The Effect of Land Conversion on Agricultural Production in North Kalimantan Province during 2012-2016 Period

R Harini*, R D Ariani, Supriyati, M C Satriagasa, B Susilo and S R Giyarsih

Faculty of Geography, Universitas Gadjah Mada, Sekip Utara, Bulaksumur, Sinduadi, Sleman, Yogyakarta 55281, Indonesia

*rikaharini@ugm.ac.id

Abstract. Need of land that increases with the increase of population and social-economic activities which is not balanced with the availability of land will lead to decrease of agricultural land area and production in an area, and North Kalimantan Province is no exception. The objectives of this study were a) to identify agricultural land conversion, b) to examine agricultural production trend, and c) to analyze effects of land conversion on agricultural production in this particular area. Agricultural land conversion was analyzed using geographic information system. Agricultural production was examined using table of frequencies as presented both in graphic and map forms. The effects of land conversion on agricultural production was analyzed using linear regression. The study results suggest that there was an increase in agricultural land conversion in in North Kalimantan (the rate was 0.04 and the total areas was 32,424 Ha). The analyses by regencies indicate increases in the agricultural land area in Bulungan, Nunukan, and Tana Tidung regencies, while on the contrary a decrease was found in Malinau regency. The agricultural production rate was 0.04. The regression analysis shows a relationship between land conversion and agricultural production in North Kalimantan.

1. Introduction
Population increase is in line with need of land for development, while the land area does not increase. To meet the need for land there are changes in the use of land or land conversions. Since the value of agricultural land is considered lower than that of non-agricultural land, agricultural land will be converted into non-agricultural land to increase its value [1]. Agricultural land conversion will have impacts on different aspects, including economic aspects for which land conversion will lessen agricultural productions.

Agricultural sector contributes to less than 2 percent of the average income of developed countries and about 2.9 percent in countries in the world as a whole. Nevertheless, agricultural sector plays a critical role in human life [2]. As an agricultural country, agricultural sector in Indonesia becomes the main livelihood of its people (more than 50 percent). However, there is currently land conversion of 100,000 hectares per annum and this could only be balanced with opening of agricultural land of 40,000 hectares per annum by the government [3]. The year 2015 data of the Department of Agriculture indicate that the growth of agricultural land in Indonesia was -0.17 percent. This means that the agricultural area in Indonesia lessens due to the increasing conversion of agricultural lands into non-agricultural lands. Agricultural land conversion does not only occur in Java but in other islands as well, including Sumatra, Bali, Nusa Tenggara, Sulawesi, and Kalimantan. The agricultural
land area in North Kalimantan Province in 2009 was 26,582 hectares but in 2014 it decreased to 21,775 hectares. This suggests that agricultural land in North Kalimantan has been decreasing.

Population growth is a contributing factor of agricultural land conversion. The Statistical Bureau data shows that the population of North Kalimantan Province in 2009 was 509,446, while in 2014 it became 618,208 [4] with population growth of 3.9 percent per annum. This data indicate that the population has been increasing with year, while the agricultural land increasing.

Of major problems resulting from agricultural land conversion is agricultural production decrease. Population increase will lead to increase in the consumption value of agricultural products. However, with such increasing agricultural land conversion will the agricultural production be able to satisfy people’s consumption needs? The study result shows positive relationship between population, land conversion, and agricultural production. This indicates that agricultural land conversion has impacts on agricultural production [5].

The lessening agricultural land area will lead to food production decrease, and if food production keeps decreasing, it may jeopardize the national food security. This has made Indonesia import food products to fulfill its domestic needs [6]. The government has made various efforts to lessen agricultural land conversion rate, including by issuing Law No. 41 of 2009 regarding protection of food crop agricultural land sustainability. However, while the government has enacted a regulation concerning protection to agricultural land sustainability, agricultural land conversions do not cease.

In 2015 the rice production of North Kalimantan Province was 112,100 tons (dried milled grain). This volume decreased by 3,520 tons or around 3.04 percent in 2014 [4]. This volume cannot fulfill the need of North Kalimantan Province’s people, and to suffice the need the rice had to be sent from Java areas. The agricultural production decrease is presumably caused by the agricultural land decrease.

2. Methods
The data used as the basis for this present study were secondary data. Data of land use of the 2012-2016 period were used to examine land conversion supported by land use data gathered from data analysis using geographic information system. The (rice) agricultural production analysis were based on Statistical Bureau’s data. The effect of agricultural land conversion was examined using regression analysis in which agricultural land areas was the dependent variable and the (rice) production volume was the independent variable.

3. Results and discussion

3.1. Agricultural land conversion
The reference [6] explains that, empirically speaking, (rice) agricultural land is most susceptible to conversion, because agricultural land ownership is much higher than dry land. From economic aspect perspective, agricultural land conversion will reduce agricultural production.

North Kalimantan is a province located in border area where land use is dominated by huge forest area covering 90.60 percent of its total area, and the total agricultural area is 1.55 percent of its total area [7]. With the local development in such border area and to support local food security, agricultural land area increases with agricultural land opening. The pattern of land conversion in North Kalimantan Province in time series can be seen in Table 1.

| Regencies | Rice Agricultural Area (Ha) |
|-----------|----------------------------|
|           | 2012 | 2013 | 2014 | 2015 | 2016 |
| Bulungan  | 10881| 17631| 17631| 17631| 17631|
| Malinau   | 10302| 7639 | 7639 | 4469 | 4469 |
| Nunukan   | 4949 | 4949 | 8898 | 6428 | 6428 |
| Tana Tidung | 610  | 610  | 4735 | 3861 | 3861 |
| Tarakan   | 35   | 35   | 35   | 35   | 35   |
It can be seen from Table 1 that an increase in land area from 2012 to 2016 occurred in Bulungan, Nunukan, and Tana Tindung regencies, while the conversion from agricultural land to non-agricultural land in Malinau regency lead to decrease in its total agricultural land area. In Tarakan regency the agricultural area was stagnant because this particular regency is the city center of North Kalimantan.

This study was emphasized on rice agricultural land conversion. Land area conversion rate in North Kalimantan Province was 0.04. This indicates that generally speaking the (rice) agricultural area increased. Land conversion occurs more often in strategic areas (city center) and main corridor. This is due to infrastructures and facilities developments in urban areas and those areas passed by main corridor (See Figure 1).

![Figure 1. Map of Land Use in North Kalimantan](image)

The map of land use in Figure 1 shows that most land uses in Kalimantan are in form of forests or plantations which include 88 percent of its total area, while rice agricultural lands or moors are distributed in several areas and include 1 percent of its total area. The widest agricultural land area was in Bulungan 37%, followed by Malinau 26%, Nunukan 25%, Tana Tidung 10%, and Kota Tarakan 1%.

### 3.2. Agricultural production

Agricultural production is an agricultural activity during certain time and measured in kg/quintal/ton. In general, agricultural production is influenced by various factors, including nature, labour, capital, and management (See Figure 2) [8].
In general rice agricultural production in North Kalimantan has been decreasing. The (rice) agricultural production in 2016 was 11,2102 or decreased by 25,468 tons (0.04%) from that of 2012. This agricultural production decrease was due to decrease 16,80 quintals/hectare (decreased by 32,70 percent) in productivity despite the increase of 5,647 hectares (0.04 percent) in the agricultural land area.

The greatest decrease in the agricultural production occurred in Bulungan regency although its production is the highest compared to the other four regencies in North Kalimantan. This was supported by the 50,000 hectares integrated agricultural area in Bulungan regency (Delta Kayan Food Estate).

Tarakan city has the lowest rice agricultural production because according to RTRW Tarakan City is not to be used as agricultural area but as economic development area. In the RTRW, agricultural area cannot be found in Tarakan City because its agricultural area is part of housing area with low density. Rice agricultural production in Tana Tindung regency has almost no potential in food crop (cereals) sector and has greater potential in plantation.

3.3. Land conversion and agricultural production
Based on the above description, the agricultural land area and agricultural production in North Kalimantan Province change fluctuatively where the agricultural land area increased while the agricultural production decreased. The effect of agricultural land conversion on agricultural production will be examined using linear regression analysis.

The calculation results indicate a significant influence (with significance value of .04) of agricultural land area decrease on agricultural production. With such significance value, agricultural land area is a factor that influences agricultural production. However, factors that influence production are not limited to land area but also other factors, including land management, capital, technology, land fertility, land suitability, climate, seeds, irrigation, and fertilization. Another study shows the influence of climate change on agricultural production in Yogyakarta Special Province where more than 70 percent of cereals commodity is affected by climate change and suffers agricultural production decrease [9]. Still another study in Yogyakarta Special Province shows that not all areas are suitable for agriculture where land is tried to be suitable for food crop agriculture (rice, corn, cassava, sweet potato). This particular study found that Ledok Wonosari, Lereng Tengah Merapi, Lereng Bawah Merapi, and Batur Agung have lands suitable for agriculture [10-13].

4. Conclusions
Agricultural land conversions in North Kalimantan Province progressively take place in development areas (city center, strategic areas, and main corridor). The increasing cases of agricultural land conversions occur because agricultural sector is not the leading sector in North Kalimantan Province. However, given the existing potentials, agriculture is feasible to be devolved by increasing the agricultural land area. The agricultural production shows a decreasing tendency. The regression
analysis result indicates that agricultural production is significantly affected by agricultural land area. However, land area is not the only factor that influences agricultural productions. Other factors assert their influence as well, included land management, capital, technology, land fertility, land suitability, climate, seeds, irrigation, and fertilization. So, there is a need to control agricultural land conversion.

Acknowledgments
The authors would like to express gratitude Ministry of Research and Technology of Higher Education (Kemenristekdikti) and the Institute for Research and Community Service (Lembaga Penelitian dan Pengabdian Kepada Masyarakat) (LPPM) of Universitas Gadjah Mada (UGM) for providing financial support through the Grant of Decentralization of Excellence Research of Higher Education (Penelitian Unggulan Perguruan Tinggi) (PUPT).

References
[1] Dewi, N Kumala and I Rudiarto 2013 Identifikasi Alih Fungsi Lahan Pertanian dan Kondisi Sosial Ekonomi Masyarakat Daerah Pinggiran di Kecamatan Gunungpati Kota Semarang Jurnal Wilayah dan Lingkungan 1 175-188
[2] F Ackerman dan E A Stanton 2013 Climate Impacts on Agriculture: A Challenge to Complacency? (Medford, USA: Tufts University)
[3] R Kadir 2015 Sensus Pertanian 2013 Kompasiana: http://www.kompasiana.com/kadirsaja/sensus-pertanian-2013_5513f6c5a333115b70ba800a
[4] Badan Pusat Statistik Provinsi Kalimantan Timur 2010 Kalimantan Timur Dalam Angka Tahun 2010 (Kalimantan Timur: Badan Pusat Statistik)
[5] Syaifuddin, H Arby and Dahlan 2013 Hubungan Antara Jumlah Penduduk dengan Alih Fungsi Lahan di Kecamatan Somba Opu Kabupaten Gowa Jurnal Agrisistem 9 2
[6] Pemerintah Provinsi Kalimantan Utara 2016 RPJMD Provinsi Kalimantan Utara Tahun 2016-2021
[7] Sumaryanto and Iqbal.- Konversi Lahan Sawah ke Penggunaan on Pertanian dan Dampak Negatifnya http://balittabh.litbang.deptan.go.id
[8] Harini, Rika and B Susilo 2017 Kajian Spasial Perubahan Iklim Terhadap Produksi Pertanian Jurnal Agribisnis dan Pembangunan Pertanian 1 1 14-20
[9] R Harini and E Nurjani 2014 Pemanfaatan Sistem Informasi Geografi Dalam Mengkaji Dampak perubahan Iklim Terhadap produksi dan produktivitas pertanian DIY Proceeding Seminar Nasional 15 November 2014 Sekolah Vokasi Universitas Gadjah Mada
[10] Harini, Rika, B Susilo and N Emilia 2015 Geographic Information System Based Spatial analysis of agricultural Land suitability in Yogyakarta Indonesian Journal of Geography 42 2
[11] A Goudie 1994 The Human Impact on the Environment (Cambridge: The MIT Press)
[12] A Rahmat and A Mutolib 2016 Comparison air temperature under global climate change issue in Gifu city and Ogaki city, Japan. Indonesian journal of science and technology. 1 1 37-46.
[13] Republik Indonesia 2009. Undang-Undang No 41 Tahun 2009 Tentang Perlindungan Lahan Pertanian Pangan Berkelanjutan. Lembaran Negara RI No 41 Tahun 2009, Sekretariat Negara, Jakarta