Food Security in the World of Natural Resource Scarcity: The Role of Technology
Dr. Mark W. Rosegrant
International Food Policy Research institute (IFPRI), USA
Wednesday December 17th, 2017
1.30-4.30 p.m.
Rama Garden Hotel

Plenary presentation: Dr. Mark Rosegrant
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Discussants: Dr. Pracha Koonnathamdee
Assistant Professor
Thammasat University

Dr. Sittidaj Pongkijvorasin
Assistant Professor
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Dr. Orachos Napasintuwong
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Moderator Dr. Witsanu Attavanich
Assistant Professor
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Dr. Mark W. Rosegrant is the Director of the Environment and Production Technology Division at the International Food Policy Research Institute (IFPRI) in Washington, DC. With a Ph.D. in Public Policy from the University of Michigan, he has extensive experience in research and policy analysis in agriculture and economic development, with an emphasis on water resources and other natural resource and agricultural policy issues as they impact food security, rural livelihoods, and environmental sustainability. He currently directs research on climate change, water resources, sustainable land management, genetic resources and biotechnology, and agriculture and energy.

He is the author or editor of 7 books and over 100 refereed papers in agricultural economics, water resources, and food policy analysis. Dr. Rosegrant has won numerous awards, such as *Outstanding Journal Article* (2008), *Quality of Communications Award* (2004), and *Distinguished Policy Contribution Award* (2002) awarded by the Agricultural and Applied Economics Association (formerly American Agricultural Economics Association); and *Best Article Award* (2005) from the International Water Resources Association. Dr. Rosegrant is a Fellow of the American Association for the Advancement of Science; and a Fellow of the Agricultural and Applied Economics Association.

Dr. Pracha Koonnathamdee is assistant professor at the Faculty of Economics and a Thammasat University Council member. He earned his BA with honors and MA in economics at Thammasat University (TU). He also earned his second MA from Georgia State University and a PhD from the University of Tennessee (UT). At UT, Pracha had worked at Agricultural Policy Analysis Center for a year. Currently, his teaching classes at TU and research interests concentrate in real sectors particular in agriculture, natural resources, environment, and services. He has regularly presented economic views and policy recommendation through his published articles and media e.g. TV programs and radio channels. Since November 2014, Pracha has appointed as associate director for academic and research at Graduate Volunteer Center, at TU.

Dr. Sittidaj Pongkijvorasin graduated his Ph.D. in Economics from University of Hawaii at Manoain 2007.Dr.Sittidaj is currently an Assistant Professor at Faculty of Economics, Chulalongkorn University, Thailand. He was awarded the Outstanding Teacher from Association of Southeast Asian Institutions of Higher Learning-Thailand in the field of social sciences in 2011, as recognition of his distinguished works with students at the Faculty of Economics.
His research works are in Environmental and Resource Economics field, involving both theoretical and empirical contributions. He has many papers published in leading journals, for example, Environmental and Resource Economics, Water Resource Research, and Resource and Energy Economics. Recently, he has worked intensively on maize farming and the deforestation problem in the Northern part of Thailand.

	**Dr. Orachos Napasintuwong** received her Ph.D. in Food and Resource Economics from University of Florida in 2004. She currently is Assistant Professor in Agricultural and Resource Economics at Kasetsart University. She has taught courses in economics of agricultural biotechnology, economics of agricultural innovation, agricultural production economics, and international agricultural trade. Her research focuses on economic analysis of agricultural technology, agricultural production, and economics issues of rice in Thailand and Southeast Asia.
	**Dr.Witsanu Attavanich** graduated his Ph.D. in Agricultural Economics from Texas A&M University in 2011 and pursued his postdoctoral training in Agricultural, Food, and Resource Economics at Rutgers University. He is currently an Assistant Professor at Faculty of Economics, Kasetsart University, Thailand. He was awarded Kasetsart University research star in 2013 as the researcher who has the highest quantities and quality of research in the field of social science and humanities. His research works are in the area of economics related to climate change, food, energy, policy evaluation, environment, and transportation. He has many papers published in leading journals, for example, *Nature Climate Change*, *American Journal of Agricultural Economics*, and *Applied Economic Perspectives and Policy*. Recently, he has joined a USDA research team to write a report on the global climate change, food security, and the U.S. food system, and become part of the International Resource Panel and UNEP team to write a report on food systems in Southeast Asia and their link to natural resources and environmental impacts.

"*Food Security in A World of Natural Resource Scarcity: The Role of Agricultural Technologies*"

Rosegrant, Mark W.; Koo, Jawoo; Cenacchi, Nicola; Ringler, Claudia; Robertson, Richard D.; Fisher, Myles; Cox, Cindy M.; Garrett, Karen; Perez, Nicostrato D.; and Sabbagh, Pascale. 2014. Food security in a world of natural resource scarcity: The role of agricultural technologies. Washington, D.C.: International Food Policy Research Institute (IFPRI). <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/128022>

Synopsis:

A wealth of technologies is now at our disposal for boosting yields of the world's key staple crops, in order to face the large demands on our food supplies by 2050. But how can we measure which ones will be most effective, when, and where? Which combinations of technologies will have the largest impact? Until now, policymakers have struggled to make informed decisions on how to boost productivity in their regions in the most sustainable way.

The book "*Food Security in A World of Natural Resource Scarcity: The Role of Agricultural Technologies*" launched by the IFPRI seeks to answer the questions of how can we measure which ones will be most effective, when, and where? Which combinations of technologies will have the largest impact? Until now, policymakers have struggled to make informed decisions on how to boost productivity in their regions in the most sustainable way. This ground breaking study divides the world's arable land into a grid of 60 kilometre by 60 kilometre cells and shows how eleven different agricultural innovations might affect maize, wheat and rice yields by 2050 under climate change conditions. Through linking this yield assessment with a global economic model, the book also reports on technology impacts on food prices, trade and food security.

The Technologies

The report reviews 11 agricultural technologies ranging from traditional low-tech practices to more advanced technologies:

1. **No-till** – minimum or no soil disturbance, often in combination with retention of residues, crop rotation, and use of cover crops
2. **Integrated soil fertility management** – a combination of chemical fertilizers, crop residues, and manure/compost
3. **Precision agriculture** – GPS-assisted delivery of agricultural inputs, as well as low-tech management practices that aim to control all field parameters, from input delivery to plant spacing to water level
4. **Organic agriculture** – cultivation with exclusion of or strict limits on the use of manufactured fertilizers, pesticides, growth regulators, and genetically modified organisms
5. **Water harvesting** – water channelled toward crop fields from macro- or micro-catchment systems, or via earth dams, ridges, or graded contours
6. **Drip irrigation** – water applied as a small discharge directly around each plant or to the root zone, often using microtubing
7. **Sprinkler irrigation** – water distributed under pressure through a pipe network and delivered to the crop via overhead sprinkler nozzles
8. **Heat tolerance** – improved varieties allowing the plant to maintain yields at higher temperatures
9. **Drought tolerance** – improved varieties allowing better yields due to enhanced soil moisture uptake capabilities and reduced vulnerability to water deficiency

10. **Nitrogen-use efficiency** – plants that respond better to fertilizers
11. **Crop protection** – the practice of managing pests, plant diseases, weeds, and other pest organisms that damage agricultural crops

Potential for yield growth and huger reduction

The book finds that widespread adoption of these technologies can significantly reduce global hunger by 2050. The number of food-insecure people in developing countries in 2050 could be reduced by 12 percent if **nitrogen use efficiency** technologies were successfully developed and adopted, by 9 percent if **no-till** is adopted more aggressively and by 8 percent with widespread adoption of **heat tolerance** and **precision agriculture.**

The book also finds that the use of **no-till** on a global scale can increase biophysical maize and wheat yields by about 30 percent, with small variations depending on climate change scenario. On a regional scale, it could increase maize yields in Sub-Saharan Africa by more than 30 percent in rain-fed environments and more than 100 percent in irrigated environments.
On a global scale, biophysical yield impacts for **crop protection** products for disease, insects and weeds are close to 10 percent each across the three crops; and will constitute an important tool to address likely growing pest pressures under both intensification and climate change. Irrigation water savings on fields under **drip irrigation** are 24 to 27 percent, depending on crop and climate change scenario, much higher than water savings for **sprinkler irrigation** systems calculated at 11 to 12 percent.

Different regions require different technologies

Agricultural technology impacts differ substantially by region and within regions by country. For example, when the impact of drought tolerance is tested globally, it seems to have a low impact, as drought only affects some regions in some seasons and years. Yet at the right time in the right region, impacts can be significant. Detailed drought yield assessment in the United States and China, two of the world's largest maize producers shows yield benefits of up to 13 percent for this technology and crop.
Given that the study generated vast datasets on these technologies and crops for all countries in the world under varying climate change scenarios, an online tool <http://apps.harvestchoice.org/agritech-toolbox/> has been developed to allow policymakers and researchers hands-on access to the results.

Combined technologies for maximum impact

Combining multiple technologies (or 'stacking' them) can have an even greater impact. Adopting the three types of crop protection (weed, disease and insects) together could reduce the number of food-insecure people by close to 9 percent.

Moreover, if all technologies with positive yield impacts were adopted together for these three crops, prices of maize, wheat and rice could be reduced by 49 percent, 45 percent and 43 percent, respectively. This is equivalent to reducing the number of people at risk of hunger by 40 percent. This first of its kind study can truly equip decision makers to take action now to secure a sustainable food supply for a healthy planet in 2050.