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PRAKATA

Buletin ini memuat makalah hasil penelitian primer ataupun *review* yang berkaitan dengan sumberdaya iklim dan air. Makalah yang disajikan sudah melalui tahap seleksi dan telah dikoreksi Tim Redaksi, baik dari segi isi, bahasa, maupun penyajiannya. Pada edisi ini terdapat lima makalah, yang disajikan dalam bahasa Indonesia.

Untuk memperlancar penerbitan tahun-tahun berikutnya, artikel yang dimuat tidak perlu terikat secara kronologis oleh penyajian makalah atau acara seminar, tetapi lebih ditentukan oleh ketanggapan penulis dan kelayakan ilmiah tulisan.

Redaksi mengucapkan terimakasih kepada semua pihak yang telah membantu memperlancar proses penerbitan. Semoga media ini bermanfaat bagi khalayak. Kritik dan saran dari pembaca selalu kami nantikan.

Redaksi

CARA MERUJUK YANG BENAR

Hervani A. 2020. Climate Change and Agriculture sector in Indonesia: Impacts and adaptation options to 2100. Buletin Hasil Penelitian Agroklimat dan Hidrologi. 17 : 3-10.

Tulisan yang dimuat adalah hasil penelitian primer maupun review yang berkaitan dengan sumberdaya iklim dan air, dan belum pernah dipublikasikan pada media cetak mana pun. Tulisan hendaknya mengikuti Pedoman Bagi Penulis (lihat halaman sampul dalam). Redaksi berhak menyunting makalah tanpa mengubah isi dan makna tulisan atau menolak penerbitan suatu makalah.

CLIMATE CHANGE AND AGRICULTURE SECTOR IN INDONESIA: IMPACTS AND ADAPTATION OPTIONS TO 2100

Anggri Hervani

INTRODUCTION

The agricultural sector in the period 2014-2015 managed to increase rice production from 70.85 million tons of dried milled grain in 2014 to 75.36 million tons in 2015 or increase at a rate of 6.37 % per annum (Statistic, 2017) . Success in increasing national rice production is making Indonesia was again self-sufficient in rice since 2008. In the same period, corn and soybean production also increased at a rate of 3.17% and 0.85% per annum (Statistic, 2017) .

Behind that success, the future agricultural development is facing various obstacles and biophysical problems, among them climate change caused by global warming due to increasing greenhouse gas (GHG) emissions. This has an impact on physical changes system and biological environments such as increased intensity of tropical storms, changes in precipitation patterns, the salinity of seawater, changes in wind patterns, periods animal and plant reproduction, species distribution and population size, and frequency of pests of plant diseases. Indonesia as a country islands located in the equator is vulnerable to climate change. Some climatic elements that undergo changes include bulk patterns rain, sea levels, air temperatures, and increased incidence of extreme climates which causes floods and droughts. Agriculture is the most sector seriously affected by climate change (Change et al; 2006).

1. Drought

The climate extreme event in Indonesia usually associated with ENSO (El-Nino Southern Oscillation) (Boer and Suharnoto, 2012). Moreover, global warming tends to increase the frequency of El-Nino (Timmermann et al., 1999). Climate change triggered the occurrence of El-Nino which will greatly affect agricultural production in Indonesia. Agriculture in Indonesia is highly dependent on rainfall for production. El Nino events contribute to delay the rainfall. Delay on rainfall until 30 days during dry season in Indonesia (July-September) will decrease the yield up to 75% in 2050 (Naylor, et al. 2007). Drought frequency in the rice fields area has increased three times (Boer, et al. 2009) (Figure 1). In addition, implication of climate change contributes to the increasing 50% of cost productivity and reducing the farmer's income at 25% (Kusumasari, 2016).

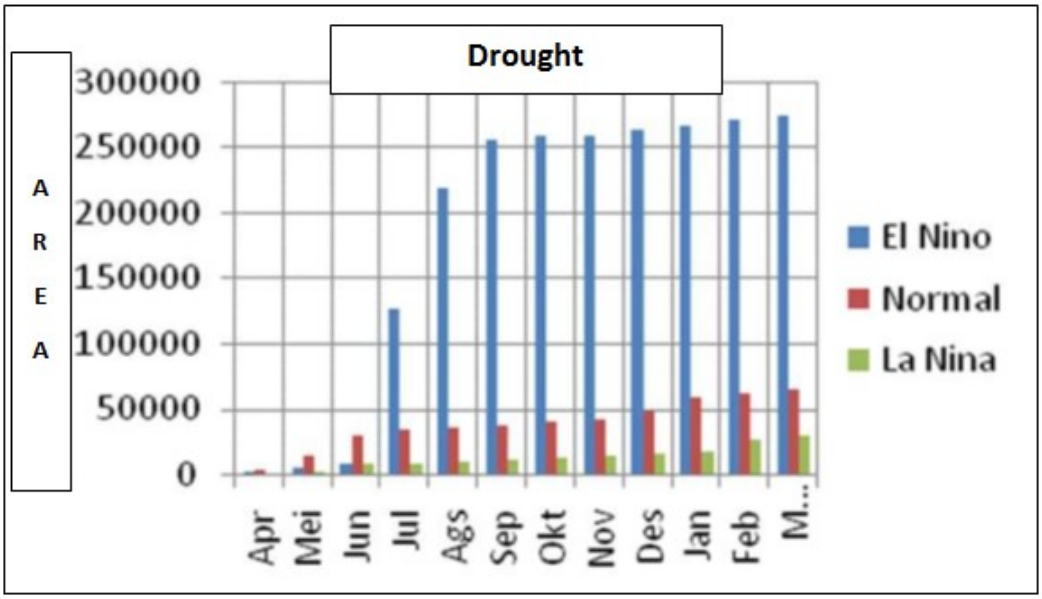

Figure 1. Drought frequency on the rice fields (Boer et al., 2009)

2. Flooded

Increasing flooded impact of climate change contributes to reducing harvested area of rice fields. The frequency of the flooded disaster on rice filed increase in the La-Nina (Boer, et al. 2009) (Figure 2).

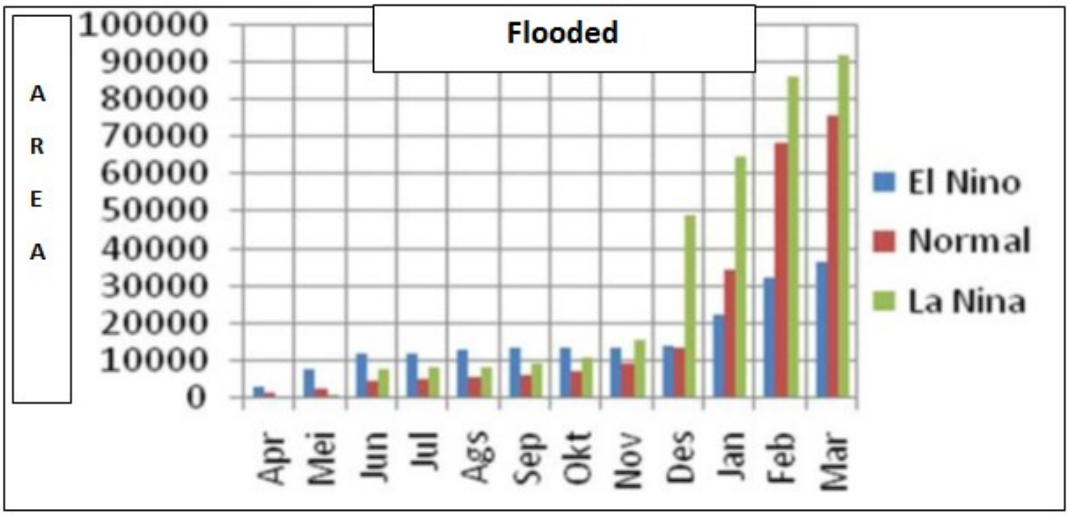

Figure 2. Flooded frequency on the rice fields (Boer et al., 2009)

Adaptation strategies in agriculture sector

Adaptation strategy is an effort to adjust activities and technology with climatic conditions caused by the phenomenon of climate change. Common strategies and policies for countering climate change impacts to agriculture is an adaptation action program in the food crops and horticulture sectors as the main priority in order to increase production and maintain national food security.

Adaptation strategy is divided into two. First is an activity to improve the resilience of production systems food from the impacts of climate change through efforts to improve physical conditions, such as the construction and repair of irrigation networks, the construction of dams and reservoirs. Second is through development of cultivation technology that is more tolerant to climate stress, strengthening institutions and regulations, empowering farmers in utilizing climate information to address and anticipate

events extreme climates are increasing in frequency. Farmers responding to the climate change by changing the planting pattern/crop rotation, technique on soil cultivation, implement the pest management practices and irrigation technique (Kusumasari, 2016).

Adaptation synergized with mitigation action

Climate change talks under the United Nations Framework Conference on Climate Change (UNFCCC) to the Conference of the Parties (COP) 22 in Morocco have yet to come to an agreement on the handling of climate change in the Agricultural Sector. The main problem that hinders agreement is that developed countries promote mitigation, while developing countries incorporated in G77 + China focus on adaptation, while mitigation is only considered an additional benefit of co-benefits. Although developed countries are urging mitigation, the United States as the second largest emitter country has now revoked previously proposed commitments. This shows that each country needs to address and take security measures against the dangers of climate change individually, without expecting assistance from developed countries. This is important because climate change is a necessity that negatively affects Indonesian agriculture. In the face of climate change in the Agricultural Sector, adaptation is a priority, but mitigation needs to be sought as long as it does not affect agricultural production, given that under the Paris Agreement, Indonesia has committed to reducing greenhouse gas (GHG) emissions by 29% under the business as usual scenario (BAU).

Adaptive activities in dealing with climate change synchronized with mitigation activities include application of rice varieties with high productivity, application of animal manure as an energy through the biogas installation and application of organic fertilizer as carbon sequestration. Using low-emission rice varieties is selected based on the high productivity of planted varieties. This is an effort to adapt and also as an effort to mitigate methane emission because each rice variety has different methane emission status (Subadiyasa, et al. 1997). Differences in methane emissions in some rice varieties are also reported in Korea and China (Gutierrez, et al. 2013; Wanga, et al., 2016). The reduction in emissions from biogas utilization is an attempt to exploit the methane produced by livestock as a fuel source, while for mitigation from organic fertilizer management is a sequestration effort of carbon into the soil.

Emissions Projection on agriculture sector from 2000 to 2100

IPCC guidelines were used to calculate the emissions from agriculture sector and linear regression from excel was used to calculate the emission projection. The greenhouse gas emissions status in agriculture sector in Indonesia starts from 2000 as the first year of calculation until 2012 based on the status obtained from report (Ministry of Environment and Forestry Republic of Indonesia 2015). Sources of greenhouse gas emissions from agricultural farms are enteric fermentation, manure management, biomass burning grassland, biomass burning cropland, liming, urea fertilization, direct N_2O soils, Indirect N_2O soils, Direct N_2O from manure, Indirect N_2O from manure and methane from rice. Some programs from the ministry of agriculture to improve agricultural production have an impact on climate change adaptation and have a co-benefit on reducing greenhouse gas emissions from agricultural sector.

The ministry of Agriculture implement the adaptation action, whilst mitigate the emission simultaneously. The action programs are low methane emissions of rice cultivars application but have a high productivity. In addition, in the scope of livestock there is a biogas unit development program and composting units that synergize each other was able to reduce greenhouse gas emissions by decreasing methane production and carbon sequestration.

With three actions practices, low emissions cultivars, development of biogas and organic fertilizer processors was able to reduce greenhouse gas emissions by 11.42 Mt CO2-eq in 2012 reported in the Biennial Update Report (BUR) to The United Nations Framework Convention on Climate Change (UNFCCC). Where the emission status with business as usual (BAU) at 102.71 Mt CO2-eq and after in reducing emissions from mitigation actions, the emission status of agriculture sector in Indonesia in 2012 is 91.31 Mt CO2 -eq (Ministry of Environment and Forestry Republic of Indonesia 2015) (Figure 3). This greenhouse gas mitigation action from the agricultural sector started from 2006 through a scheme of state budget revenue and expenditure without foreign assistance.

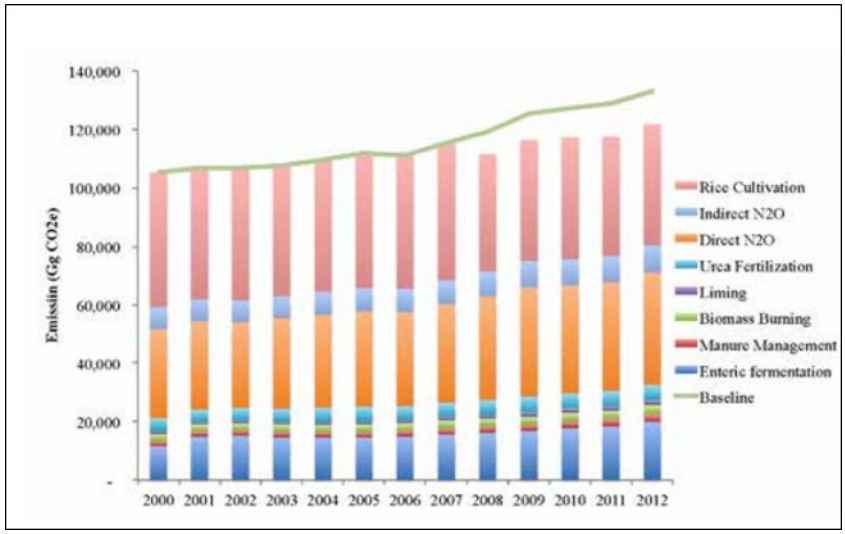

Figure 3. Baseline vs Actual GHG Emissions of Agriculture Sector (Ministry of Environment and Forestry Republic of Indonesia 2015)

The projected GHG emissions from the agricultural sector in Indonesia as BAU reached 264.29 Mt CO2-eq in 2100 and by applying mitigation action there will be an emission reduction of 159.89 Mt CO2-eq resulting in total greenhouse gas emissions contribution from agriculture sector in Indonesia to 104.40 Mt CO2-eq (Figure 4).

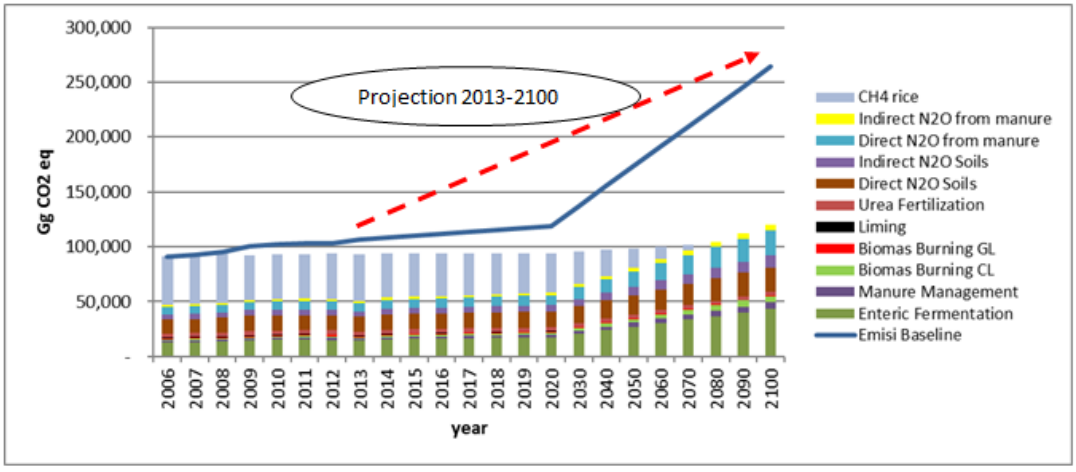

Figure 4. projection of emissions from agriculture sector from 2013 to 2100 in Indonesia

Limitation of the projection measurements

No correction factor for the implementation process of adaptation and mitigation program in the field. Calculations assume that all projects are implemented and accumulate 100% each year. There should be a decrease in the level of application program every year due to damage or other causes in the production unit of biogas and organic fertilizer processing unit.

Activity data in the projection calculation there is no correction factor. The assumptions used in projected emission status after 2013 are linear regressions.

CONCLUSIONS

The agricultural sector in Indonesia is a vulnerable sector affected by climate change because it is still dependent on rain for production. Adaptation measures in the form of development of water reservoirs, improvement of irrigation facilities, application of organic fertilizers and the use of high yielding varieties are expected to be agricultural activities to adapt from climate change. Besides as an adaptation effort, it turns out that the use of selected varieties, the utilization of energy from biogas and the application of organic fertilizer can reduce the greenhouse gas emission of agriculture sector. Status of emissions from the agricultural sector is increasing when referring to business as usual activities without mitigation action.

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