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South Korea, Climate Volatility

Combatting Food-security Challenges Caused by the Impacts of Climate Change Though Agricultural/Social Policy Adaptations in the Republic of [South] Korea

South Korea (The Republic of Korea) is a democratically governed country comprising the southern part of the Korean Peninsula. Its only direct neighbor is North Korea (The Democratic People's Republic of Korea), with which it shares a heavily militarized border. Though it split from North Korea in 1953 following the Korean War, from 1961-1979 its per-capita income rose 17 times more than that of its northern neighbor (CIA World Factbook). With a population of 51.42 million, South Korea experienced rapid growth in the past fifty years, with a GDP currently of $1.414 trillion (International Monetary Fund), the 11th highest in the world. It is a materially developed country on many metrics, yet food security remains still a pressing issue.

Food security is defined as the availability of nutritionally adequate and safe foods together with the ability to acquire acceptable foods in socially acceptable ways. Food insecurity is the opposite (Anderson, 1990). Food insecurity concerns developed countries as well as developing ones, with research showing that even affluent nations experience it, if to a lesser degree (Turner, 2004). One of the primary factors that will affect food security in the coming years is climate change. This danger will certainly affect South Korea. Starting in the 1970s, its arable land has declined. Consequently, the agricultural sector has experienced a 33% decrease in production while agricultural imports have grown fivefold (Kim et al., 2012). This paper analyzes the potential impact of climate change on South Korea's food security and proposes policy solutions to ameliorate the problem.

South Korea is a primarily mountainous country, and as such the cultivatable area of the country is limited. The country has a total area of 99,990 km^2, which is similar to the size of Kentucky and Ohio (Aquastat), though its population is five times that of Ohio (United States Census Bureau). Only 18% of the country is cultivated, which is similar to the percentage of people in rural areas, 17% (Aquastat). About 6% of the economically active population works in agriculture. These low percentages suggest the issues South Korea already has in supplying its own food. Consequently, much of the its food is imported. Currently, South Korea is the eighth-largest agricultural importer in the world (USDA, Foreign Agricultural Service).

South Korea's family structure is based on Confucian principles, with extended families often living together. Ramirez and Rubio point to the hierarchy and bureaucracy emphasized in Confucianism as profound factors in South Korea's economic development (Ramirez and Rubio 2010). Given the pressure to perform well in school (Cultural Atlas). Furthermore, the younger generation is growing increasingly individualistic as technology enables Westernization and cross-cultural contact.

The typical family acquires their food from grocery stores and does most of their cooking at home. Yet eating out has also increased dramatically in the past 15 years as more women join the workforce (Kim, 2018). Additionally, consumption of imported foods is growing as diets become more globalized. In 2017 for the first time, the percentage of processed foods in the Korean diet rose above that of fresh foods. This trend indicates a growing nutritional imbalance which has led to increases in dietary diseases like diabetes. Some 98% of the country has access to pure drinking water, with rural areas faring 12% worse than urban ones (Aquastat), so drinking-water availability is not currently a serious issue. Recently, the Korean diet has been investigated for its potential health benefits. Compared with a typical U.S. diet,

Korean food includes a much higher percentage of fermented items and a great deal of boiling versus baking and frying (Kim et al., 2016). Cooked rice and kimchi (salted and fermented vegetables) are staples.

Food-supply management has been a significant area of concern for the South Korean state since its early efforts to industrialize following the Korean War, even though the country has been one of the most economically successful post-colonial states. Since the 1950s South Korea has been dependent on food imports. Food-import management has been a significant focus of state-led development. Food-security and economic-development policies are clearly interconnected (Timmer, 2005). South Korea's dependence on food imports has received little attention in the literature on South Korea's development since the early 1980s. As Timmer argues (2005), the mainstream assumption is that food security ceases to be a problem once a country becomes sufficiently wealthy. Nevertheless, food remains central to economic development since it provides the nutrition on which industrialization depends (Friedmann and McMichael, 1987; McMichael, 2009b; McMichael, 2013). Food insecurity, though potentially not as visible in developed countries, can still be an issue, and problems such as climate change will exacerbate the harm it causes.

Climate change has and will continue to have large effects on the productivity of agriculture and on food security. The average temperature of the earth has risen 1.5°C over the past 100 years. The UN Intergovernmental Panel on Climate Change (IPCC) provides substantial scientific evidence supporting this conclusion in its Fifth Report on Climate Change (2014). These impacts are increasing the risk to food supplies at both the global and the local level. Temperature rise has brought us global warming along with new noxious insects. Both together cause serious crop damage. Rice crops have the highest self-sufficiency in South Korea. Still, affected districts have been devastated by blight, a viral disease, with the damaged area almost 14,137ha, or 34,933 acres (South Korean Rural Development Administration, 2008).

As a result of climate change, agricultural cultivation areas have extended northward, and the damage caused by blight and harmful insects during the winter has increased. This phenomenon has brought about a decrease in agricultural productivity (Kim, 2016). The current global food supply is now confronted by the challenges of climate change, world population growth, the economic development of emerging countries, and increased demand for bioenergy sources.

The fundamental driver of global agflation ("rising food prices caused by increased demand for agricultural commodities" as defined by Google) in 2008, the global grain price rise in 2010, and increased cabbage prices in South Korea were all caused by climate-based abnormal weather, e.g., droughts, floods, and heavy rainfall (Kim et al., 2016). *The Global Risks 2014* report by the World Economic Forum includes both failed climate-change mitigation and adaptation and food crises among their top ten global risks (World Economic Forum, 2014). In addition, the FAO, the OECD (Organization for Economic Co-operation and Development), and the World Bank all understand the need to address the important issue of climate change and food security.

Securing a stable food supply is thus an existential challenge for all countries as the threat of serious climate change increases. Within a nation, an adequate food supply must be maintained to cope with instances of food shortages or any sharp rise in food prices. Climate change is expected to continue for a considerable period during which time unusual weather phenomena will become both more frequent and more intense.

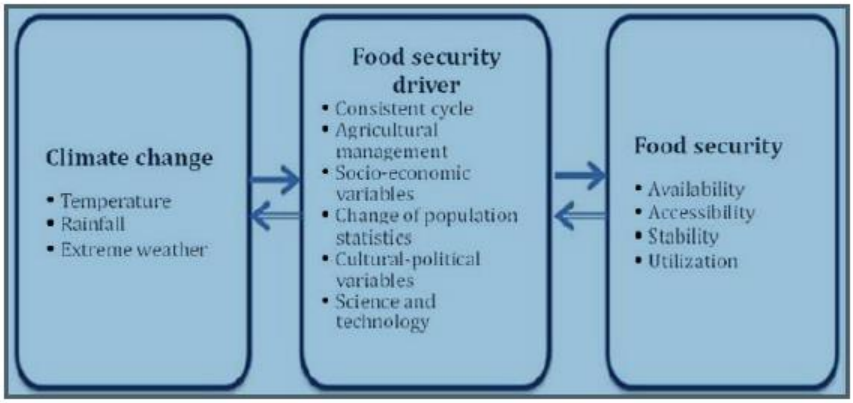
The direct impact of climate change on the food supply is on South Korea's agriculture, while the indirect impact is on the food production by overseas crop producers. Climate change may increase temperatures and the crops that can be grown, with a mostly negative effect because of the reduction in usable water and a shortening of growth periods caused by increased temperatures. The result will be lower crop yields and quality. There will also be a lowering of fruition owing to poor pollination brought about by high

temperatures, increasing rice and salt damage, and disturbances to the agricultural ecosystem from revitalized diseases and pests (Kim, 2016).

According to the World Bank, one of the main threats to South Korea from climate change is an increase in extreme storms (World Bank). The country already experiences frequent typhoons, cyclones, and periods of intense rainfall. Climate change will only exacerbate these issues. Storms and flooding can easily destroy crops, leaving South Korea vulnerable to this threat.

Climate change will also impact the major crops that Korea currently imports. Low-latitude regions will have negative impacts from increased crop stress caused by reduced water availability, lower crop yields, and lower crop quality owing to temperature increases. Negative impacts will also stem from ecosystems disturbed by the increased occurrence of diseases and pests, restricted water for agriculture from water shortages, and submerged agricultural land in coastal areas caused by rising sea levels. The graph below shows the linkages between climate change and food security (Figure 1). The cycle and management of the biophysical system are affected both directly and indirectly by climate, which impacts socio-economic variables, variables of population statistics, and cultural-political variables.

Fig. 1. Connection between climate change and food security



Source: Ziervogel and Ericksen (2010), p.528.

The results of climate change also influence the four main factors of food security: availability, accessibility, stability, and utilization. Food accessibility may be affected by extreme weather, e.g., droughts and floods. Heat stress may destroy infrastructure, including roads. The latter may also be damaged by frequent flooding, which in turn may affect food distribution. Food utilization may be affected by climate change, depending on the types or volume of usable food. All the above may bring about far-reaching changes in terms of nutrition.

In the context of South Korea, climate change clearly impacts food security both directly and indirectly. Directly, climate change impacts the availability of domestically produced food. Climate change also affects the ability of the countries which South Korea imports food from to grow crops. Indirectly, climate change can impact the transport of food, the health of populations that produce food, and the political stability of the regions which produce food for the country. Thus, countermeasures are needed to address both climate change and the specific threat of food insecurity caused by climate change (Kim, 2016).

Policy Changes to Combat Climate Change

Further policy changes that could help secure South Korea against the threat of climate-change-caused food insecurity include improving access to information for policymakers and increasing technological adaptation research and implementation. Key tasks for improving the capacity for policy countermeasures

include refining and further using the climate-change impact-analysis models, expanding investment in research and development, building a system for vulnerability assessment, strengthening education and training, and creating climate-change adaptation centers. It is necessary in these regards to develop and use a reliable impact-analysis model that can be linked to policy formulation and adjustment to meet the needs of policymakers, giving them reliable scientific information to help them handle food issues. Policymakers need accurate identification of food supply-and-demand to prepare for a weather-caused food crisis. They also need a model that can assess the damaged areas and reduced per-unit yields when abnormal weather occurs, maximize the use of domestic farmlands through optimal cropping systems including double cropping, and estimate the demand for the grains needed based on changing population.

There is a need to invest in established mid- and long-term R&D plans to deal with the changing climate. R&D will continue to highlight the impact of climate change and predict the state of future agricultural ecosystems and changes in food productivity. Technology should be developed based on studies exploring how to build a framework to deal with climate-change impacts, a climate-change monitoring system, vulnerability assessments, and prediction technology to enable all the above. The outcome of technology development should be linked to policy programs. Predictions of the frequency and intensity of abnormal weather occurrences, an early-warning system for predicting agricultural weather changes, managing agricultural water and disease, and creating disaster-resistant varieties of crops are crucial for building a stable food supply.

The ideal operation of a stable food-supply system adapted to climate change should be improved based on findings from studies, reflect farmers' needs, and provide a provisional Center for Climate Change Adaptation in Agriculture to facilitate the establishment and assessment of necessary policies in a comprehensive way. The center should run studies and policy program development that links the impacts of climate change with various policies developed and assessed by both the central government and local governments. The center would be responsible for assessing future policies by analyzing the impacts of climate change for each field and item, designing a roadmap for each step of adaptation and mitigation, and suggesting climate-change adaptations in each region based on a vulnerability assessment. The South Korean Ministry of Agriculture, Food and Rural Affairs (MAFRA) should take the lead in effectively promoting climate-change adaptation policies in agriculture and in implementing ideal role-sharing among research institutions, involved organizations, and farmers.

Conclusion

Climate change is predicted to continue having a significant impact on agriculture, in South Korea and elsewhere. The global situation, insofar as it concerns food supply and demand, is already volatile. Food supply is not keeping pace with growing demand. South Korea increasingly depends on food imports, placing it in a vulnerable situation. According to the IPCC Fifth Climate Change Assessment Report, major food-crop production, including wheat, rice, and maize, will be notably reduced beginning in 2030.

South Korea already has urgent food issues stemming from climate change. They occur from the increasing frequency and intensity of uncooperative weather, the need to shift crop-cultivation limits further north, heavy snowfall in winter, abnormally low temperatures and hail in the spring, a lack of sunshine in the summer, stronger typhoons and heavier rainfall, drought, and the more frequent occurrence of diseases and pests. If special action is not taken to increase food production by adapting domestic natural resources to combat the effects of climate change, a significant reduction of yields will be unavoidable.

In summary, the changing circumstances, both globally and in South Korea, regarding food security in the context of climate change require a useful escalation of sensible and responsive political action. South Korea is situated in a region where climate change already negatively impacts agriculture. Thus, it is important to establish a special adaptation scheme for improving food security. A stable supply of food in a post-climate-change world will necessitate that step-by-step positive actions to control national risks be

taken. It will be necessary to analyze the impacts of climate change on the food supply and to develop and disseminate climate-change adaptation technology. Additionally, the country should build a national food-integration system that considers current and likely future need and agricultural best practices by using convergence technology as well as build a risk-management system to tackle the uncertainty of climate change. Also, for the solutions to key challenges to work properly, a consortium of research activities in the related fields of agriculture, agricultural meteorology, and agricultural economics will be necessary to help prepare the specific action programs required for each field. Taken together, research can then be used to prepare effective measures in the struggle to build a stable food-supply system for generations to come.

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