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**Adaptation in the Philippines for Resilient Agriculture**

**William Steimel  
B1778102**

**Coordinator**  
Kensuke Fukushi

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## **Introduction**

There is a clear relationship between higher GDP and having a smaller agricultural population around the world. Countries like the United States and Japan who once were more agro-based have transitioned to non-agro-based service-based economies where farmers no longer make up the majority of the labor force. This labor transition can be argued to be due to economic development and increased GDP which lead to improved efficiency and technological development. According to Robert Mendelsohn and Ariel Dinar, “Most developing countries depend heavily on agriculture; the effects of global warming on productive croplands are likely to threaten both the welfare of the population and the economic development of the countries.” [1] One could look at the previous trend and see another relationship between GDP and an agricultural sectors climate resilience. Nations who have not reached this stage of development with higher agricultural population and less economic resources are not only at risk to climate change but in need of further analysis to ensure widespread impacts are reduced and controlled in the future.

The Philippines is a country with a higher agricultural population comparatively and considered to be at great risk in a variety of sectors for climate change. The goal of this essay is to analyze climate changes’ impact on Agriculture in the Philippines and to discuss methods for adaptation management policy plan creation for an ideal future state of agriculture that contributes to national food security and economic development. As mentioned by the Intergovernmental Panel on Climate Change (IPCC) Climate Change 2014 Synthesis report, “Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.” [2] Effective adaptation measures will be essential for risk management in the Philippines and other developing regions who are still in this state of vulnerability for the realization of an ideal future state of agriculture.

This report will contain five sections including a review on climate changes impact on agriculture and food security, the current state of agriculture in the Philippines, potential climate change impact to the Philippines, a proposed method for adaptation management to promote ideal agriculture in the Philippines, and a conclusion.

## **Agricultural Impacts due to Climate Change**

This section will define the main agricultural impacts faced due to climate change from a global perspective as well as their implications for food security and economic development.

The IPCC’s Technical Summary report details that climate change is projected to cause precipitation change, temperature increases, biodiversity loss, warming/acidifying oceans, and more extreme weather events which all have the potential to have negative impacts on agricultural productivity in vulnerable areas. [3] This can also contribute to positive or negative impacts on crop yield, fisheries, and livestock output which are all considered key areas of agriculture. The above impacts on agriculture have the potential to cascade downwards to other societal dimensions. Food Security defined by the World Food Programme is “the condition in which all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.” [4] A research paper by Cynthia Rosenzweig and Martin L. Parry concluded that developing countries will be disproportionately impacted by climate changes impact on the world food supply. [5] As mentioned previously, many developing countries with lower economic resources often have a higher share of farmers as part of the working population which to some degree indicates a countries dependence on local agriculture for sustenance. Many farmers in agrarian societies also depend on the yield of their crop, fishing, and livestock output for their economic livelihoods. There are risks

related to food security, peace, and economic development in regions that lack resources or have not implemented sufficient adaptation policy around the world. Climate change impacts have the potential to disrupt these vulnerable societies undermining economic development and putting people at risk who have contributed little to our current emissions and climate.

### **The Current State of Agriculture in the Philippines and Challenges**

The next section of this paper reviews the current state of agriculture in the Philippines and analyzes the potential future challenges the nation may face in regard to its agriculture industry. According to the Central Intelligence Agency, the most commonly produced agriculture products in the Philippines include rice, fish, livestock, poultry, bananas, coconut, corn, sugarcane, mangoes, pineapple, and cassava. [6] Another report titled *The State of Philippine Agriculture* by Bernadette Romulo-Puyat, indicates that the Philippines has a total land area of 29.82 million hectares with 41 % of it detected to agriculture and a labor force made up of 27 % farmers. [7]

The food infrastructure and farmers that produce these products for the Philippine population will have a higher likelihood of impact by increased extreme weather events like droughts and floods. The Philippines has already been extremely vulnerable to these types of events in the past and as the trend of extreme weather events continues to increase around the world, the potential for loss also does. An article by Reuters quantified agricultural economic damage from Typhoon Mangkhut in September 2018 to be around 11 to 12 billion pesos (\$ 220 Million). [8] Regional water scarcity due to droughts also have the potential to impact regions dependent on water for their agriculture and sustenance disproportionately impacting the poorer more arid regions. A report by the Philippines government revealed that 413,456 farmers were impacted by droughts in 2015-2016 during El Nino which lead to violent protests. [9] Another global risk cited by the IPCC Climate Change 2014 Synthesis report, was the potential for conflicts due to people's loss in livelihood which will also disproportionately affect those without the adaptation measures necessary to manage food supply and demand. [3] With climate change as an increasing contributor to these extreme weather events it is forecasted that economic damage will further increase also contributing to food insecurity and potential conflict in the Philippines sensitive areas.

Another climate change risk listed in many scientific reports is related to the acidification and warming of oceans leading to decreased biodiversity in oceans around the Philippine sea. An additional figure from the IPCC Synthesis report projects the Philippines as potentially losing up to 21 to 50 % maximum catch potential by 2051-2060. [2] With decreased maximum catch potential, fisherman who depended on this way of life in the region will be at risk along with ordinary people who depend on this other main source of sustenance.

Perhaps the most common climate change risk we are all aware of is the increase in global temperatures that is currently occurring due to human emissions and activity. Depending on the future climate RCP mitigation scenario our world follows in the future, many models predict somewhere in the range of 1 to 6 degrees increase by year 2100. [2] Although it is unknown what the exact impact on yield will be, increases in global temperature can lead to certain crops being pushed over their temperature for growth threshold. One study by John Reilly lists the optimum temperature range of rice and maize crops at 25-30 Celsius with high temperatures having a negative impact on these crops' development. [10] With a projected increase of extreme heat days over 35 degrees, it is possible for important crops like rice and corn to be negatively impacted by high temperatures and water scarcity as well as the health of these farmers who must work in these conditions.

This combination of the above risk factors puts the Philippines as a nation at risk for food insecurity and will exacerbate already short resources. Another Research Study by the

International Food Policy Research Institute based on their climate modeling scenarios revealed that total crop production in the Philippines is estimated to drop 4 % by 2050 with prices of commodities expected to grow. [11] With climate changes potential to leave such a huge impact on the Philippines, the importance of adaptation policy for ideal agriculture cannot be overlooked which the next section will review.

### **Formulation of an Adaptation/Transition Plan**

This next section will review ways to approach formulation of an adaptation plan from the Philippines perspective which contributes to realizing ideal future agricultural conditions.

According to the IPCC Synthesis Report, adaptation is defined as “the process of adjustment to actual or expected climate and its effects.” which can include the utilization of potential benefits of climate change as well as the avoidance of harm. [2] As mentioned above, the Philippines has its own unique challenges due to its geographical location and resource limitations. In addition, each region in the country or even farm has a different potential for impact, which means a very local based approach to adaptation is needed. Public Policy guided by citizen engagement to drive innovative solutions that work for the Philippines local use cases is important for positive outcomes.

Many typical strategies for Agricultural Adaptation from the farmers perspective include shifting of planting dates, switching variety of crops, changing crops, expanding area, expanding irrigation, diversification of land area, or migration. [10] Research by Robert Mendelsohn and Ariel dinar suggests that public policy can be used to assist farmers by monitoring weather to help them adjust cropping patterns, advisement for adaptation to new climates, as well as investment in new technology's like climate resilient crops. [1] Some examples of adaptation measures in the Philippines specific case would be improved monitoring of drought like weather-conditions and communication to farmers to ensure effective farming, local small farmer education about climate change, and utilization of Technology and Information services to promote data driven approaches to agriculture management. Through collaboration with government, farmers can reduce the damage that will potentially be inflicted on their crops in the future. These are all factors of collaboration at a local level that can contribute to greater overall national climate resilience.

Although adaptation will not remove all risk it will greatly reduce some of the pain that will be experienced in the future in comparison to a future without action. It can also be argued that an effective adaptation/transition plan to the post climate change world would be the most important step for any at risk developing nation to realize its optimal agricultural yield. This type of planning at all levels of society promotes an agricultural environment that is sustainable and robust enough to meet future needs of its people.

### **Conclusion**

The Philippines is an interesting case to study regarding adaptation as it is in a transition phase from a development perspective with a comparatively high number of farmers and huge potential for impact due to climate change. Building climate resilience through adaptation will have the greatest net impact on many societal systems including agriculture positively combatting the big threats of food insecurity, conflict, and economic loss that many in the developing world are expected to face. To realize this goal of climate resilience, it is essential for policy makers to conduct analyses with the consultation of local stakeholders, scientific projections of future climate change impact, and an understanding of available adaptation responses to most effectively analyze the cost and benefits of each decision. This decision driven promotion of climate resilient society around the world is a step towards sustainable development and promotes an inclusive global future for all.

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