Challenges for ASEAN Agriculture and Food Security

September 5, 2016

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and
Principal Officer
National Institute of Education

The evolving ASEAN landscape

- Challenges to agriculture
  - Crop yield-growth decline
  - Environmental degradation (loss of land and water resources)
  - Climate change

- Challenges to food security:
  - Demographics of supply: declining & ageing farmer population
  - Demographics of demand: Population growth, urbanization, increased income
  - Diet changes (more diverse and high protein food): TRADE
  - Food/feed diversion to other uses

• What is the status of ASEAN agriculture?
• How food secure are ASEAN countries?
• Assuring food security for ASEAN
### Agriculture in Southeast Asia: Export earnings and food security

**Arable land is about 16% of total land area in SE Asia**

<table>
<thead>
<tr>
<th>Classification</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land area</td>
<td>434,070</td>
<td>434,070*</td>
</tr>
<tr>
<td>Agricultural area</td>
<td>129,257</td>
<td>130,562</td>
</tr>
<tr>
<td>a. Arable land</td>
<td>68,412</td>
<td>69,504</td>
</tr>
<tr>
<td>b. Permanent crops</td>
<td>43,807</td>
<td>44,019</td>
</tr>
<tr>
<td>c. Permanent meadows and pastures</td>
<td>17,038</td>
<td>17,038</td>
</tr>
<tr>
<td>Forest area</td>
<td>212,978</td>
<td>211,892</td>
</tr>
<tr>
<td>Other land</td>
<td>91,835</td>
<td>91,617</td>
</tr>
</tbody>
</table>

* Arable land per capita in Southeast Asia is about 0.12 ha.  
10% in plantation crops

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**2011 Country**

**ASEAN: Top 3 World Ranking in Many Agri-Food Commodities Produced**

<table>
<thead>
<tr>
<th>Country</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>Rice, vegetables, fruits; chickens, eggs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burma</td>
<td>#2 pigeon peas, beans; #3 mustard seed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cambodia</td>
<td>Rice, vegetables, fruits, groundnuts, sugarcane</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>#1 - palm oil, cloves, cinnamon, coconuts; #2 - rubber, nutmeg; #3 - rice, coffee, cassava</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laos</td>
<td>Sugar cane, maize, bananas, fruits,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>Rice, vegetables, sugar cane, maize, cassava, sweet potatoes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>#2 - coconuts, pineapple; #3 - bananas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>Sugarcane, rice, maize, vegetables, fruits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>Eggs, vegetables, fish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td>#1 - cashew pepper; #2 - coffee, rice; #3 - cinnamon</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**ASEAN Agriculture**

**Agriculture’s contribution to GDP declining but still important source of livelihood to many people in lower-income economies**

<table>
<thead>
<tr>
<th>Country</th>
<th>Agriculture labour, % of total labour force, 2010</th>
<th>Agriculture, % of GDP 1990</th>
<th>Agriculture, % of GDP 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>-</td>
<td>0.98</td>
<td>0.76</td>
</tr>
<tr>
<td>Cambodia</td>
<td>72.3</td>
<td>50.12</td>
<td>36.02</td>
</tr>
<tr>
<td>Indonesia</td>
<td>38.3</td>
<td>17.55</td>
<td>15.34</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>72.2</td>
<td>45.06</td>
<td>29.72</td>
</tr>
<tr>
<td>Malaysia</td>
<td>13.6</td>
<td>14.89</td>
<td>10.49</td>
</tr>
<tr>
<td>Myanmar</td>
<td>-</td>
<td>57.26</td>
<td>36.36</td>
</tr>
<tr>
<td>Philippines</td>
<td>33.2</td>
<td>19.14</td>
<td>12.31</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.1</td>
<td>0.34</td>
<td>0.03</td>
</tr>
<tr>
<td>Thailand</td>
<td>38.2</td>
<td>10.01</td>
<td>10.86</td>
</tr>
<tr>
<td>Vietnam</td>
<td>49.5</td>
<td>38.74</td>
<td>20.58</td>
</tr>
</tbody>
</table>

Source: ADB Key Indicators 2013; UNCTAD Stat 2013

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**How food secure are we?**

Hungry people as an indicator of food insecurity

1 in 10 people in ASEAN is hungry!
Increasing realization that......

Producing enough food is only one part of the equation to achieve food security...

---------P. Teng (2013)

"Asia and the Pacific’s drive for food security has focused too narrowly on quantity, with a surge in obesity and still high levels of malnutrition in some countries highlighting the need for a new approach"


Evolution in Thinking about and acting on Food Security
• Uni-dimensional to Multi-dimensional
• Supply side only to include demand side influences
• Single sector to Multi sector interventions

What is food security?

"Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active life."


Four Dimensions of Food Security
- Food Availability
  Production, Imports, Stockpiles
- Food Access (Physical)
  Access to markets, Logistics & Infrastructure,
  Trade (Supply chains), Storage & processing facilities
- Food Access (Economic)
  Safety nets, Food pricing, GDP per capita
- Food Utilization
  Nutrition & Health, Food Safety, Sanitation & Hygiene

Country-level Food Security

Global Food Security Index. 9 June 2016
DUPONT-Economist Intelligence Unit,
Developing economies that prioritise investment in agricultural storage and transport infrastructure increase their capacity to ensure food security for burgeoning populations.

<table>
<thead>
<tr>
<th>Country</th>
<th>Rank</th>
<th>GFSI Score</th>
<th>Country</th>
<th>Rank</th>
<th>GFSI Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>1</td>
<td>86.6</td>
<td>Indonesia</td>
<td>71</td>
<td>50.6</td>
</tr>
<tr>
<td>New Zealand</td>
<td>11</td>
<td>81.1</td>
<td>India</td>
<td>75</td>
<td>49.4</td>
</tr>
<tr>
<td>Australia</td>
<td>4</td>
<td>82.6</td>
<td>Myanmar</td>
<td>80</td>
<td>46.5</td>
</tr>
<tr>
<td>Singapore</td>
<td>3</td>
<td>83.9</td>
<td>Pakistan</td>
<td>78</td>
<td>47.8</td>
</tr>
<tr>
<td>Japan</td>
<td>22</td>
<td>75.9</td>
<td>Bangladesh</td>
<td>95</td>
<td>36.8</td>
</tr>
<tr>
<td>S. Korea</td>
<td>28</td>
<td>73.3</td>
<td>Nepal</td>
<td>82</td>
<td>42.9</td>
</tr>
<tr>
<td>Malaysia</td>
<td>35</td>
<td>69.0</td>
<td>Cambodia</td>
<td>89</td>
<td>39.8</td>
</tr>
<tr>
<td>China</td>
<td>42</td>
<td>65.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>51</td>
<td>59.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>65</td>
<td>54.8</td>
<td>Canada</td>
<td>8</td>
<td>81.9</td>
</tr>
<tr>
<td>Vietnam</td>
<td>57</td>
<td>57.1</td>
<td>Brazil</td>
<td>41</td>
<td>67.6</td>
</tr>
<tr>
<td>Philippines</td>
<td>74</td>
<td>49.5</td>
<td>Argentina</td>
<td>37</td>
<td>68.3</td>
</tr>
</tbody>
</table>

Global Food Security Index: INDICATORS (19).

Affordability (6): Food consumption as a share of household expenditure; Proportion of population under global poverty line; Gross domestic product (GDP) per capita (at PPP, exchange rates); Agricultural import tariffs; Presence of food safety-net programmes; A

Availability (8): Sufficiency of supply; Public expenditure on agricultural research and development (R&D); Agricultural infrastructure; Volatility of agricultural production; Political stability risk; Corruption; Urban absorption capacity; Food loss; Access to financing for

Food quality & safety (5): Diet diversification; Nutritional standards; Micronutrient availability; Protein quality; Food safety
Rice Bowl Index: “Food Security Robustness”
“Robustness”: a country’s ability to withstand any disturbances to its food security system

The last country above the threshold is Vietnam and the first to fall below is Indonesia.

http://www.ricebowlindex.com/

RBI: Most ASEAN countries are weak in their ability to withstand shocks on food security

Farm-level Factors are the major contributor to the robustness of a country’s food security system

Source: Syngenta/Frontier Strategy Group

Food Security: the main “Food Taps”

Self-sufficient
1. Self Production
- Limited by production factors of land, water, labour

2. Imports
- Determined by food surplus in exporting countries

3. Reserves/Stockpiles

4. Contract Farming??

5. Food Aid

ASEAN CROP YIELDS, 2015/16

<table>
<thead>
<tr>
<th>ASEAN member</th>
<th>CORN</th>
<th>RICE</th>
<th>SOYBEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield t/ha</td>
<td>Yield t/ha</td>
<td>Yield t/ha</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2.95</td>
<td>4.71</td>
<td>1.33</td>
</tr>
<tr>
<td>Malaysia</td>
<td>-</td>
<td>4.01</td>
<td>-</td>
</tr>
<tr>
<td>Philippines</td>
<td>2.93</td>
<td>3.90</td>
<td>-</td>
</tr>
<tr>
<td>Thailand</td>
<td>4.31</td>
<td>2.53</td>
<td>1.73</td>
</tr>
<tr>
<td>Vietnam</td>
<td>4.60</td>
<td>5.75</td>
<td>1.46</td>
</tr>
<tr>
<td>Myanmar</td>
<td>-</td>
<td>2.76</td>
<td>-</td>
</tr>
<tr>
<td>Cambodia</td>
<td>-</td>
<td>2.34</td>
<td>-</td>
</tr>
</tbody>
</table>
Addressing Crop yield levels

**Genetically modified factors?**

**Defining factors**
- CO2
- Radiation
- Temperature
- Crop features

**Limiting factors**
- Water
- Nutrients

**Reducing factors (Loss)**
- Biotics
  - Weeds
  - Insect pests
  - Diseases
- Abiotics

Need to raise yield levels in both food surplus and food deficit countries

Derived from “production ecology” of C.T. de Wit, Wageningen, Netherlands

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Rice production situations (PS) and injury profiles (IP) in Asia’s lowlands characterized

**CLUZ**
- FAIZ
- HG
- Z
- ILO
- LAG
- COT
- MD
- RRD
- CTEW
- ADU
- PAT
- GAZ
- KAR
- WJ

**Tropical/Subtropical Desert Division**
- Savanna Division
- Rainforest Division
- Rainforest Regime Mountain
- Savanna Regime Mountain
- Subtropical Division
- Subtropical Regime Mountain

(After R. G. Bailey, 1998)

**CLUZ**
- FAIZ
- HG
- Z
- ILO
- LAG
- COT
- MD
- RRD
- CTEW
- ADU
- PAT
- GAZ
- KAR
- WJ

**Disturbances from stresses are the norm in rice systems**

Rice loss due to Diseases and pests and others (tons/yr)

- Thailand: 2,072,790
- Philippines: 770
- Malaysia: 18,482
- Indonesia: 1,784
- Cambodia: 2,784
- Bangladesh: 70
- China: 23
- South Korea: 3

**Rice loss due to floods (ha)**

On average 37% loss from pests and diseases

Data source: ASEAN Food Security Information System, as presented in Q2 2014

**Rice “YIELD GAPS”**

**Average crop yields 2013, t/ha**

<table>
<thead>
<tr>
<th>Country</th>
<th>Food status</th>
<th>Maize</th>
<th>Soybeans</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.A.</td>
<td>Exporter</td>
<td>9.97</td>
<td>2.9</td>
</tr>
<tr>
<td>Canada</td>
<td>Exporter</td>
<td>8.9</td>
<td>2.9</td>
</tr>
<tr>
<td>Argentina</td>
<td>Exporter</td>
<td>6.6</td>
<td>2.5</td>
</tr>
<tr>
<td>China</td>
<td>Importer</td>
<td>6.1</td>
<td>1.9</td>
</tr>
</tbody>
</table>

**Sources:** FAO Statistics; USDA FAS

**Biotechnology crop varieties**

**Farmers’ Record Yields**

<table>
<thead>
<tr>
<th>Crop</th>
<th>2013 (t/ha)</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>22.3</td>
<td>Chile</td>
</tr>
<tr>
<td>Soybean</td>
<td>10.8</td>
<td>MO, US</td>
</tr>
<tr>
<td>Wheat</td>
<td>15.5</td>
<td>NZ</td>
</tr>
<tr>
<td>Rice</td>
<td>18.0</td>
<td>China</td>
</tr>
</tbody>
</table>

From: Fisher, Edmeades & Byerlee, 2013

---

Farm level crop yields are important for food security

**Actual Yield**

- Water & Nutrient-limited Yield

Genetically modified factors?

**Theoretical Yield**

- Potential Yield

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N = 1051 individual fields surveyed

- Standardized protocol (IN, PS) = 60 variables per field
- 14 sites
- Period covered: 23 years (1987–2011)

Rice production situations (PS) and injury profiles (IP) in Asia’s lowlands characterized


---

Average Rice yield levels

<table>
<thead>
<tr>
<th>Country</th>
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<th>Soybeans</th>
</tr>
</thead>
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<td>2.9</td>
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<tr>
<td>Argentina</td>
<td>Exporter</td>
<td>6.6</td>
<td>2.5</td>
</tr>
<tr>
<td>China</td>
<td>Importer</td>
<td>6.1</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Sources: FAO Statistics; USDA FAS

From: Fisher, Edmeades & Byerlee, 2013
With Climate Change by 2050

Yield
- Rice: 14.26%
- Wheat: 32 – 44%
- Maize: 2.5%
- Soybean: 18%

Price
- Rice: 29-37%
- Wheat: 81-102%
- Maize: 58-97%
- Soybean: 14-49%

Source: V. Anbumozhi, ADBI. 2012

"Countering Climate Extremes Key to Asia’s Food Future”
Asia and the Pacific faces a food ‘storm’ in the coming decades unless it takes decisive steps to respond to a host of pressures on its food supplies - including from climate change.

“This will require a combination of conserving and managing existing resources more effectively, tapping science to grow food from less land, and drawing in investment to meet growing food demand,” said Mahfuz Ahmed, Asian Development Bank (ADB) Technical Adviser for Rural Development and Food Security.

Asian Development Bank
5 Oct 2015

Reducing Food Loss & Waste

Per capita food losses and waste (kg/year)

- Consumer
- Production to retailing

Developed countries: Low Loss, High Waste
Developing countries: High Loss, Low Waste

FAO. 2011.

"....on average, each person in Singapore generated about 116kg of food waste a year”

Tackling urban and rural food wastage in Southeast Asia: Issues and interventions

- Incentivise the development and use of improved food storage, transport and packaging in traditional supply chains.
- Modify policies to reduce and prevent retail and consumer food wastage in urban environments.
- Enhance government support for innovative means of using food that is wasted in urban environments.

Food Security: the main “Food Taps”

Self-reliance

2. Imports

Determined by food surplus in exporting countries

3. Reserves/Stockpiles

4. Contract Farming??

5. Food Aid

The ASEAN (Southeast Asia) region is growing in its demand for animal feed and wheat products

IMPORTS OF FOUR KEY AGRIC COMMODITIES INTO ASEAN 2016 ESTIMATES

<table>
<thead>
<tr>
<th>ASEAN member</th>
<th>WHEAT</th>
<th>CORN</th>
<th>SOYBEAN meal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X 1000 MT</td>
<td>X 1000 MT</td>
<td>X 1000 MT</td>
</tr>
<tr>
<td>Indonesia</td>
<td>9,100</td>
<td>3,000</td>
<td>4,700</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1,630</td>
<td>3,600</td>
<td>1,650</td>
</tr>
<tr>
<td>Philippines</td>
<td>4,800</td>
<td>900</td>
<td>2,750</td>
</tr>
<tr>
<td>Thailand</td>
<td>3,600</td>
<td>600</td>
<td>3,300</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2,700</td>
<td>6,000</td>
<td>5,200</td>
</tr>
</tbody>
</table>

* Percent of ASEAN total

Source: USDA FAS

The New Reality: Geographic connectivity:

Countries compete with each other to import food from the same sources around the world

World Rice Trade is Relatively Thin!

http://www.indexmundi.com/agriculture/?commodity=(crop)&graph=imports

* Percent of ASEAN total
Moving forward: What can be done to assure food security?

- Emergent approaches and technologies to assure available, stable supplies of food
- Tackling food utilization issues (nutrition, safety, waste)

Genetic improvement to address stresses: new crop varieties

- Single biotic stress – single gene
- Single set of abiotic stresses – single gene
- Multiple biotic stresses – stacked genes
- Multiple stresses (biotic + abiotic)
- Epidemiological theories – vertical (single gene resistance) versus horizontal resistance (polygenic, QTLs)

Genetic improvement to address nutrition insecurity

- Quality traits, e.g. Vitamin A, Iron-enriched crop varieties
- Other quality traits

Genetic improvement to address food safety

- Reducing contaminants (e.g. mycotoxins)

Genetic improvement to address food loss

- Traits to delay senescence/ improve storability & handling

ICT applications in three main categories

- Knowledge
- Market prices
- Weather
- Crop management
- Variety choice
- Yield forecasts
- Inputs/outputs
- Value chain services

From Paulo Ficarelli and Poornima Sankar, 2016

Courtesy: N. Magor, IRRI.
Food Security is not a single-issue problem
It is a “problematique”

ICT applications for dissemination
ACCESS TO INFORMATION AND KNOWLEDGE

Courtesy: N. Magor, IRRI.

Adapt ‘precision farming’ for small landholdings

Large landholding
1. Observe: Obtain location-specific information
2. Calculate: Determine ‘actionable’ management practices
3. Respond: Implement selected management practices

Small landholding
1. Observe: Obtain field-level information from farmer interview
2. Calculate: Determine field-specific management practices
3. Respond: Provide ‘actionable’ advice to farmer

From Buresh et al., 2015

Need to address all four food security dimensions

Action Recommendations

Food Availability
• Increase agricultural productivity – sustainable technologies
• Reduce losses
• Encourage int’l trade
• Supportive agricultural policies
• Inclusive farming

Physical Access To food
• Improve transport logistics and infrastructure
• Link farmers to markets
• Reduce loss
• Urban farming

Economic Access To food
• Keep food prices low and stable
• Social programs, safety nets
• Increase entrepreneurial skills of farmers
• Non-farm employment

Food Utilization
• Nutrition security
• Food safety: Improve infra-structure & hygiene
• Reduce waste
• Biofortification, dietary supple-ments, education

**Theme 1: Food Reserves, Trade and Investment**
- Sub-Theme 1.1: Food Reserves (FS Dimensions 1, 2, 3, 5)
  - Project 1.1.1: Comparative study on food reserve management and policies in Southeast Asia (Government and Community Regional)
  - Project 1.1.2: Investment requirement and optimal location and storage facilities for food reserve within the Southeast Asian Region
- Sub-Theme 1.4: Standards on Food Quality and Safety (FS Dimensions 1, 2, 3, 4, 5)
  - Project 1.4.1: Development of risk-based food safety measures and harmonization of standards based on ISO 22000 for the ASEAN food commodities
  - Project 1.4.2: Capacity Building for the ASEAN Food Safety and Security

**Theme 2: Sustainable Food Production and Utilization systems (FS Dimensions 1, 4, 5)**
- Sub-Theme 2.1: Efficient Food Production Systems in Southeast Asia
  - Project 2.1.1: Accelerating improvements in food production efficiency and sustainability
- Sub-Theme 2.3: Knowledge Management to improve food production systems
  - Project 2.3.1: Emergent food sources including underutilized crops, fungi and algae
  - Project 2.3.2: Capacities building workshops on emergent technologies

**Theme 3: Emerging Issues Related to Food Security (FS Dimensions 1, 2, 3, 4, 5)**
- Sub-Theme 3.1: Systems of Knowledge Sharing
  - Project 3.1.1: Meta-analyses of all food security-related work in MIC and partner institutions
  - Project 3.1.2: Genesis, building and knowledge management in food security
- Sub-Theme 3.2: Emerging Technologies
  - Project 3.2.1: Emergent food sources including underutilized crops, fungi and algae
  - Project 3.2.2: Capacities building workshops on emergent technologies

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**Executive Forum on Food Security: Leaders in ASEAN Agriculture and Development**
levelling up leaders in public and private agriculture
6-10 June 2016
SEARCA, College, Los Banos, Laguna, Philippines

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**Module 1: New Elements in the Agriculture-Development Landscape**
- Globalized Environment
- Scientific Advancements and Technological Innovations
- Core Issues
- Systematic Impact Issues
- Climate Change Mitigation and Adaptation

**Module 2: The ASEAN Landscape for Agriculture vis-à-vis the Global Agriculture Landscape**
- The ASEAN Community: Dynamics and Processes
- Food Security: The Global Picture in an ASEAN Context
- Global and Regional Knowledge Management

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Thank you - Terima Kasih - धन्यवाद - คำนับ谢你 - Maraming salamat - Merci - Gracias - 너를 감사하십시오 - Thank you

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Ispaul.teng@ntu.edu.sg