equation of double logarithm model. Data used was secondary data, 2000 – 2014, namely GDRP of Central Sulawesi, areal size of cacao, production volume of cocoa beans, prices of cocoa beans at farm level. The result of analyze showed that climate change has been impacted on productivity of cacao farm. It was indicated by coefficient of year as a proxy insignificant affect to variety of productivity of cacao farm, so it could be interpreted that the productivity to be constant. Consequently, the productivity couldn't push up GDRP of cocoa beans. However, GDRP of cocoa beans could still push up the macro-economy of Central Sulawesi. The macro-economy of Central Sulawesi was increasing. Thus, although climate change impacted on the productivity, but GDRP of cocoa beans could still push up the macro-economy of Central Sulawesi. It means that management of pest and disease of cacao farm in a prototype to be important performed.

Key Words: Cocoa beans commodity, impact of climate change, macro-economy of Central Sulawesi.

INTRODUCTION

Central Sulawesi Province is defined under region criteria of administrative programming. The location lies between $2^{o}22'$ North Latitude and $3^{o}48'$ South Latitude, and between $119^{o}22'$ until $124^{o}22'$ East Longitude. The land area is about 68.033 KM^2. This province consists of two coastal regions, namely east coast and west coast. These two regions create two type of climates. The dried West monsoon take place during October – March, in west coast is dry season, but in east coast is rainy season. In contrast, in the rainy East monsoon take place during April – September, in west coast is wet season, but in east coast is dry season (BPS, 2014a). This condition of climate caused supply of cocoa beans in Central Sulawesi to be constant all along the year (Yantu, 2011, Yantu *et al.*, 2010 and Sisfahyuni *et al.*, 2011). According to Pusat Penelitian Kopi dan Kakao Indonesia (2008), transition from dry to wet period is an important factor in regulating for intensity of cacao blossom. Unfortunately, climate change resulted on emerging of cacao pests and diseases that causes continuously decreasing of cacao productivity.

Agricultural intensification and climate change were causing irreversible losses in biodiversity and associated ecosystem functioning. Ecosystem properties and human well being are profoundly influenced by

environmental change which is often not considered during land use intensification (Tscharntke *et al.,* 2010). Impact of climate change on biodiversity can result in species enrichment as postulated for many biomasses of cooler climates as well as in species losses as predicted for many biomes most dry biomes and for parts of the wet tropics as well (Bendix *et al.,* 2010).

The decreasing of cacao farm productivity was reported by researchers such as Yantu et al. (2015a, 2015b, 2015c, 2014a, 2014b, 2013, 2011, 2010, 2009a, 2009b, 2009c), Yantu (2011), Yantu dan Sisfahyuni (2010), Yunus et al. (2014), and Sisfahyuni et al. (2010, 2011). It has been caused farmers converting their cacao plantation to others plantation, such as oil palm, clove and coffee farms. This has been impacted on macro-economy of Central Sulawesi Province. Generally, the aim of this study is to analyze impact of climate change on macro-economy of Central Sulawesi for case cocoa beans commodity. Particularly, the aim of this study is (i) to analyze impact of climate change on productivity of cacao farm; (ii) to estimate effect of the productivity on GDRP of Cocoa beans; (iii) to estimate effect of the GDRP of cocoa beans on macro-economy of Central Sulawesi; and (iv) to estimate trends of macro-economy of Central Sulawesi.

METHODOLOGY

Impact of climate change on macro-economy of Central Sulawesi would be measured as follow first; its impact would be measured to base on trends of productivity of cacao farm. Furthermore, estimate how to cacao productivity will affect *Gross Domestic Regional Product* (GDRP) *of* cocoa beans. Finally, estimate how to GDRP of cocoa beans will affect Macro-economy of Central Sulawesi. The macro-economy will be measured with GDRP of Central Sulawesi.

Measurement of impact of climate change on productivity of cacao farm will be done because there weren't data of particularly climate change observed or collected in this study. Thus, in this study, climate change is assumed has impact on productivity of cacao farm, and the impact seems in trends of the productivity. This assumption is realistic, since it was based on reports of research results. Oyekale et al. (2009) reported that rainfall, temperature and sunshine were observed to have been the most important climatic factors that affect cocoa production. Anderson et al. (2004) reported that severe weather events are important drivers of plant disease emergence.

Based on the assumption above could be used econometric approach, i.e. pattern approach. According to the approach that effects of all of variables on given variable can be known to pass through trend of the given variable in past time. Baltagi (2007) said that past experience which is a good proxy for the omitted variables shows up as a significant determinant of future probability of occurrence of this event.

Beside pattern analyses, factor analyses were also used in achieving the aims of this study. To achieve the aim of this study were developed simultaneous equation analyses of double logarithm based on approach of pattern and factor analyses (Verbeek, 2008) as follow

$$\text{Ln } Y_{1i} = a_1 + b_1 \text{ Year}_i + e_{1i}, \ldots\ldots\ldots\ldots(01)$$

$$\text{Ln } Y_{2i} = a_2 + b_2 \text{ Ln } Y_{1i} + e_{2i}, \ldots\ldots\ldots\ldots(02)$$

$$\text{Ln } Y_{3i} = a_3 + b_3 \text{ Ln } Y_{2i} + b_4 \text{ Year}_i + e_{3i}, \ldots(03)$$

Expected value for $b_i > 0$

Where Y_{1i} is productivity of cacao farm year i^{th} (ton). Y_{2i} is GDRP of cocoa beans year i^{th} (IDR. Tillion). Y_{3i} is GDRP of Central Sulawesi year i^{th} (IDR. Tillion). GDRP of cocoa beans was calculated by using production method (Yantu et al., 2015d) as follow

$$\text{GDRP}_i = Q_i \text{ x } P_i - IC_i, \ldots\ldots\ldots\ldots\ldots(04)$$

Where Q is volume of cocoa beans in year i^{th} (ton), P_i is price of cocoa beans at farm level in year i^{th} (IDR/ton); and IC_i = intermediate cost, i.e. cost in performing cacao farm in year i^{th} (IDR).

The equation (01) – (03) is recursive model, so it can be estimated by using Ordinary Least Square (OLS). In the recursive model is no interdependence among endogenous

variables, so OLS method can be applied to each equation separately (Gujarati, 2003).

The equation (01) – (03) need time series data during 2000 to 2014. The period was selected for analyses of long run. All of data will be converted to real data, so Year 2010 will be constant year. It will be selected because *Gross Domestic Product* (GDP) of Indonesia to use at constant year 2010. The data were about GDRP of Central Sulawesi, Size areal of cacao, and production volume of cocoa beans. The data were presented in Appendix 1.

The data were converted into value of logarithm natural, since analyses used was double log model. Furthermore, the data in form of logarithm natural were tested level of its stationer with using Augmented Dicky-Fuller (ADF) test (Verbeek, 2008) as follow

$$\Delta Y_t = \alpha Y_{t-1} + \varepsilon_i \text{ …..... (05)}$$

Hypothesis for parameter of equation (05) was formulated as follow

$$H_0 : \alpha_i = 0 \text{ dan } H_1 : \alpha_i < 0 \text{ ..... (06)}$$

Testing for the hypothesis was done by using *Eviews release 6*. The result of the testing was presented in Appendix 2 to show that level of stationer of the data to be different at level of alpha 20%. The critical value was used because data used to be secondary data. Thus, all of data (variables) were done to be *stationer* at level of integrated *2* by using the difference method (Verbeek, 2008) as follow

$$\bar{\nu} = x_t - x_{t-1}, \text{.....(07)}$$

Where $\bar{\nu}$ is level of stationer; x_t is variable in year t; and x_{t-1} is variable in year t-1.

The data that was analyzed by equation (07) to be presented in Appendix 3.

THE RESULTS AND DISCUSSION

Macro-Economy of Central Sulawesi Province. Macro-economy of Central Sulawesi Province was represented by total activity of Central Sulawesi economic, namely GDRP. In Year 2014, GDRP of Central Sulawesi at current price is IRD 96.26 trillion. This value is just 0.88 percent of *Gross Domestic Product* (GDP) of Indonesia, so it was less than the expected value of contribution on national economy. Yantu (2013, 2011, 2007) and Yantu et al. (2011) said that based on land resources, the value is 3.49 percent.

Although small contribution, however economic growth of the province can be classified into high growth. According to data of BPS (2014b), during 2010 – 2014, the province economy was increasing 8.68 percent. Unfortunately, the growth was decreasing as it seems in Table 1.

Agriculture sector has been still prime mover of the province economy. It was indicated by contribution of agriculture sector that 34.37 percent of total GDRP of Central Sulawesi. Plantation subsector has been main contributor for agriculture sector. The subsector shared 15.31 percent for GDRP of Central Sulawesi.

Share of cocoa beans value on GDRP of plantation subsector was 41 percent (Yantu, 2011). The share was decreasing to follow volume of cocoa beans production. Yantu et al. (2015a, 2015c, 2013) reported that cacao farmers converted cacao areal to be other farm. Yantu et al. (2015a, 2013) reported that there were 10 percent of local farmers converted their land. Besides that, the farmers converted focus of their labor on the other farms included to be farm laborer. All of that caused cacao farm to be neglected.

Table 1. Economic Growth of Central Sulawesi During 2010 – 2014

Year	Growth (%)
2010	9.37
2011	9.82
2012	9.53
2013	9.55
2014	5.11
Average	8.26

Source: BPS (2014b).

Impact of Climate Change on Productivity of Cacao Farm. Based on explanation above, cocoa beans commodity cannot be rely on as a superior commodity in economy of Central Sulawesi. For that, Yantu *et. al.* (2013) developed prototype of smallholder cacao farm of Central Sulawesi. Yantu et al. (2014a) and Yunus et al. (2014) tested workability of the prototype. The result of the test showed that the workability of the prototype put to a test. Yantu et al. (2014a) and Yunus et al. (2014) reported that the prototype to be named *Prototype of cocoa farm's Yantu* et al. *Untad.*

According to Yunus et al. (2014) Workability of *Prototype of Cocoa Farm's Yantu* et al. *Untad* put to a test. It was indicated by values of *event of* harvest fail decreasing are less than hypothesized value of the decreasing. The decreasing of harvest fail will has positive *consequence,* namely increasing of productivity of cocoa farm in Central Sulawesi. The increasing is almost 2 in magnitude from hypothesized value, so the productivity will increase and close to expected productivity, namely minimal 2.5 ton/ha/year.

The result of analyses used *Eview 6* was presented in Table 2. The analyze was done with OLS option and select *White Heteroskedasticity-Consistent Standard Errors & Covariance*, so the result can be free of *heteroskedasticity*. Furthermore, the analyze was done with *no intercept*, since data used was data of difference analyze based on equation (07). *Variance of Inflation Factor (VIF)* was added to show multi-colinearity in data. The result of VIF has the value < 5 to show that there was not multi-colinearity.

Equation (01), namely equation of the productivity showed that year variable had positive coefficient but insignificant at level of alpha 0.20. The result of analyze means that productivity of cacao farm was constant. Thus, in long run the productivity in Central Sulawesi was constant. The result of analyze is consistent with that reported by Yantu et al. (2011). According to researches that productivity of cacao farm in Central Sulawesi was constant and even to be decreasing. Yantu (2005) reported that in short-run, not long-run productivity of cacao farm response cocoa beans price and laborer wage.

In last 5 years, there were trends of increasing of cacao productivity. Yantu et al. (2010) and Yantu (2011) reported that averages of cacao productivity in Central Sulawesi was only 0.288 ton/ha/year. Sisfahyuni et al. (2010, 2011) reported 0.442 ton/ha/year. Yantu et al. (2011) reported 0.552 ton/ha/year. Yantu et al. (2013) reported 0.669 ton/ha/year. Finally, BI Sulteng (2014) reported 0.720 ton/ha/year. Thus, although the productivity of cacao farm was low, and less than expected value, however it was increasing. Unfortunately, the growth was decreasing as to be presented in Table 3.

Table 2. The Result of Simultaneous Equation

DV Equation	Coef. IV	VIP	Prob	
Ln Y_{1i} =	2.61E-06 $Year_i$,	1.000	0.8570	(01)
Ln Y_{2i} =	0.656771 Ln Y_{1i},	0.289	0.4313	(02)
Ln Y_{3i} =	0.024175 Ln Y_{2i} + 2.04E-06 $Year_i$,	1.129	0.0980	(03)
		0.0883		

Notes: Level of Alpha 0.20 was used, Since Data was Secondary Data No Constant, Since Estimate No Intercept because Data Difference at Level of Integrated 2.
DV = Dependent Variable; IV = Independent Variable; VIP* = *Variance Inflation Factor* = $1/(1-R^2)$ (Verbeek, 2008).

Table 3. Trends Increasing of Productivity of Cacao Farmin Central Sulawesi

Tahun	Productivity (ton/ha)	Growth (%)
2010	0.288	0
2011	0.442	53.47
2012	0.552	24.89
2013	0.669	21.20
2014	0.720	7.62
Averages	0.530	21.44

Based on data appendix 1, productivity of cacao farm is only 0.95 ton/ha/year. However, the value could be classified into high productivity if compared with that presented in Table 3. Unfortunately, the value was still less than expected productivity of cacao farm in Central Sulawesi. Yantu (2011) reported that level of expected productivity in Central Sulawesi is 2.50 ton/ha/year. It was based on *Surat Keputusan* of Governor of Central Sulawesi *Number:525/116/RO.EKBANG-G-ST/2007* about decision of cacao *entrys* sources as superior clone of Central Sulawesi cacao, i.e. (i) *Bulili clone (BP – 07)* with productivity potential is 2.686 kg/ha/year, and (ii) *Sausu clone (SP – 07)* with productivity potential is 2.453 kg/ha/year. Actually, the number of new clone with potentially production 2 – 3 ton/ha/year was launched, such as ICCRI 03 and ICCR 04 (Suhendi et al., 2004 *in* Prawoto dan Sophia, 2009), and expected clone of SULAWESI 01, SULAWESI 02, and KW 165 (Prawoto dan Sophia, 2009).

Based on pattern approach in econometrics, the explained condition above could be caused by climate change. Thus, climate change impacted on productivity of cacao farm in Central Sulawesi in the long run. The impact has been decreased growth of the productivity. This is a bad condition for income of cacao farmers in aspect of microeconomic. In return, this will has chained impact to affect on performance of macro-economy of Central Sulawesi.

Eqution (2) showed that variety of the productivity insignificant affect on variety of GDRP of cocoa beans. This is not expected condition. The condition was caused by the productivity was constant. According to Lin (2011) that recognition on climate change could have negative consequences for agricultural production has generated desire build resilience into agricultural system. Thus, application of *Prototype of cocoa farm's Yantu* et al. *Untad* to be important performed.

Equation (3) showed that variety of GDRP of cocoa beans significant affect on variety of GDRP of Central Sulawesi. This signs that price of cocoa beans had important role, so strong impacted on value of GDRP of cocoa beans, since GDRP is multiply price with production volume. Thus, price of cocoa beans that determined by supply and demand of cocoa beans world will be still motivation for cacao farmers. Although, according to Yantu (2014) there are the law of one price that will be producers (farmers) to be *price takers*, so farmers shall perform management of their farm based on analyze of *break event point*. Krugman and Obstfeld (2003) said that the law of one price states that in competitive markets free of transportation cost and official barriers to trade (such as tariffs), identical goods sold in different country must sell for the same price when their prices are expressed in term of the same currency.

Equation (3) showed that GDRP of Central Sulawesi was significant increasing. However, the increasing was very low as that indicted by coefficient of year as a proxy. Actually, it signs that push up of GDRP of cocoa beans could be classified into small value as that indicated by regression coefficient of GDRP of cocoa beans. It means that when GDRP of cocoa beans will increase 1 percent, macro-economy of Central Sulawesi will increase only 0.02 percents.

The result of analyses above showed that impact of climate change has chained affects. It means that climate change needs specially attention, so performing of cacao farm will improve its productivity. Thus,

statement before about application of *Prototype of cocoa farm's Yantu* et al. *Untad* to be important done could be righted.

CONCLUSION AND RECOMMENDATION

Climate change impacted on productivity of cacao farm in Central Sulawesi where in the long-run, the productivity was constant. Consequently, the productivity insignificant affect on GDRP of cocoa beans commodity. However, GDRP of cocoa beans significant affect on GDRP (macro-economy) of Central Sulawesi. It signs that the price of cocoa beans has important role. Unfortunately, the role had only small effect on macro-economy of Central Sulawesi. Thus, climate change bad impact on macro-economy of Central Sulawesi.

Decrease the impact to need improvement of pest and disease management in performing of cacao farm. Thus, *Prototype of cocoa farm's Yantu* et al. *Untad* to be important performed.

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REFERENCES

Anderson, P.K., A.A. Cunningham, N.G. Patel, F.J. Morales, P.R. Epstein and P. Daszak, 2004. *Emerging Infectious Diseases of Plants: Pathogen Pollution, Climate Change and Agro-technology Drivers.* Trends in Ecology and Revolution Vol. 19 Issue 10 Oct 2004: 535-544.

Baltagi, B.H. 2007. *Econometric Analysis of Panel Data.* Third Edition. John Wiley & Sons. Ltd. England.

Bendix, J., H. Behling, Th. Peters, M. Richter and E. Beck, 2010. *Functional Biodiversity and Climate Change along an Altitudinal Gradient in A Tropical Mountain Rainforest.* In Tscharntke, T., Cristoph Leuschner, Edzo Veldkamp, Heiko Faust, Edi Guhajar, Arifuddin Bidin (Eds.), 2010. *Tropical Rainforests and Agroforests under Global Change: Ecological and Socio-economic Valuation.* Springer. Berlin.

BI Sulteng. 2014. *Analisis Tataniaga, Struktur Pasar, dan Pengembangan Industri Pengolahan Kakao Sulawesi Tengah*. Bank Indonesia. Propinsi Sulawesi Tengah. Palu.

BPS. 2014a. *Sulawesi Tengah dalam Angka Tahun 2013.* Badan Pusat Statistik Indonesia. Propinsi Sulawesi Tengah. Palu.

BPS. 2014b. *Produk Domestik Regional Bruto Sulawesi Tengah Menurut Lapangan Usaha 2010 - 2014.* Badan Pusat Statistik Indonesia. Propinsi Sulawesi Tengah. Palu.

BPS. 2011. *Harga-harga Produsen Sektor Pertanian.* Badan Pusat Statistik Indonesia. Propinsi Sulawesi Tengah. Palu.

BPS. 2009a. *Sulawesi Tengah dalam Angka Tahun 2008.* Badan Pusat Statistik Indonesia. Propinsi Sulawesi Tengah. Palu.

BPS. 2009b. *Produk Domestik Regional Bruto Sulawesi Tengah Menurut Lapangan Usaha 2004 - 2009.* Badan Pusat Statistik Indonesia. Propinsi Sulawesi Tengah. Palu.

BPS. 2004b. *Sulawesi Tengah dalam Angka Tahun 2003.* Badan Pusat Statistik Indonesia. Propinsi Sulawesi Tengah. Palu.

BPS. 2004c. *Produk Domestik Regional Bruto Sulawesi Tengah Menurut Lapangan Usaha 2000 - 2003.* Badan Pusat Statistik Indonesia. Propinsi Sulawesi Tengah. Palu.

Gujarati, D. N. 2003. *Basic Econometrics.* Interntional Student Edition. New York.

Krugman, P.R. and M. Obstfeld. 2003. *Internasional Economic, Theory and Policy*. Sixth Edition. Sixth Edition. World Student Series. Addison-Wesley Egland, Don Mills. Ontario. Sidney. Mexico City. Madrid. Amsterdam.

Lin, B.B., 2011, *Resilience in Agriculture Through Crop Diversification: Adaptive Management for Environmental Change*. Oxford Journal Vol. 61 Issue 3. Pp. 183-193

Oyekale, A.S., M.B. Bolaji and O.W. Olowa, 2009. *The Effects of Climate Change on Cocoa Production and Vulnerability Assessment in Nigeria.* Agricultural Journal 4 (2): 77 – 85. ISSN : 1816-9155.

Prawoto, A. A. dan D. Faila Sophia. 2009**.** *Inovasi Teknologi Budidaya Guna Mendukung Peningkatan Produktivitas dan Peng. Pengendalian Hama Penggerek Buah Kakao. Di Donggala*. Prosiding Seminar Nasional Dalam Rangka Dies Natalis ke – 45 Fakultas Pertanian Universitas Jember. ISBN 979-8176-73-1.

Pusat Penelitian Kopi dan Kakao Indonesia. 2008. *Panduan Lengkap Budidaya Kakao*. Cetakan Pertama. PT. Agromedia Pustaka. Depok.

Sisfahyuni, M.S.Saleh dan M.R.Yantu. 2010. *Kajian Revitalisasi Kelembagaan Pemasaran Kakao Biji Di Tingkat Petani untuk Pengentasan Kemiskinan Di Perdesaan Propinsi Sulawesi Tengah.* Laporan Tahap I. Hibah Kompetitif Penelitian Sesuai Prioritas Nasional T.A. 2010. Nomor : 531/SP2H/PP/DP2M/VII/2010 Tertanggal 24 Juli 2010. Fakultas Pertanian. Universitas Tadulako. Palu.

Sisfahyuni, M.S. Saleh dan M.R.Yantu. 2011. *Kelembagaan Pemasaran Kakao Biji Di Tingkat Petani Kabupaten Parigi Moutong Propinsi Sulawesi Tengah*. Jurnal Agro Ekonomi 29 (2): 191 – 216.

Suhendi, D., H. Winarno dan A.W. Susilo. 2004. *Peningkatan Produksi dan Mutu Hasil Kakao Melalui Penggunaan Klon Unggul Baru.* Simposium Kakao 2004. Jogjakarta 4 – 5 Oktober 2004. 15 p.

Tscharntke, T., Cristoph Leuschner, Edzo Veldkamp, Heiko Faust, Edi Guhajar, Arifuddin Bidin (Eds.), 2010. *Tropical Rainforests and Agroforests under Global Change: Ecological and Socio-economic Valuation*. Springer. Berlin.

Verbeek, M. 2008. *A Guide to Modern Econometrics*. John Wiley & Sons. LTD. Chichester. New York. Weinheim. Brisbane. Toronto. and Singapore.

Yantu, M.R., M. Yunus, Sisfahyuni dan M.U. Bustami. 2015a. *Pengembangan Prototipe Usahatani Kakao Rakyat Sulawesi Tengah Di Bawah Kondisi Risiko dan Ketidakpastian. Dalam* Buku Master Plan Percepatan Pembangunan Ekonomi Indonesia (MP3EI) Koridor Sulawesi. Universitas Hasanuddin. Makasar.

Yantu, M.R., M. Yunus, Sisfahyuni dan M.U. Bustami. 2015b. *Kinerja Usahatani Kakao Rakyat Sulawesi Tengah: Suatu Analisis Komparatif Tanaman Lokal dan Sambung Samping*. Media BALITBANGDA SULTENG 8: III Tahun 2015.

Yantu, M.R., M. Yunus, Sisfahyuni dan M.U. Bustami. 2015c. *Analyses of Response for Productivity of Smallholder Cocoa Plantation in Central Sulawesi Indonesia: An Agroecosysten Approach*. J. Agroecology 01 (1): 41 – 47. June 2015. ISSN : 2460 – 6936.

Yantu, M.R. Marhawati_Mappatoba and A. Lamusa. 2015d. *Macroeconomic Theory: Lectures Materials for International Class.* Department of Agribusiness. Faculty of Agriculture. University of Tadulako. Palu.

Yantu, M.R. 2014. *Manfaat Perdagangan Internaional WTO Bagi Perekonomian Wilayah Sulteng.* Makalah Pengantar dalam Kuliah Perdagangan Internasional. Pertemuan ke – 9 dan ke – 10. Rabu 05-11-2014 dan 12–11–2014. Kelas AGB 2. Semester Ganjil 2014/2015. Program Studi Agribisnis. Jurusan Agtibisnis. Fakultas Pertanian. Universitas Tadulako. Palu.

Yantu, M.R., M. Yunus, D. Widjajanto dan Sisfahyuni. 2014a. *Pengembangan Prototipe Usahatani Kakao Rakyat Sulawesi Tengah Di Bawah Kondisi Risiko dan Ketidakpastian.* Laporan Tahunan Penelitian Prioritas Nasional Master Plan Percepatan dan Perluasan Pembangunan Ekonomi Indonesia 2011 – 2015 (PENPRINAS - MP3EI) Tahap II. TA 2014. Universitas Tadulako. Desember 2014. Palu.

Yantu, M.R., M. Yunus, D. Widjajanto dan Sisfahyuni. 2014b. *Testing for Workability of Prototype Smallholder Cocoa Farm in Central Sulawesi: in Perspective of Social and Economic of Organic Agriculture and Agroecology.* Paper for International Organic Agriculture Conference and Exhibition on November 12th, 2014. Organized by Faculty of Agriculture. University of Brawajaya. Malang. Indonesia.

Yantu, M.R. 2013. *Strategi Pembangunan Ekonomi Wilayah Sulawesi Tengah Berbasis Agribisnis Berkelanjutan.* Makalah Disampaikan pada Seminar Nasional Bertema *Sustainable Agribusiness* yang Diselenggarakan Oleh Perhimpunan Organisasi Profesi Mahasiswa Sosial Ekonomi Pertanian Indonesia (POPMASEPI) DPW V POPMASEPI, Himpunan Mahasiswa Sosial Ekonomi Pertanian (HIMASEP) Fakultas Pertanian Universitas Tadulako. 11–03–2013, Pogombo. Palu.

Yantu, M.R., M. Yunus, Sisfahyuni dan M.U. Bustami. 2013. *Pengembangan Prototipe Usahatani Kakao Rakyat Sulawesi Tengah Di Bawah Kondisi Risiko dan Ketidakpastian.* Laporan Tahunan Penelitian Prioritas Nasional Master Plan Percepatan dan Perluasan Pembangunan Ekonomi Indonesia 2011 – 2015 (PENPRINAS - MP3EI) Tahap II. TA 2014. Universitas Tadulako. Desember 2013. Palu.

Yantu, M.R. 2011. *Model Ekonomi Wilayah Komoditi Kakao Biji Propinsi Sulawesi Tengah.* Disertasi Doktor pada Program Studi Ilmu-ilmu Perencanaan Pembangunan Wilayah dan Perdesaan. Institut Pertanian Bogor. Bogor.

Yantu, M.R., Sisfahyuni dan N. Sari. 2011. *Fungsi Produktivitas Usahatani Kakao Rakyat Provinsi Sulawesi Tengah*, J. Agroland 18 (1): 57 – 64.

Yantu, M.R., B. Juanda, H. Siregar, I. Gonarsjah dan S. Hadi. 2010. *Integrasi Pasar Kakao Biji Perdesaan Sulawesi Tengah dengan Pasar Dunia.* J. Agro Ekonomi 28 (2): 113 – 225.

Yantu, M.R. dan Sisfahyuhni. 2010. *Pengembangan Model Ekonomi Wilayah Berbasis Komoditi Kakao Biji untuk Pengentasan Kemiskinan Di Perdesaan Propinsi Sulawesi Tengah.* Laporan Penelitian Strategis Nasional. Nomor: 264/H.3/LL/2010 Tanggal 20 April 2010. Fakultas Pertanian Universitas Tadulako, Palu.

Yantu, M.R, M.S. Saleh dan Sisfahyuni. 2009a. *Pengembangan Model Perdagangan Komoditi Kakao Biji Untuk Pengentasan Kemiskinan Di Perdesaan Propinsi Sulawesi Tengah.* Laporan Penelitian Lembaga Penelitian Universitas Tadulako. Palu.

Yantu, M.R, Sisfahyuni, Ludin dan Taufik, 2009b, *Strategi Pengembangan Subsektor Perkebunan dalam Perekonomian Sulawesi Tengah*. Media LITBANG Sulawesi Tengah. II (1): 44 -50.

Yantu, M.R., M.S. Saleh dan Sisfahyuni. 2009c. *The Performance of Cocoa Plantation's Smallholders in Central Sulawesi.* Prosiding Seminar Nasional Dalam Rangka Dies Natalis Ke – 45. Fakultas Pertanian Universitas Jember. ISBN: 979-8176-73-1.

Yantu, M.R. 2007. *Peranan Sektor Pertanian dalam Perekonomian Wilayah Sulawesi Tengah.* Jurnal Ilmu-ilmu Pertanian Agroland Vol.14 No.1: 31 – 37. Maret 2007. Fakultas Pertanian Universitas Tadulako Palu.

Yantu, M.R. 2005. *Analisis Respon Penawaran Kakao Rakyat Propinsi Sulawesi Tengah.* J. Agrokultur 2 (2): 1 – 11.

Yunus, M., D. Widjajanto, Sisfahyuni and M.R. Yantu,. 2014. *Prototype of Smallholder Cocoa Farm Based on Organic Agriculture : Lesson from Central Sulawesi Indonesia.* The Agroland: The Agriculture Journal 1 (1): 47 – 57.

Appendix 1

Database for during 2000 – 2014

Year	Cacao[1)]			GDRP Constant Year 2010 (IDR. Trillion)	
	Areal Size (ha)	Production (ton)	Productivity (ton/ha)	Cocoa Beans[2)]	Central Sulawesi[3)]
2000	54,920	100,897	1.84	1.36	25.40
2001	62,876	112,602	1.79	1.52	26.69
2002	69,955	112,465	1.61	1.52	28.19
2003	92,136	116,035	1.26	1.57	29.94
2004	125,046	152,299	1.22	2.06	32.08
2005	126,624	145,354	1.15	1.96	34.39
2006	154,769	159,663	1.03	2.16	37.21
2007	162,363	146,475	0.90	1.98	40.18
2008	160,242	151,651	0.95	2.05	44.19
2009	166,691	137,851	0.83	1.86	47.59
2010	166,732	138,306	0.83	1.87	51.75
2011	195,725	168,858	0.86	2.28	56.83
2012	196,623	174,575	0.89	2.36	62.25
2013	196,985	195,846	0.99	2.64	68.19
2014	198,722	208,235	1.05	2.81	71.68

Source: [1)] BPS (2014a, 2009a, 2004a,); [2)] production volume was multiplied by cocoa beans price at level farm at year 2010 (BPS, 2011). The result must be still substrated by intermediate cost 30%, such as it was showed by equation (04).
[3)] BPS (2014b, 2009b, 2004b); the data 2000-2009 was calculated with using deflator GDRP at constant year 2000 on 2010

Appendix 2

Stationery Level of Database in Logarithm Natural at Level of Alpha 20%

Null Hypothesis: Unit root (individual unit root process)
Series: ln Y1i, ln Y2i, ln Y3i
Date: 07/12/15 Time: 21:50
Sample: 2000 2014
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic selection of lags based on AIC: 0
Total (balanced) observations: 42
Cross-sections included: 3

Method	Statistic	Prob.**
ADF - Fisher Chi-square	4.17207	0.6534
ADF - Choi Z-stat	1.65625	0.9512

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Series	Prob.	Lag	Max Lag	Obs
ln Y1i	0.1708	0	2	14
ln Y2i	0.7275	0	2	14
ln Y3i	0.9993	0	2	14

Series	Prob.	Lag	Max Lag	Obs
D(ln Y1i)	0.9047	2	2	11
D(ln Y2i)	0.0053	0	2	13
D(ln Y3i)	0.2769	0	2	13

Series	Prob.	Lag	Max Lag	Obs
D(ln Y1i,2i)	0.0003	1	1	11
D(ln Y2i,2i)	0.0001	0	1	12
D(lnY3i,2i)	0.0786	0	1	12

Appendix 3

Database at Stationery Level of Integrated *2* In Logarithm Natural

Year	Productivity	GDRP of Cocoa Beans	GDRP of Central Sulawesi
2000	0.000000	0.000000	0.000000
2001	0.000000	0.000000	0.000000
2002	-0.082377	-0.467652	0.004939
2003	-0.136259	-0.324208	0.005632
2004	0.210702	-0.115971	0.008759
2005	-0.025752	-0.675302	0.000392
2006	-0.047604	-0.216108	0.009424
2007	-0.027293	-0.536779	-0.001984
2008	0.181988	-0.235737	0.018129
2009	-0.182742	-0.486810	-0.020716
2010	0.137914	-0.257971	0.009519
2011	0.036217	-0.160381	0.009876
2012	-0.010548	-0.522968	-0.002648
2013	0.084416	-0.274997	0.000155
2014	-0.060575	-0.410311	-0.041320