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CAUSE AND IMPACT OF LAND-USE CHANGE (LUC) ON FOOD SECURITY (CASE STUDIES IN PADANG, BANTEN, YOGYAKARTA, WEST LOMBOK, and BALI)

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Abstract

The protection of the utility of rice land is very important because every year rice lands in Indonesia are reduced by 150 thousand to 200 thousand hectares. Rice lands are the most quickly changed because they are easily be treated. In addition, rice lands are also considered an attractive investment because they are cheap. Rice land's contour is flat, has water, near access road, and economically a very attractive location for investment. Rice land value is relatively cheaper than the other land use as economically. Land use change caused frail food security, so the land use change has to be stopped by government.

This paper is to discuss about the land use change and susceptible food security. The purpose of this study was to: determine the cause LUC in agricultural and the impact of LUC in food security

The main determining factor of land use change was: 1). Increasing population; 2). Disobeying the rules of land use. The determining factor of food security was the massive land use change. Recommendations of this study were: 1). Decreasing population by using Family Plan Program; 2) decisive of the rules.

Keywords: Land Use Change, Food Security

A. Introduction

Indonesia is known as a fertile archipelago region for agricultural, especially in Java Isand and Sumatra Isand. Java and Sumatra have plenty volcanoes and still active until now, so that it become fertile lands. This condition makes Indonesia has to stable on food security, but in fact, The Jakarta Post reported:

“While data has become the primary fuel for the digital economy, the accuracy of our agriculture data, notably on the production and consumption of food commodities, has always stirred up heated debates every time prices rise and commodities must be imported to stabilize prices”..¹

That is the ironic, Indonesia has fertile lands, but consumption of food commodities must be imported. Why? The PAN AP² data said that

”Precious rice land is being lost to industrialisation and urbanization in many Asian countries. Rice farmers are removed from their livelihoods, become victims of forced migration and suffer from hunger. Invasions of rice lands by foreign investors have

¹ <https://www.thejakartapost.com/academia/2018/05/28/broadening-food-security.html> Jakarta / Mon, May 28, 2018 / 07:59 am

² Pesticide Action Network Asia and the Pacific (PAN AP) is one of five regional centres of PAN, a global network which aims to eliminate the harm caused by pesticides and promote biodiversity-based ecological agriculture. It is committed to the empowerment of people especially women, agricultural workers, peasants and indigenous farmers. PAN AP launched its Save Our Rice Campaign in 2003 in response to the powerful threats arising against rice, the staple food of half the world's population. The foundation of the Campaign is the “Five Pillars of Rice Wisdom”: (1) Rice Culture, (2) Community Wisdom, (3) Biodiversity-based Ecological Agriculture, (4) Safe Food and (5) Food Sovereignty. The Campaign is dedicated to saving traditional local rice, small rice farmers, rice lands and the rice heritage of Asia. PAN AP Rice Sheets provide relevant information on the threats to rice and are written from the people's perspective. Enquiries may be sent to: panap@panap.net.

been encouraged by the nation states as well as by global actors like World Bank (WB) and the International Monetary Fund (IMF), in line with the neo-liberal open market policies” (Anonymous, no date)

That is why food security in Indonesia always depends on import commodity. As PAN AP data, rice land being lost because of LUC. Conversion of land in term LUCs³, it cannot be avoided in implementation of development. Demands of society needs more higher for the lands, often lead to conflict of interest in land use (Rumetna, Sedyono and Hartomo, 2017). The result of Rumetna et al.

“The results of this study of land use in 2011, there are thirty one classifications, while in 2015 there are thirty four classifications. The pattern of distribution of LUC shows that LUC in 2011-2015 has a Complete Spatial Randomness pattern. Land use suitability with the direction of area function at RTRW is 24030,406 Ha (46, 995406%) and incompatibility of 27103,115 Ha or equal to 53, 004593% of the total area of Bantul Regency”.

It is terrible fact that land use suitability in Bantul just only 46, 9%, and incompatibility 53, 01%. This data indicated LUC in Bantul is very massive.

In National scale, Pahala Nainggolan is one of deputy in KPK (Corruption Eradication Commission) said that, “every year, land-use change (rice fields) 50.000 hectare – 60.000 hectare”.⁴ How horrible it is, when rice fields reducing per years 50.000 hectare, how about food security in Indonesia, when the population are always rises.

This study aims to determine

1. causes of LUCs, and
2. Implication to food security.

B. Causes of LUC

In Indonesia, Land use itself divided two types of utilization, agricultural lands, and non-agricultural lands. Non-agricultural lands, according Boedi Harsono is the lands that used for off farms activity. The use of no agricultural lands, are:

1. Housing includes: residential, recreation area, cemetery, fields, and soon.
2. Company land (for example, lands use for: markets, shops, warehouses, cinemas, banks, stations, and so on)
3. Industrial land (for example, land use for: fabrics, printing shop, printing office, and so on)
4. Services land (for example, land use for: government offices, churches, mosques, hospitals, schools, and other public facilities).
5. Empty land, is the land that is ready to build.

Commonly, the drift of change of land use actually from agricultural to non-agricultural, it is impossible when the opposite drift. According N Supardan et al.

³ It is similar within the term of land use change and land conversion

⁴ <https://www.mongabay.co.id/2016/11/23/pemda-masih-minim-terapkan-larangan-alih-fungsi-lahan-pertanian/>

“LUC or land conversion can be interpreted as a change in the function of part or the entire region of the original function into other functions that have a **negative impact** on the environment and the potential of land itself”. (Supardan et al, 2018).

The term of negative impact on environment described by Radoslava Kanianska, who was research in Europe, explain that LUC could influence:

1. ***Traditional landscape disappearance***

The disappearance of traditional agricultural landscape is an on-going process, accompanying the general trend of agricultural abandonment in Europe. In Slovakia, traditional agricultural landscape is described as agricultural ecosystems that consist of mosaics of small-scale arable fields or permanent agricultural cultivations such as grasslands, vineyards, and high-trunk orchards or early abandoned plots with a low succession degree. (Kanianska, 2018)

2. ***Contribution of climate change***

Anthropogenic land-use activities and changes in land use/cover caused changes superimposed on the natural fluxes. Land-cover changes are responsible for surface and vegetation modifications that reflect in surface albedo and thus surface-atmosphere energy exchanges, which have an impact on regional climate. Terrestrial ecosystems are important sources and sinks of carbon and thus land-use changes reflect also in the carbon cycle. The important contribution of local evapotranspiration to the water cycle—that is precipitation recycling— as a function of land cover highlighted yet another considerable impact of land-use/cover change on climate, at a local to regional scale. (Kanianska, 2018)

3. ***Biodiversity losses***

Agriculture has impact on biodiversity. Biodiversity according Webster’s dictionary is biological diversity in an environment as indicated by numbers of different species of plants and animals. Thus many species of plants and animals has losses, caused by LUC.

4. ***Eutrophication***

Eutrophication is a process of pollution that occurs when a lake or stream becomes over rich in plant nutrients as a consequence it becomes overgrown in algae and other aquatic plants.

5. ***Agro ecosystem services degradation***

Disservices from agriculture can include degradation or loss of habitat, soil, water quality, and other off-site, negative impacts.

And the other hand Castro et al, argued: two contrasting trends in Land Use and Land Cover changes have been identified over the last several decades. First, industrial development, which is an intensification of agricultural practices and urban expansion, is reshaping the landscape. Second, a concurrent increase in the abandonment of rural areas has led to a decrease in traditional agricultural practices. Both processes feature heavily in the case study and are identified as the key drivers of global change. (Quintas-Soriano *et al.*,

2016).Castro's research in condition that industrial development is making reshaping landscape and economic profits provided by greenhouse. But, industrial development itself has negative impact, pollution and ecological impact.

In Indonesia, the impact of LUC not only as described by Kanianska, but also influence on food security.

Lamidi et al, have researched in Serang city (Banten), the result showed:

" The annual change of rice fields in the period of 1993-2000 is 265.14 Ha, in 2000-2007 is 90.43 Ha, and in 2007-2016 is 91.67 Ha. Overall, during the period of 1993-2016 (23 years) the rice fields in Serang City decreased by 29% from 11576 Ha in 1993 to be 8262 Ha in 2016. This means that every year the rice fields in Serang City decreased about 144 Ha or about 1.3%. The biggest rice field conversion is to be settlement and agro forest".(Lamidi et al., 2017)

Emphasis of that data are every years the rice fields in Serang city decreased about 144 ha, whereas Serang city has 8,138 ha of technical irrigated rice field. It means sixty years later Serang City has no rice field. Next Lamidi explained about the type of conversion, that the conversion of rice field is mostly for housing construction needs. Almost 74.96% rice field becoming housing. It is not surprisingly, when the data of population in Serang showed increasing.⁵ The increase of population leads to LUC, especially in housing. People need lands to build a house as a dwelling, while land does not increase in area.

In Bali, LUC has been researched by Supardan et al.," The land conversion is mainly for housings and settlement purposes".

Table 1. Land Use Change of Denpasar City 2002-2015

LUC	Topographic Map 2002 (Ha)	SPOT Imagery 2015 (Ha)	LUC (Ha)
Lake	10.33	10.33	0
Ponds	384.14	384.14	0
Mangroves Forest	2.27	2.27	0
Swamp forests/Peat	245.47	245.47	0
Grasslands	195.53	182.62	-12.91
Plantations/garden	687.68	660.78	-26.90
Settlement and its activities	8621.76	10357.34	1.735.58
Swamps	33.79	33.79	0
Rice fields	5238.15	3543.34	-1.694.81
Scrub	20.5	19.98	-0.52
Moor / fields	111.23	110.79	-0.44
Non-cultivated vegetation area	32.5	32.53	0

Source: Supardan et al, 2018

⁵ In the period of 2001-2006 when Serang was still part of Serang District, the population growth was just average 1.3% per year. In the period of 2008 - 2016 after Serang became an autonomous city, the population increased from 493,232 in 2008 to 643,205 in 2015 or increased by 25% or an average of 3.5% per year.

Tabel 1 shows rice fields decreased 1.694.81 ha between 2001-2015, and Settlements increased 1.735.58 ha. It means, alot of rice fields have changed becoming settlements. The twelve indicators of LUCs, only settlements have increasing. Settlements take over all LUC in Denpasar.

LUC In Sidoarjo district East Java Province increasing 2.66% at 2012, and 60% converted by settlements/ housing. (Linda Cristi Corolina dkk, 2012)

Agus Ikhwanto said” in Malang city which covers an area of 110.06 km² year to year it continues to shrink due to the shifting function of rice lands into settlements as well as area used for the economy”.(Ikhwanto, 2019)

In Padang, West Sumatra, LUC to settlements is about 150 to 200 hectares.(Mustafa, 2017) acording Cetral Bureau of Statistics (BPS), Suryamin in (Mustafa, 2017)⁶, household that planted rice 14.2 million in 2003, and fell down to 14.1 million in 2013. It means in decenial, peasent in Padang has decreased a hundred thousand peasant.

König et al., have researched in Yogyakarta:

“From 1993 to 2006, urban built-up areas and new rural settlements doubled, while the area of agricultural land decreased by 25%. Rural areas, including home- or forest gardens, now account for 16%, and urban areas for 4%. The remaining area belongs to forests and coastal protection zones”(Hannes Jochen König et al, 2010)

All LUC’s researchers have data that showed LUC in their research sites changed to be settlements (housing). When population growth is increasing, and people needs settlements for livinghood, thus settlement demands is increasing too. LUC from agrarian to non-agrarian more profitable than the opposite way. That’s why people prefer exchange their rice fields to settlement.

Population change was the most direct factor affecting land use change, causing changes in the intensity and structure of land use by changing the quantity structure, pattern and product demand of land use. (Li *et al.*, 2015)

C. The Impact Of LUC on Food Security

Food security is the fact that a place is able to produce or obtain enough food to feed its population⁷. In Yogyakarta the conversion of wetlands led to the loss of rice production by 18.359,27 tons during the period 2006-2015.(Yoga Prasada et al, 2011). Rate of LUC on rice shoes in table 2 bellow:

⁶ Badan Pusat Statistik, <http://www.voaindonesia.com/content/bps-jumlah-petani-diindonesia-terus-berkurang/1949152.html>.. Accessed on 19-08-2019: 13:42

⁷ definition food security took from.Cambridge dictionary

Table 2. Rate of LUC on Rice Field in the Yogyakarta Province

Year	Rice Field Area (ha)	LUC of Rice Field (ha)	Opening Rice Field Area (ha)	Reduction of Rice Field Area Rate (%)
2006	56.218,00	0,00	0,00	0,00
2007	55.540,00	678,00	0,00	-1,21
2008	55.332,00	208,00	0,00	-0,37
2009	55.325,00	7,00	0,00	-0,01
2010	55.523,00	0,00	198,00	0,36
2011	55.291,00	232,00	0,00	-0,42
2012	55.110,00	181,00	0,00	-0,33
2013	55.336,00	0,00	226,00	0,41
2014	54.417,00	919,00	0,00	-1,66
2015	53.553,00	864,00	0,00	-1,59
Total	551.645,00	3.089,00	424,00	-4,82
Rate	55.164,50	308,90	42,40	-0,48

Source: BPS 2016

The table 2 describes that rice field area have fluctuation year to year. LUC of rice field area has decreased 3.089 ha in period 2006 to 2015. Although in 2010 and 2013, there are opening rice field area, but it is not enough to cover up of LUC. Remember that opening opening rice field area wasn't taken from settlement, but the other land use such as forest, field, and plantation land.

Lost of rice production data shows bellow in table 3:

Table 3. The Impact of LUC of Rice Field on The Lose of Rice Production (2006-2015)

Year	Productivity (ton/ha)	LUC of Rice Field area (ha)	Lost of Rice Production (ton)
2006	5,35	0,00	0,00
2007	5,82	678,00	3.948,03
2008	5,69	208,00	1.184,53
2009	6,27	7,00	43,90
2010	6,05	0,00	0,00
2011	6,05	232,00	1.403,80
2012	6,74	181,00	1.220,70
2013	5,79	0,00	0,00
2014	5,79	919,00	5.318,26
2015	6,06	864,00	5.240,04
Total	59,62	3.089,00	18.359,27
Rate	5,96	308,90	1.835,93

Source: BPS, 2016

Rice production in Yogyakarta is decline along 2006 until 2015. If table 2 is compared with table 3, there are linkages each other. When The opening area of Rice field happen, there were not lost of rice production. It can be resumed that LUC of rice field annoying rice production.

Malthus has warned 200 year ago that people have to preserved their land for agricultural.

“Let us now take any spot of earth, this Island for instance, and see in what ratio the subsistence it affords can be supposed to increase. We will begin with it under its present state of cultivation.

If I allow that by the best possible policy, by breaking up more land and by great encouragements to agriculture, the produce of this Island may be doubled in the first twenty-five years, I think it will be allowing as much as any person can well demand.

In the next twenty-five years, it is impossible to suppose that the produce could be quadrupled. It would be contrary to all our knowledge of the qualities of land. The very utmost that we can conceive, is, that the increase in the second twenty-five years might equal the present produce.

Let us then take this for our rule, though certainly far beyond the truth, and allow that, by great exertion, the whole produce of the Island might be increased every twenty-five years, by a quantity of subsistence equal to what it at present produces. The most enthusiastic speculator cannot suppose a greater increase than this. In a few centuries it would make every acre of land in the Island like a garden. Yet this ratio of increase is evidently arithmetical. It may be fairly said, therefore, that the means of subsistence increase in an arithmetical ratio”.(Malthus, 1798)

We must concern about Malthus’s warning, population will always tend to outrun the growth of production, thus the increase of population must be controled for food security. The increase of population causes LUC, and LUC causes decrease of production (food).

Table 4 shows the projection of population in Indonesia 2010-2035. “The Result of projection show that the Indonesia’s population next twenty five years are increasing from 238.5 million in 2010 to 305.6 million in 2035”.(BAPPENAS-BPS-UNFPA 2013)

Table 4. The Projection of Population in Indonesia 2010-2035

No	Province	Year					
		2010	2015	2020	2025	2030	2035
1	Aceh	4 523,1	5 002,0	5 459,9	5 870,0	6 227,6	6 541,4
2	Sumatera Utara	13 028,7	13 937,8	14 703,5	15 311,2	15 763,7	16 073,4
3	Sumatera Barat	4 865,3	5 196,3	5 498,8	5 757,8	5 968,3	6 130,4
4	Riau	5 574,9	6 344,4	7 128,3	7 898,5	8 643,3	9 363,0
5	Jambi	3 107,6	3 402,1	3 677,9	3 926,6	4 142,3	4 322,9
6	Sumatera Selatan	7 481,6	8 052,3	8 567,9	9 000,4	9 345,2	9 610,7
7	Bengkulu	1 722,1	1 874,9	2 019,8	2 150,5	2 264,3	2 360,6

8	Lampung	7 634,0	8 117,3	8 521,2	8 824,6	9 026,2	9 136,1
9	Kep. Bangka Belitung	1 230,2	1 372,8	1 517,6	1 657,5	1 788,9	1 911,0
10	Kepulauan Riau	1 692,8	1 973,0	2 242,2	2 501,5	2 768,5	3 050,5
	Pulau Sumatera	50 860,3	55 272,9	59 337,1	62 898,6	65 938,3	68 500,0
11	DKI Jakarta	9 640,4	10 177,9	10 645,0	11 034,0	11 310,0	11 459,6
12	Jawa Barat	43 227,1	46 709,6	49 935,7	52 785,7	55 193,8	57 137,3
13	Jawa Tengah	32 443,9	33 774,1	34 940,1	35 958,6	36 751,7	37 219,4
14	DI Yogyakarta	3 467,5	3 679,2	3 882,3	4 064,6	4 220,2	4 348,5
15	Jawa Timur	37 565,8	38 847,6	39 886,3	40 646,1	41 077,3	41 127,7
16	Banten	10 688,6	11 955,2	13 160,5	14 249,0	15 201,8	16 033,1
	Pulau Jawa	137 033,3	145 143,6	152 449,9	158 738,0	163 754,8	167 325,6
17	Bali	3 907,4	4 152,8	4 380,8	4 586,0	4 765,4	4 912,4
18	N T B	4 516,1	4 835,6	5 125,6	5 375,6	5 583,8	5 754,2
19	N T T	4 706,2	5 120,1	5 541,4	5 970,8	6 402,2	6 829,1
	Bali dan Kep. Nusa Tenggara	13 129,7	14 108,5	15 047,8	15 932,4	16 751,4	17 495,7
20	Kalimantan Barat	4 411,4	4 789,6	5 134,8	5 432,6	5 679,2	5 878,1
21	Kalimantan Tengah	2 220,8	2 495,0	2 769,2	3 031,0	3 273,6	3 494,5
23	Kalimantan Selatan	3 642,6	3 989,8	4 304,0	4 578,3	4 814,2	5 016,3
24	Kalimantan Timur	3 576,1	4 068,6	4 561,7	5 040,7	5 497,0	5 929,2
	Pulau Kalimantan	13 850,9	15 343,0	16 769,7	18 082,6	19 264,0	20 318,1
25	Sulawesi Utara	2 277,7	2 412,1	2 528,8	2 624,3	2 696,1	2 743,7
26	Sulawesi Tengah	2 646,0	2 876,7	3 097,0	3 299,5	3 480,6	3 640,8
27	Sulawesi Selatan	8 060,4	8 520,3	8 928,0	9 265,5	9 521,7	9 696,0
28	Sulawesi Tenggara	2 243,6	2 499,5	2 755,6	3 003,0	3 237,7	3 458,1
29	Gorontalo	1 044,8	1 133,2	1 219,6	1 299,7	1 370,2	1 430,1
30	Sulawesi Barat	1 164,6	1 282,2	1 405,0	1 527,8	1 647,2	1 763,3
	Pulau Sulawesi	17 437,1	18 724,0	19 934,0	21 019,8	21 953,5	22 732,0
31	Maluku	1 541,9	1 686,5	1 831,9	1 972,7	2 104,2	2 227,8
32	Maluku Utara	1 043,3	1 162,3	1 278,8	1 391,0	1 499,4	1 603,6
	Kep. Maluku	2 585,2	2 848,8	3 110,7	3 363,7	3 603,6	3 831,4
33	Papua Barat	765,3	871,5	981,8	1 092,2	1 200,1	1 305,0
34	Papua	2 857,0	3 149,4	3 435,4	3 701,7	3 939,4	4 144,6
	Pulau Papua	3 622,3	4 020,9	4 417,2	4 793,9	5 139,5	5 449,6
	Indonesia	238 518,8	255 461,7	271 066,4	284 829,0	296 405,1	305 652,4

Source:(BAPPENAS-BPS-UNFPA, 2013)

The problem is land has not increase but the population has increase, whereas increasing of population need more production.

D. Conclusion

1. The Government should be prevent LUC, especially from agricultural land to non-agricultural land. Therefore The Government should be inforce Government Regulation Number (No). 1 of 2011 on Regulation of the Impementation of Law No. 41 of 2009. The purpose of The Government Regulation are:
 - a. To guarantee the reserved sustainable agricultural land;
 - b. To control sustainable of LUC of agricultural;
 - c. To establish independence, sustainability, and sovereignty National food;
 - d. To increase empowerment, revenue, and prosperity for peasant;
 - e. To assurance farming business;
 - f. To establish equilibrium of the ecology;
 - g. To prevent redundant the investment of agricultural infrastructure.

Although this Government Regulation is enough to prevent LUC, but in fact until now LUC from agricultural land to non-agriclultural land always occur. So The Government must be firm about implementation of this Government Regulation.
2. When the Developers want build settlement, they must be build with layers building. for exampes developer has 5 parcels of land and building, land ownership and the building was made into the one area of land with a building field 5 layers. Like *spekkoek*⁸ that has many layers. so the settlement does not require huge lands.
3. The Government must drum up Familiy Plan⁹ programs again. The purpose of the Family Plan Program in Indonesia was limited the maximum a family only had two children.

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⁸ Cake from Netherland

⁹ In Indonesia known with KB (Keluarga Berencana), this program was implemented 1980 till 1995. But up to 1995 this program was not actived.

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