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# Food Security, Trade and Partnerships: Towards resilient regional food systems in Asia



The **Murdoch**  
Commission

Abridged Report  
Chinese | December 2015

# FOOD SECURITY, TRADE AND PARTNERSHIPS: TOWARDS RESILIENT REGIONAL FOOD SYSTEMS IN ASIA

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# MURDOCH UNIVERSITY: AN OVERVIEW

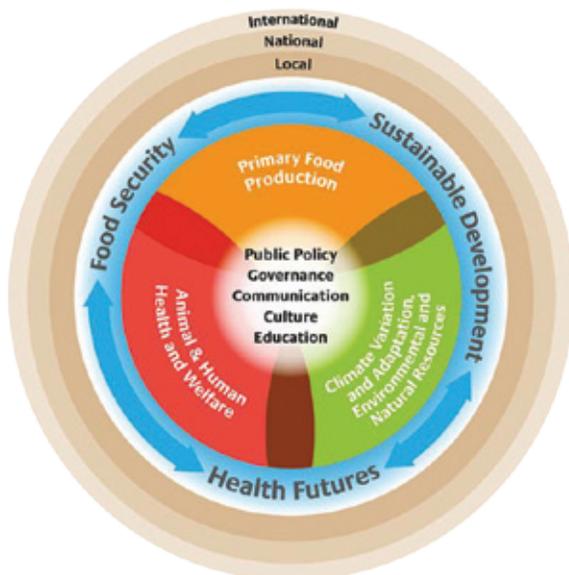
Murdoch University is a research-led university with a reputation for world-class translational research in select areas of knowledge. Located in Perth, Western Australia, the University was ranked 65 in the top 100 universities under the age of 50 in the Times Higher Education World University Rankings (2015).

Established in 1975, the University attracts more than 24,000 students from over 90 countries, and has approximately 2,000 staff. Murdoch's Perth campus is complemented by two satellite campuses in Rockingham and Mandurah, Study Centres in Singapore and Dubai, and close ties to Indonesia, Malaysia and China.

Murdoch focuses on providing research-led teaching in a rich and diverse academic environment, equipping graduates with life-long learning skills and the capacity to enter the global workplace with both scholarly and 'real world' experience.

It's research efforts focus on key areas of national and international significance, including; primary food production, climate change, environmental sustainability, human and animal health and welfare, public policy, governance, education, communication and culture. Murdoch's research is translational in nature and has a strong focus on collaboration with communities, industry and international partners.

## Murdoch Mandala



*The sustainability of the world seems to hang in the balance as we contemplate population growth, land fertility, food and water security, as well as pandemic infectious diseases, those diseases afflicting the aged and the myriad diseases and health conditions that blight so many lives. At Murdoch we already excel in many of these areas and thus Murdoch can, and therefore must, make a contribution to these challenges of the 21st century.*

### Professor David Morrison

Deputy Vice Chancellor, Research and Development

# ACTING VICE CHANCELLOR'S FOREWORD: PROFESSOR ANDREW TAGGART



Professor Andrew Taggart

2015 is Murdoch University's 40th anniversary, during which we have been celebrating our international reputation for innovative and high quality translational research, education and engagement. Since its inception in 1975, Murdoch researchers have engaged with the most pressing social and scientific challenges of our time, including primary food production; climate variation and adaptation; human and animal health and welfare; environment and natural resources; public policy and governance. Murdoch has also established a proud reputation for its engagement with and in Asia, particularly through the work of its highly respected Asia Research Centre and collaborative research initiatives in many countries across the region.

As the global community works towards the finalisation of the Sustainable Development Goals, Murdoch's strategic research strengths in food security, sustainable development and health futures have never been more relevant. Or, indeed, held more potential for Murdoch to enhance its contribution as a responsible global citizen by continuing to work with its students, staff and partners towards a more sustainable, equitable, healthy and food-secure world. The Second Murdoch Commission is an important part of Murdoch's commitment to this charge, which will shortly be enhanced by the launch of a multi- and inter-disciplinary research centre in Singapore – SCRIPT. (Singapore Centre for Research in Innovation, Productivity and Technology.)

Herewith, the publication of the Commission's Final Report is a judicious contribution to food policy debates in Asia as the region continues to evolve within an increasingly dynamic and unpredictable global context. The leadership from the two Co-Chairs, Professors Mely Anthony and John Edwards, has been critical in driving the Commission's research and my heartfelt thanks go to them for their unerring stewardship. My thanks must also go to the unfailing engine room of the Commission Secretariat – Dr Chris Vas (Executive Director) and Ms Cat Bevan-Jones (Research Coordinator) – who have provided an expert environment that has fostered the cultivation of this truly worthy report.

# CO-CHAIR'S FOREWORD: PROFESSOR MELY CABALLERO ANTHONY AND PROFESSOR JOHN EDWARDS



Professor Mely  
Caballero Anthony



Professor John Edwards

Food security, trade and regional partnerships are complex and intertwined areas. Asia, being home to a great diversity of approaches to these areas, is well poised to manage this growing interconnectedness, as well as ensuring the on-going availability of and access to safe and nutritious food for populations in the region. Whilst significant achievements have been made across the region in reducing poverty and increasing food security, there is considerable room for improvement. More work remains to be done.

What is perhaps more important to recognise however are the opportunities that might arise if, as a collective whole, the region could leverage the combined learning from national approaches and transform them into a cohesive regional strategy for food security grounded in concepts of shared responsibility, partnership and trust.

For these reasons the Commission decided to focus on areas where it felt it could make the best contribution, which it achieved by combining analysis of the current situation in the region with an exercise to develop scenarios for the future. This allowed the Commission to develop recommendations that address areas where attention is needed to ensure that an ecosystem for food and trade is regionally based, stable, sustainable, resilient and environmentally balanced.

We hope that the recommendations will contribute to future policy development in applicable areas, and promote enhanced collaborations between national and regional organisations for education, training, research, development and extension in areas such as policy analysis, food security, agricultural science, veterinary science, biotechnology, biosecurity, public health, one health, agribusiness and environmental science.

As Co-Chairs of the Commission, it has been a privilege to work with our group of distinguished Commissioners, all of whom are internationally recognised experts representing seven countries. Collectively they have outstanding expertise on all aspects of food security, trade and partnerships. The contribution of our Western Australia Advisory Group, a reference group comprised of leaders in food security and trade in Western Australia, is also greatly appreciated. The Commission's work was coordinated and supported by a very capable secretariat led by Dr Christopher Vas and Ms Cat Bevan-Jones.

# ACKNOWLEDGEMENTS

Members of the Murdoch Commission gratefully acknowledge the contributions of more than 185 institutions, organisations, young professionals and individuals, who provided invaluable insights to the Commission's research, and assisted in arranging various field trips in the region. Assistance provided by the Young Professionals for Agricultural Development (YPARD) network and the Australian Youth Food Movement were critical in ensuring that the Commission captured the views and ideas of youth and emerging leaders working in food and agriculture.

The Commission Secretariat has been fortunate to receive the assistance and support of a number of individuals during the course of the Second Murdoch Commission work program. These include members of the Australian Department of Foreign Affairs and Trade based in Perth and at various offshore missions who, together with members of Western Australia's Department of State Development International Trade and Investment Division, provided invaluable support to our regional meeting programs.

Professor Peter McKiernan, Dean of the School of Management and Governance at Murdoch University, freely gave his time and considerable expertise to oversee the Commission's scenario study. Professor Jurgen Brohmer, Dean of the School of Law at Murdoch University, kindly reviewed an early draft of the report and made many helpful suggestions.

Dr Jeffrey Wilson, Fellow of the Asia Research Centre and former Commissioner on the First Murdoch Commission, contributed significantly to the framing of this second inquiry and provided valuable contributions and insights during our work program and on early drafts of the final report.

Research professors at Murdoch University kindly contributed their time and expertise at a round table consultation session on the role of research, education and innovation in food security in Asia. This helped strengthen the Commission's thinking in many areas, but particularly around innovation for food systems in Asia, and the opportunities that are on offer in this space.

We are very grateful for the research support provided by our two Research Assistants, Ms Ciara O'Loughlin and Mr Lewis Walden, as well as the administrative assistance provided by Ms Nic Rahilly and Mrs Kerry Franklin during their time in the Secretariat.

We would also like acknowledge Associate Professor Michael Crozier for his efforts in framing our inquiry and directing the work program during the Commission's initial months, as well as our colleagues in the Vice Chancellery for their invaluable support.

亚洲在减少贫困和食品不安全方面已取得重大进展，区域内许多国家在短时间内已实现食品安全。消除食品不安全是一个长期性的问题，然而面对人口不断增加的压力、城镇化以及环境恶化等问题，亚洲能否提供足够的安全、优质营养食品不断成为人们关注的焦点。

食品安全是一个错综复杂、相互关联且受到共同关注的问题，这成为设立第二个默多克委员会（SMC）的出发点。SMC的一项重要任务是调查在日渐相互依赖的食品系统中，亚洲目前的食品安全现状，并对“**亚洲将如何在未来二十年为自己提供最好的食物？**”作出回答。

面对资源有限的不同国情（包括土地、劳动力及资本、国家经济及政治问题以及气候变化带来的日趋不稳定的天气条件），SMC关注的焦点是调查发展多边及跨区域架构及合作关系要如何协助解决食品安全问题

委员会成员及区域会议为此项调查提供大量援助。连同其广泛研究，委员会在印度、中国、越南及印尼进行的咨询及实地考察为最终报告及建议提供了宝贵依据及见解。

委员会的工作内容是针对“2035年亚洲的食品安全”这一主题对未来进行研究。这一主题研究协助委员会成员探寻直至2035年区域内可预见的食品安全推动因素，随后成为本报告及其建议形成的根据。

委员会拟制定一项精细策略，既可解决各国食品安全的相关问题，同时通过注册形成的区域性合作亦将有助于在亚洲建立稳定而具有弹性的食品系统。委员会关注的区域为东南亚国家联盟+6国集团（东盟）<sup>1</sup>。澳大利亚作为联盟成员国，且凭借其作为优质农产品出口国的身份以及其在鲜活农产品行业及相关领域（如食品安全及生物安全性方面）的强大科技实力，在解决区域性食品安全问题方面发挥着重要作用。西澳大利亚州在有关领域的强大实力也成为区域性食品安全的重要部分。

区域化合作形成的结构已成功解决区域性食品生态系统的问题，表明亚洲需要更多策略性及整体性的方案来创造区域性食品系统内的弹性，并确保供应的充足性以及使用及利用的可持续性。

尽管如此，加强及深化区域性合作将成为管理食品不安全性的重要工作。这需要的是在政府框架结构之外建立起伙伴关系，同时引入更多的利益相关团体（私营企业、民间团队、学术界以及其他相关单位）以制定发展综合性食品安全议程的政策。

由于许多食品安全问题存在跨国界性质，因此需要与全球的其他食品生产系统一同发展具弹性的区域性食品生态系统。

<sup>1</sup>东盟+6国集团包括：文莱、柬埔寨、印尼、老挝、马来西亚、缅甸、菲律宾、新加坡、泰国、越南加中国、印度、日本、韩国、澳大利亚及新西兰。

## 主题及建议

食品安全是一个广泛的领域，对其各方面的详尽分析并非委员会研究的范围。最终报告及建议针对在委员会的研究及咨询过程中所提出关于食品安全的问题，并如何综合委员会的专业知识，创造出最大价值。

同样地，委员会的研究并非以亚洲未来食品的量化及预测性做研究。有关研究将引领委员会对亚洲未来的固有不确定性现象进行定性思考，以及为减少该区域于2035年面临的部分可预见的食品安全性风险应采取的行动。有关研究旨在为食品安全问题作出有利贡献，并鼓励针对该区域共同面临的挑战与机遇采取其他积极措施。

## 食品安全：现状

达到国家食品安全不只是单靠在国内生产足够食品来满足国民的需求那么简单。在确保各别人士能够获得优质、安全的营养食品，并有效利用于积极健康生活中也至关重要。全球面临的许多食品安全问题都大致相同，且均源自类似的因素。从国家、区域、次区域和地方层面而言，这些问题有什么样的本质区别，本节将探寻影响食品安全四大“方面”（可得性、可及性、可用性及稳定性）的问题并探讨这些问题对亚洲的成长与发展所产生的影响。着重强调有关建议可加强弹性区域化食品系统发展的措施，同时考虑各国针对其各自情况需遵循的最佳发展道路。

### 第2.1条建议

通过协调亚洲地区食品标准加大提升食品安全的力度。有关标准将于各项活动的价值链过程中创立并实施。有关努力可通过协调APEC、东盟和其他区域性组织得以良好实现。

### 第2.2条建议

创建识别及管理生物安全威胁的区域性团队，从而建立并采纳统一方案和一致的标准。

### 第2.3条建议

制定主流气候适应策略，尤其是与加强食品安全相关的课题。这些适应策略应通过信息传播、知识利用及技术转让方案有效协调各区域主体。

## 食品体系生产力及公众投资

亚洲地区的多样性致使其难以为其食品生产找到单一的亚洲模式或方案。一般情况下，亚洲的农业分部以小农户为主导。该区域57%的人口生活在农村地区，81%的农村人口依赖农业生存。城镇化和环境恶化给农业生产力带来下调压力，且人们不断担忧该区域的食物供应无法满足需

求。本章探索影响农业生产系统生产力的问题和风险，如城镇化、气候变化和病虫害。本章讨论能够解决这些问题的机制，并就促进生产力的改革提供建议。

### 第3.1条建议

发展及促进采纳新的、经改良的环保技术及措施，从而提升食品生产系统的生产力。为整个亚洲地区提供适合的方案措施，以改革及改变农耕方式，如对有害生物的综合治理。

### 第3.2条建议

考虑改革土地法规，包括租赁权、土地兼并、保护耕地及水资源等自然资源的改良市场。

### 第3.3条建议

在各国，尤其是在国内生产总值中农业（不仅仅是主食）占比较低的国家增加基础设施建设及研发的公众投入。

### 第3.4条建议

鼓励小农户加入合作社，以通过农场规模扩张以及降低生产成本实现规模经济，同时亦可利用当地的生产研发成果。

### 第3.5条建议

依据相对优势定义生产系统，以促进区域食品系统概念的发展。这样，区域经济须考虑新兴生产国（如缅甸、老挝和柬埔寨）的内部结构限制。

### 第3.6条建议

促使及推动私有企业在整个供应链的投资，包括提供投入、运输、加工及配送服务。这项区域合作必须获得政治承诺的支持。

## 食品经济的贸易政策及区域框架

亚洲地区经济因各地政治背景、食品安全及贸易方式的差异而以不同速度发展及成熟。目前面临的挑战是如何制定更好的政策以提高现今及未来的食品安全。本章节考虑食品贸易趋势及价格策略趋势，及评估现有区域架构在促进食品安全及区域贸易（尤其是面对价格波动和冲击时）的有效性。建议旨在提高区域能力以创造及维持高效、稳定、可持续及有弹性的食物生态系统。

#### 第4.1条建议

在地区及全球范围内，加速自由贸易协定及食品市场的自由化。

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#### 第4.2条建议

通过向所有利益相关团体提供适当资料及提高其利益意识，在亚洲各国之间传达食品贸易自由化的益处。

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#### 第4.3条建议

通过促进私有企业及外商直接投资食品生产系统，致力于减少价格扭曲及促进增加对基础设施的投资。

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#### 第4.4条建议

制定相关政策，以降低贸易相关交易成本、建立完善的信息系统、制定更好的营销策略及创建基础设施，如为食品价值链中公立及私立机构提供的存储、配送及运输系统。

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#### 第4.5条建议

审查APTERR框架，旨在扩大其范围，尤其是以下方面：

- 增加成员；
  - 扩大区域大米储备范围，以应对因自然灾害及突发事件发生时的不时之需，从而持续稳定市场；
  - 将小麦纳入APTERR框架；
  - 授权私营企业经营者通过区域公私合作储存及管理有关储备。
- 

#### 第4.6条建议

考虑成立独立泛区域食品安全部门：

- 搜集相关资料和数据；
- 发展及实施数据管理策略；
- 就信息共享达成一致，如存销比率；
- 召开年度区域食品安全展望会议；
- 就食品安全和营养安全等食品安全问题建立连贯的亚洲食品安全合作关系；
- 制定区域策略，以最大限度地减少食品损失（如贮藏技术的提升），并传达管理及减少食品浪费的重要性。

## 食品安全创新

不断恶化增长的资源紧缺问题及气候变化问题对区域食品生产力造成压力。其结果不仅导致需要为不断增长（不断兴盛）的人口生产更多食品，亦有效地利用要求能够使用有限的土地、水资源及其他资源投入更有效地为人民生产足够的食品。该地区的国家亦需要建立可确保食品具备营养性、可得性及使用有效性的价值链、组织及机构。解决这些问题不仅需要提高现有系统及操作的效率，亦需制定可表明生产力阶段性变化的创新解决方案，从而在环境恶化、气候改变及资源紧缺的情况下确保食品的安全。本章考虑教育、研究及创新在区域食品系统内的作用，并就此作出建议。

### 第5.1条建议

维持两种教育课程的平衡，一种课程培育具备专业技能的人才，另一种则培育具备系统层面的思考能力和执行解决方案能力的通才。

### 第5.2条建议

维持传统公共领域扩展系统，确保小农户能够继续获取新的知识及技术，同时鼓励私营企业重视技术转让系统，从而推进新私营企业技术的采纳。

### 第5.3条建议

在区域内传达转基因产品的优点，从而为增加私人研发投入奠定基础。为确保食品生产及生产力足以满足亚洲所需，以及食品出口国能持续出口食品，研发新的生物技术必不可少。

### 第5.4条建议

通过合作性安排（如研究／培训联盟及其他区域性论坛）利用区域中心的专业知识共享产能及研发能力的提升。中等收入国家亦应继续支持国际农业研究咨询组织(CGIAR)及其他国际研发机构，从而完善国家农业研究系统(NARS)。

### 第5.5条建议

提升机构能力，以在整个食品价值链上发展跨学科研究人员以及延伸及转移技术的技术人员。

### 第5.6条建议

通过坚持不懈的研发努力及公私合作促进新业务模式以及信息及通讯技术的发展。该等创新应缓解供应链限制、培养技术及管理能力和应对气候变化的影响。

# 1: INTRODUCTION

## *How can Asia best feed itself in 2035?*

The Second Murdoch Commission (SMC) is an independent international inquiry established by Murdoch University to investigate how contemporary food security in Asia is embedded in increasingly interdependent food systems.

Comprised of experts from the Asia region and Australia, the Commission examined the challenges involved in these systems, ranging from the technical and scientific, to the economic and policy dimensions.

A driving concern was to investigate how the development of regional frameworks and partnerships that are more multilateral and interdisciplinary in approach may assist in addressing food security challenges, and what role Australia (and the state of Western Australia) may play in advancing this agenda.

The Commission's aims were:

- To identify and examine the main dimensions and challenges facing food systems in the Asia region, especially in eastern, south-eastern and southern Asia.
- To investigate the merits of building partnerships and collaborative approaches to meet the complexities associated with food security.
- To identify the concepts, tools and frameworks needed to help grasp the growing interdependency of contemporary food systems in the region.
- To develop recommendations that advances the stability, sustainability and resilience of regional food systems in the context of increasing complexity and interconnectedness.

## **Methodology**

The Commission was keen to develop a nuanced strategy that acknowledged the challenges associated with food security for each country, while registering avenues by which regional collaboration could help cultivate stable and resilient food systems in Asia, with a focus on the Association of South East Asian Nations and plus six (ASEAN+6) group of nations<sup>2</sup>.

The membership and regional sittings of the Commission supported this endeavour by facilitating the detailed examination of food security and development challenges from a range of perspectives. Together with its broader research, the Commission's consultations and field trips in India, China, Vietnam and Indonesia formed a valuable evidence base and source of insights for the final report and recommendations. They were conducted on the basis of non-attribution, especially in the case of discussions focused on sensitive issues. Some of the insights from the regional consultations are provided within the country briefs as an attachment to Chapter 2.

The themes of the Commission's deliberations included:

- The reality of food security;
- Food system productivity and public investment;
- Trade policies and regional frameworks; and
- Innovation for food security.

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<sup>2</sup>The ASEAN+6 group of nations includes: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam, plus China, India, Japan, South Korea, Australia and New Zealand.

## **Conceptualising food security in Asia**

Food security is complex and, perhaps more importantly, context-dependent. Against a diverse national background of limited resources – land, labour and capital, national economic and political concerns, and increasingly unstable weather conditions brought on by climate change – the Commission formed the view that Asia needs a more strategic approach to create resilience within regional food systems and ensure adequacy of supply, and sustainable access and utilisation.

In addressing the question **how can Asia best feed itself**, the region requires a decisive and coordinated regional response, with concrete policy measures and achievable goals that countries in the region can work towards. In drawing out concrete policy measures, the policy community need not re-invent the wheel. Building on current regional food security initiatives would allow policy makers, as well as other stakeholders (private sector, civil society, academia and other relevant actors) to craft policies that advance a comprehensive food security agenda.

Given the common concern and shared interest in addressing current and future uncertainties in food security, strengthening and deepening regional cooperation will be critical in managing food insecurities. Such an endeavour would also require partnership building beyond inter-governmental frameworks, and involve bringing in the wider range of stakeholder groups. Developing an effective strategy in this way requires governments across the region, as well as organisations and institutions, to be able to respond effectively to issues in the present, and to consider the issues and mitigate the risks that might impact food security in the future.

With this in mind the Commission undertook a futures study using the Hudson Institute's possible futures methodology. Entitled *Food Security in Asia in 2035*, the scenario study assisted Commission members to explore the foreseeable drivers of food security in the region as they might impact the agri-food sector in the coming 20 years. It identified Geopolitical Stability and Climate Change<sup>3</sup> as the most impactful and uncertain drivers of food security in 2035 and the Commission used these drivers to develop plausible scenarios for the future. A subsequent scenario to policy exercise informed the development of this report and its recommendations. A full outline of the scenario study is detailed in Chapter 1 of the full Report.

## **Geopolitical stability, climate change and food security in 2035**

Broadly speaking Asia's geopolitical landscape is shaped by a range of strategic tensions and historical legacies, including long-standing territorial and maritime disputes and ongoing strategic rivalry. Despite significant growth and socio-economic development over the past few decades, both developed and developing Asia is experiencing growing inequalities and exclusion grounded in increasing extremes of wealth and poverty within and between nations. This creates vulnerabilities that could potentially undermine domestic political stability and exacerbate intra-regional tensions.

Although urbanisation continues apace in Asia, 57 per cent of the region's population live in rural areas. The livelihoods of 81 per cent of the total rural population are dependent on agriculture and the natural resources that support food production. These natural resources are directly impacted by changes to Asia's

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<sup>3</sup>A note on *New Technology* - While in the majority of scenario studies the impacts of new technology are rated as highly uncertain, this driver proved difficult for Commissioners to place. Discussion focussed on disparities in how new technology is defined by and experienced between developed and developing countries in the region, where proven technologies that have been in operation for many years in countries such as Australia, South Korea and Japan might be considered 'new' to countries such as Myanmar and Cambodia. In this context the Commissioners were of the view that the impacts of new technology were comparatively certain, or could be reasonably accurately predicted. The Commissioners were also conscious that where new technological innovations do arise in the coming two decades there is likely to remain considerable variance in countries' capacity to implement these advances, especially in the case of developing countries that have limited resources, scientific and technical capacity, and infrastructure capability. New technology was therefore, and perhaps quite unusually, placed as only moderately uncertain. In acknowledgement of the potential uncertainty usually associated with this driver however, Commissioners gave it special attention in the development of the scenario stories.

inherently variable climate a high susceptibility to natural disasters and extreme weather events. Climate change is expected to increase this vulnerability by exposing the region to a range of new challenges arising from, for example, changing precipitation patterns, temperatures and sea levels. The possible impacts include, but are not limited to, changes in yields (crop and fishery), the relocation of production centres, and alterations to pest and disease regimes.

The Commission adopted an issues based approach when considering how climate change and geopolitical stability might interact in the future. The Commission drew on the parameters of the Representative Concentration Pathway scenarios (RCPs) developed in support of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) guide its thinking qualitatively about how projected changes in temperature, precipitation, sea level and ocean conditions could impact the region's agriculture, fisheries and food systems. It conceived of Asia's geopolitical stability as being the level of cohesion and commitment of countries in the region to act in the interests of regional food system stability, sustainability and resilience, and to manage domestic and trans boundary issues relevant to food security as a shared responsibility and common concern. These issues might include:

- The management of trans boundary water resources, forests, and fisheries;
- Pollution and erosion of waterways and arable land;
- Biodiversity loss; and
- Disease risks associated with the cross-border movement and trade of crops and live animals.

Addressing these issues includes the region's capacity to foster stable governments that can effectively manage increasingly scarce domestic resources and participate as responsible partners towards developing a more stable and cooperative Asia.

The scenario study made it clear to the Commission that the impact of food production on the environment and the threat of climate change have become real and pressing. For Asia to cope with a diverse range of possible futures in 2035 it will need to foster resilience and safeguard environmental balance within the regional food system.

### **Resilience and environmental balance**

Resilience is the practical approach at the systems level of markets, communities and ecosystems to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.

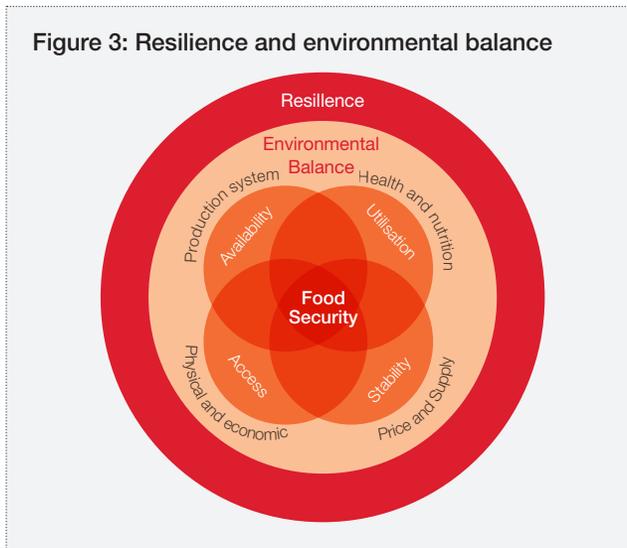
*"Building resilience means helping people, communities, countries, and global institutions prevent, anticipate, prepare for, cope with, and recover from shocks and not only bounce back to where they were before the shocks occurred, but become even better-off" (Fan et.al., 2014).*

In the context of a food system, shocks may be caused by economic shocks such as volatile food prices and financial crises; environmental shocks such as climate change and erratic weather patterns; natural disasters such as floods and earthquakes; and social and political shocks such as conflicts and violence. Environmental Balance captures longer term concerns relating to how water, land and energy are used in food production systems, and the effects of their use over a sustained period of time.

The underpinning premise here is that, in the long-term, total food production would depend on the availability of natural resources, which is dependent on the state and the quality of these natural resources, and also the innovation system that is created to sustain the food system.

In the context of food security, resilience and environmental balance are multi-faceted and interlinked (Figure 3). Resilience and environmental balance:

- Links into production efficiencies related to the sustainable use of land, water and energy resources for agriculture;
- Relies on the adoption of changing agricultural practices/technology to address climate change and biodiversity issues; and
- Relates to the distributional consequences of changes in agriculture-related policies such as governance of trade in agriculture and its effect on the livelihood of farm-dependent households.



By making resilience and environmental balance an integral part of a regional food security framework, the framework becomes more comprehensive in projecting coherent and coordinated policy options to address issues relating to food security. Chapters 3, 4 and 5 discuss production systems, trade and regional frameworks, and innovation systems in further detail.

# ANNEX-FOOD SECURITY IN ASIA 2035 PLAUSIBLE SCENARIOS

Note: more detailed scenario studies are available in the Annex to Chapter 1 of the Full Report.

## Scenario 1 – High geopolitical stability and high climate change

**‘A little help from my friends’:** In this scenario Asia is able to leverage cooperation between harmonious regional groupings to ensure food security in the face of ‘high’ levels of climate change. Regional relationships are built on cooperation and comparative advantage, with enhanced diplomatic, business, education and research linkages engendering a culture of trust in the region.

Climate change is experienced widely and variably across the region, manifesting in a range of social, ecological, and economic impacts and shocks, however the region is characterised by stable governments and equitable and inclusive societies that are resilient and better equipped to safeguard food security in this challenging context.

Significant intergovernmental collaboration and cooperation create a more balanced regional approach to the development and application of new technologies across the agri-food value chain. Progress in policies to improve land and water use, address environmental balance issues, strengthen communities, implement climate adaptation and mitigation initiatives, and improve capacity-building enhance all aspects of food and nutrition security. Appropriate investments in infrastructure and food system innovations minimise food loss and waste. Price volatility in agricultural commodities is mitigated by high levels of geopolitical stability, a more open approach to trade, and economic regionalism. Enhanced information sharing and pooling across the region promotes evidence-based decision-making and transparent governance. These measures help governments avoid insularity in response to political disturbances, and ensure that food remains available, safe and economically accessible.

## Scenario 2 – High geopolitical stability and little climate change

**‘Harmony’:** This scenario is the story of the best of all possible worlds for Asia. Against a backdrop of high levels of intraregional cooperation and stability (See Scenario 1 above), climate change effects in this version of Asia are comparatively low and more manageable in terms of impact. Some countries do still experience notable climate change effects however. For example, sea level rise continues to cause adverse effects on rice production in the Mekong Delta, disrupts broader agricultural production in other coastal areas, and displaces affected coastal communities. Wheat and sorghum yield in South Asia, particularly in India, is under threat from changes in precipitation, however the lower levels of climate change experienced by the region overall provide a greater resource base and enhanced capacity for governments to provide focused interventions where they are required. More resources are available to spend on enhancing food safety, quality, nutrition and environmental outcomes. The development and application of new technologies remains a priority and contributes to ongoing food security and climate mitigation.

## Scenario 3 – Low geopolitical stability and little climate change

**‘The great divide’:** In this story, Asia is characterised by politically insular governments that favour policies that strengthen sovereignty and food self-sufficiency. These policies lead to greater national and regional instability through market distortions and the diversion of government funds to costly and sometimes inefficient schemes that support domestic food production at the expense of other critical needs such as education, health and infrastructure. In developed and developing nations alike, domestic income inequalities deepen, especially for vulnerable groups such as remote rural populations, the urban poor, ethnic minorities, older people and women.

Historical intra-regional maritime and territorial disputes remain unresolved and new issues have arisen including disputes over shared water resources, the illegal trade of livestock, low-quality fertilisers, seeds and pesticides across borders causing loss/damage to local production industries, the spread of disease,

and environmental degradation. Regional disparities in agricultural research and development funding means that countries tend to share research and technology advances only with their trusted partners. In the absence of a regional collaborative approach to information sharing and pooling, knowledge transfer, and capacity-building, domestic economic inequalities and developmental disparity between Asian nations widen. Governments are unstable, communities are vulnerable, price volatility increases and the region's food system is far less stable. Climate change impacts, where they are experienced, are largely left to individual nations to deal with alone.

#### **Scenario 4 – Low geopolitical stability and high climate change**

**'Anarchy':** In this scenario Asia is not only geopolitically unstable, but must also deal with the ravages of high levels of climate change. Food security in the region is characterised by disruptions of supply in the midst of short supply. Unstable and uncooperative governments engender increased income inequality, more poverty, greater food and nutrition insecurity, and higher levels of social unrest across the region. In some countries food riots occur as individual food insecurity increases. Other countries experience significant internal and international migration, particularly where food insecurity accompanies population displacement caused by climate change induced increases in natural disasters, extreme weather events or rising sea levels. This places an additional burden on the resources of receiving communities. The relocation of agricultural production centres reduces food supply, and the changing climate increases pest and disease outbreaks, impacting food quality and safety, and challenging public health and quarantine capacities. Minimal progress is made to address environmental balance issues beyond the efforts that are needed to enhance local production capacity, and a collaborative approach to trans boundary environmental issues suffers in the face of national interest.

The impacts of climate change are exacerbated by a lack of control and collaboration within and between governments to manage, mitigate and adapt to a changing climate. Under these conditions, the resources available for mitigation and adaptation are greatly reduced as countries work in isolation to manage the impacts of climate change and food insecurity. Lack of collaboration and information-sharing hampers governments' capacity to undertake evidence-based decision-making and consequently food system governance becomes increasingly opaque.

## 2: FOOD SECURITY: THE REALITY

Experience over the past 50 years has shown that secure food systems at the national level are not achieved simply through the domestic production of sufficient food to meet national needs. It is also critical to ensure that individuals are able to access good quality, safe and nutritious food, and to utilise it effectively for an active and healthy life. Underlying this deceptively simple statement are a myriad of complex issues relating to production, diversity of products, trade, climate and environment, health and welfare, technological developments, cooperation and collaboration. While many food security issues facing the global community are similar and arise from common drivers, how they play out differs substantially at the national, regional, sub-regional and local levels.

To meet global food needs and demands in 2050 the world would need to increase food production – particularly cereals and meat – by approximately 65 per cent and 56 per cent respectively above current levels (Hanjra and Qureshi, 2010). Nearly 30 per cent of the global increase in population by 2050 will be in Asia, and the region will experience a near-doubling of its share in world gross domestic product from 35 per cent in 2011 to more than 50 per cent in 2050. Asia will also account for 47 per cent of the increase in global urban population during this period (The Economic Times, 2011). Food production systems across the region will face mounting competition for resources; existing arable land will increasingly need to support agricultural production for human, livestock and energy needs, and Asia's finite natural resources of soil, water and land will continue to be susceptible to inefficient use and degradation.

Added to these complexities are the region's unique characteristics including:

- Its diverse range of political, social and cultural traditions;
- The importance of the rice market;
- Asia's significant population of smallholder farmers and 81 per cent share of the world's population that is economically engaged in agriculture;
- The farmer/youth paradox<sup>4</sup>;
- A highly variable climate; and
- The region's intrinsic susceptibility to natural disasters and extreme weather events.

### **Food Availability**

Availability refers to the supply of food, whether it is produced domestically or imported. Fundamentally availability is about food production capacity, which is influenced by a number of important factors (Economic Research Institute for ASEAN and East Asia (ERIA) including the state of agro-ecosystems, climate change, competition for land, and changing demographics that determine where and how farmers perform in response to market conditions.

While a detailed analysis of all the aspects of food availability is beyond the scope of this report, the following sections consider food availability and access issues, as they have arisen during the Commission's consultations.

### ***Farm size and production in Asia***

There are approximately 570 million farms globally, 75 per cent of which are found in Asia. China and India account for approximately 35 per cent and 24 per cent of the global farm count respectively (Lowder, Skoet and Singh 2014). In Asia, the average farm size is one to two hectares; In India and China respectively 81 and 95 per cent of farms have land holdings of less than two hectares. To ensure these smallholder farms

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<sup>4</sup>Asia has the highest levels of rural youth as a percentage of the population, and agriculture is a leading employer of young people in the region. However most countries Asia are characterised by an ageing farming population, with average farmer ages in China, Australia, the Philippines and Japan recorded at 55, 53, 57 and 66 years of age respectively.

remain sustainable in the long term, it is important that more effective mechanisation or technological advancement and even land consolidation efforts are put to use to improve productivity. These issues are further discussed in Chapter 3.

### ***Food loss and waste impacting food availability***

Food losses are the decrease in food available for consumption resulting from constraints and limitations during production, post-harvest or processing. Approximately one-third of the edible parts of food produced for human consumption are lost or wasted, totalling 1.3 billion tonnes and costing producers an estimated \$1 trillion per year (Gustavsson et al., 2011). In South and South East Asia an estimated annual loss of approximately 115kg per capita occurs during pre-consumption food supply chain activities. The figure is higher for Asia's industrialised nations, where approximately 160kg of food per capita is lost prior to consumption.

In developing economies, food losses tend to be a consequence of poor transport systems, inadequate storage facilities and improper packaging (FAO, 2012). In Asia losses are incurred in the early stages of the food supply chain (harvest and post-harvest phases) as the majority of smallholders are prone to infrastructure constraints that reinforce loss of food (Teng and Trethewie, 2012; Escaler and Teng, 2011; FAO, 2012). Addressing these issues has the potential to make a significant proportion of additional food available to the region. For example, ASEAN countries experience post-harvest losses during rice production of between 10 and 15 per cent. Halving these losses could release an additional 4.3 million tonnes of rice for consumption, which could help meet demand in countries such as Indonesia, Malaysia, Philippines, Thailand and Vietnam (Alavi et al., 2012). Some countries in the region are attempting to address this issue. Vietnam, which experiences post-harvest losses of 13 to 15 per cent, has set a food loss target of eight per cent, which it aims to achieve by creating appropriate storage options balanced between small-scale on-farm storage and larger-scale warehouse storage.

Food wastage occurs when good quality food is intentionally discarded by the consumer and managing food wastage is a simple yet efficient means of easing the strain on food supplies. Whilst of growing concern, levels in Asia generally remain below those of most other regions, and in particular below the mid- and high-income countries where the problem is prolific. Research shows that European and North American consumers waste approximately 95 to 115 kilograms of food per year (Gustavsson et al., 2011) and industrialised parts of Asia are considered food wastage 'hot spots' for cereals, fruit and vegetables. Meat wastage volumes are comparatively low for all regions, but are still of concern given the high environmental impact of meat production.

Thus, in the context of food availability diminishing food losses and managing food wastage are simple yet efficient means of easing the strain on food supplies.

### **Access to Food**

While food availability is a necessary precondition for food security, it is not sufficient on its own to ensure food security at the household level. Consumers, particularly those in vulnerable households, must be able to physically and economically access available food supplies in order to become food secure, either through their own production activities or through the marketplace. Factors that impact physical access to food include war and conflict, poor infrastructure, inadequate logistics for food distribution, and market imperfections (Teng and Escaler, 2014). These factors give rise to inadequate, inefficient or disrupted supply chains, greater food loss, and uncertainty of prices and supply.

Economic access to food – or the ability of a household to buy the food it requires – is a concern both for developed and developing countries. It “weighs in more heavily in urban settings, where poorer consumers might spend a significant proportion of their household budget on food” (ERIA.org). Influencing factors include income security, policies such as government subsidies, price control, taxes and tariffs, and market prices. The presence of infrastructure bottlenecks, particularly those relating to logistics and transportation, may impact economic as well as physical access to food by reducing the efficient functioning of bridges and ports and has been shown to raise food prices for ASEAN consumers by as much as 25 per cent (Alavi et al., 2012).

### **Box 2.1: Access in India’s food security challenges**

India’s food security challenge relates primarily to the issue of people’s access to adequate food. It is largely a product of weak governance systems, policy imposed distortions in the food economy and inadequate growth in purchasing power for a large segment of the population. For example, the minimum support price offered by the government to farmers for a few selected crops impacts the commodity price signals in the marketplace often creating distortions, which influences farmers’ production decisions. Farmers are also being encouraged to produce crops that might not be appropriate for their land but appear attractive because of the public procurement backed by minimum support prices and government subsidies on utilities, electricity as well as water for supporting irrigation. Moreover, these crops have gradually substituted the cultivation of traditional and more nutritious food staple thus also contributing to nutritional insecurity among a large part of the population.

The efforts to support food access and consumption through India’s public distribution system and food subsidy for the consumers have been undermined by leakages, misappropriation and corruption. This combined fiscal impact of leakage and subsidies is known to have cost the government significantly and more importantly crowded out the public investment in agriculture. At the same time, the Food Corporation of India, which is responsible for the procurement, storage and distribution of grain, has a very high cost structure and is mismanaged, with significant amounts of food stocks be wasted and allowed to deteriorate. Public and private sector investment in agriculture infrastructure, technologies, and research and farm-farmer capability have not kept pace with the needs of sustainable agricultural transformation of the economy.

### **Food Utilisation and nutritional security**

Utilisation is commonly understood as the ability of an individual to consume available, accessible and safe food in support of an adequate and nutritious diet. Utilisation is typically reflected in an individual’s nutritional status and can be influenced by factors such as:

- The quantity and quality of food;
- Food preparation;
- Food storage;
- Food safety (also linking biosecurity issues); and
- The health status of individuals (a complex measure including public health aspects such as maternal and child nutrition and health, access to clean freshwater, and sanitation).

As Asian communities move progressively towards more sustainable and equitable economic growth, there has been a growing realisation that food utilisation is increasingly intertwined with the need to improve nutrition. Of the world’s population 11.3 per cent are estimated to be malnourished, with approximately

99 million children being underweight. The Asia region is expected to retain the highest overall levels of malnutrition in 2050 (approximately 50 million children (Conforti, P. (2011)). More than 32 per cent of Vietnam's children are malnourished and underweight. South Asia has the third highest prevalence of stunted children under the age of five at 36 per cent, after Eastern Africa (41 per cent), and Oceania (38 per cent) (WHO, 2013).

Developmental disparities also contribute to ongoing utilisation and nutritional security deficits. In developed countries, 60 per cent of dietary protein comes from animal products, compared to just 22 per cent in developing countries. Despite meat and egg production in developing countries rising by 127 per cent and 331 per cent respectively over the past 20 years, most people in developing countries cannot afford adequate animal protein; per capita consumption of meat in the region is only 17.7 kilograms per year, compared to 81.6 kilograms per year in developed countries (Alexandratos, N., & Bruinsma, J. (2012), FAO.org). This is a stark example of the interconnected nature of food security, where lack of economic access to protein precludes the consumption of a balanced, nutritious diet, even if food security is 'achieved' via the consumption of adequate calories in the form of a staple food such as rice.

### ***Food safety and Biosecurity***

As the distance between consumers and the location of food production increases, there is a greater need to ensure food freshness and safety as it is transported over longer distances. Activities along the supply chain, such as processing, packaging, marketing and distribution, therefore form important elements of the utilisation of food and nutritional security. Food safety concerns were recurrent in the Commission's consultations and continue to gain prominence at all levels in society and across all sectors. These concerns, which include chemical residues, microbial threats and food supply chain scandals, have resulted in increasing apprehension by consumers. Other major concerns relate to farming in areas where industrial pollution is high, the use of grey water (domestic wastewater excluding sewage) is widespread, or the management of livestock waste is poor. As a result, biological and chemical hazards are widespread in many regional food systems, and are transferred to the food emerging from them.

In China, trading centres in Hunan came to a standstill when cadmium was found in rice, a legacy of cultivation in polluted soils. In a separate incident, thousands of dead pigs were reportedly dumped in rivers and reservoirs near Shanghai, further undermining trust in the safety and wholesomeness of pork. In Vietnam, 97 per cent of pork is sold in traditional wet markets where there is no mechanism for tracing the meat's origin. Even in Malaysia, where incomes are higher and supermarkets are commonplace, traditional wet markets remain the preferred place for buying fresh meat, with similar traceability issues.

While globalisation has brought about benefits to the food system and the potential for safer food, the trade and marketisation of food products has promoted the rapid movement of products and associated biosecurity threats, highlighting the need for improved biosecurity measures and quality control systems.

Biosecurity concerns encompass the entire food value chain 'from the farm to the fork.' Rising demand for the riskiest foods such as meat and vegetables from less safe sources is increasing biosecurity risks. The rapid intensification of agriculture to meet these demands has, with few exceptions, been accompanied by lagging food governance systems. The emergence of new avian influenza viruses has revealed the generally low levels of biosecurity on farms and in live bird markets, as well as the unsanitary conditions in the slaughter, processing, and retail facilities in South Asia and South-East Asia. These are also a threat for many other more common microbial and parasitic food safety risks. Marked both by a high absolute burden of foodborne disease and a high level of concern, these places are in what the International Food Policy Research Institute (IFPRI) terms foodborne disease "hot spots". To reduce the risks from avian

influenza viruses, Hong Kong has significantly increased processed poultry meat consumption, limited its reliance on live bird imports and implemented safe supply chains. In mainland China, human deaths from H7N9 influenza, mainly in live bird markets, are resulting in a progressive shift away from live marketing.

### ***Nutrition security***

Responses to the issues effecting nutrition security also vary, in keeping with the circumstances of individual countries. Innovative approaches to food production – such as science based methods using low external inputs – minimise the use of harmful agents and help to preserve soil fertility, quality management systems, new technologies, improved genetics, minimum tillage and integrated pest management (Pender 2008). Diverse diets also have a beneficial impact on nutrition security. Plant-based diets, particularly in low-income economies, often fail to meet the required nutrient content without adding animal-source food (Acharya et al., 2014). Fish, considered an important food source in Asia, is a rich source of essential protein, lipid and micronutrients, which minimise the risk of malnutrition and disease (HLPE 2014).

Given these dynamic pressures, it is timely to move beyond the question of whether there is access to enough food and to ask instead whether people have access to sufficient quantities of quality food. Across the region, soaring prices of staple food have forced the most vulnerable to lower the quantity and quality of their food, as well as to cut down on other equally important non-food expenditures such as health and education. This has long-term repercussions for physical and mental development, particularly among the young. It is therefore important to develop national and regional approaches that help the most disadvantaged and vulnerable populations gain access to nutritious food. This will not only improve individual health and opportunity, but will also increase broader social and economic gains by reducing productivity losses and direct healthcare costs. IFPRI's latest data for the malnutrition status of the ASEAN+6 grouping shows that in Indonesia an investment of US\$1 to reduce stunting is estimated to return approximately US\$48 per person (IFPRI.org).

The Asia-Pacific Economic Cooperation's (APEC) Agricultural Technical Working Group, has been charged with strengthening food safety standards and responding to food security challenges. Promoting regional cooperation on food security should therefore also mean more cooperative policies towards better nutrition, including efforts to improve the dietary quality and overall nutritional security of communities in the region. Alongside this effort, "agricultural sustainability, supply chain infrastructure, product innovation for nutrition and promoting healthier eating and lifestyle choices" (Cheam and Tang, 2015) are needed.

To achieve nutritional security it is also necessary to mainstream "nutrition-sensitive agriculture and rural development" (IFAD, 2015). This approach emphasises the nutrition problems and potential interventions across every segment of the value chains. For example, within this approach agriculture should focus on the development or production of commodities that are nutrient rich. This also requires the development of storage and processing equipment that can enrich or preserve the products' nutrient content. These efforts must be complemented with education and information awareness for consumers, as well as appropriate packaging and labelling.

#### **RECOMMENDATION 2.1**

Enhance efforts at improving food safety through the establishment of mutual recognition of food standards across Asia. These standards have to be created and implemented across the value chain of activities. This effort can be best realised through coordination among regional bodies such as APEC, ASEAN and others.

## **Stability and Risk Management for Food Security**

Stability underpins all aspects of food security and effective food supply chains by enabling ongoing access to sufficient and nutritious food at all times despite sudden shocks (for example economic or climatic crisis) and cyclical events (for example seasonal food insecurity) (FAO, 2006). Stability in food prices and supply ensure food is available, accessible and can be utilised effectively. Ensuring stability has long been a central concern for national governments but more recently, following the food price spikes of 2008, 2010 and 2012, has become a concern for global multilateral institutions involved with food and agriculture (Caballero-Anthony et al., 2015).

Risks and uncertainty are inherent in food supply chains and arise from different sources. These risks can affect the reliability, costs and efficiency of production, processing and marketing activities (Jaffee et al., 2010). Supply chain risks that are neither avoided nor mitigated have the potential to destabilise a country's food security.

## **Politics of Food Security**

Food security is inextricably linked to political and market dynamics, which together have a direct impact on the production, consumption, utilisation, price, accessibility and availability of food. On the one hand, markets remain the main mechanism through which most people access and procure food. On the other hand, governments and politics continue to play a key role in formulating policies to motivate food production, food trade, management of stocks, effective allocation of land and resources; and to provide necessary inputs, extension services, infrastructures, and research and development investments for the future. This complements governments' role in tackling poverty, unemployment and malnutrition, and in enforcing interventions such as price stabilisation, insurance, trade protection, and measures to improve value chains when necessary (Ha-Joon Chang, 2012).

The stability of national and regional political systems influence food security, for example by guaranteeing food supplies at affordable prices (through domestic production or trade), as well as by ensuring adequate food governance that promotes safety, quality and standards. For example, ongoing tensions between India and Pakistan frustrate efforts to create a meaningful sub-regional framework within the South Asian Association for Regional Cooperation (SAARC) grouping.

In Indonesia the Ministry of Agriculture's (2014) strategic goal for agricultural development includes self-sufficiency in rice, maize, and soybean, and increase production of beef and sugar. Specific policies to achieve self-sufficiency in rice include:

- development and rehabilitation of irrigation infrastructures;
- dissemination of new production technologies;
- facilitation of the availability of production inputs (seed, fertiliser, chemicals);
- provision of subsidies on fertiliser, seed, and mechanical equipment;
- procurement of limited quantities of paddy at the reference price; and
- support to extension services around the country.

These types of *food self-sufficiency* approaches focus on the domestic production of food and minimise dependence on trade (Konandreas, 2000). In extreme cases, this means no imports at all of designated food items. Self-sufficiency policies can be considered to be redistributive towards farmers (who are typically rural poor) at the expense of urban communities (both poor and rich). These policies can be couched as trying to strike a balance between the interests of rural and urban constituencies.

Another approach is *food self-reliance* that, whilst not discounting domestic production, relies on international trade as an instrument to supplement domestic food sources. The Philippines is one country that has adopted such a policy. It varies its rice imports to address local excess demand and stabilise domestic prices. At the same time it has expressed the goal of becoming self-sufficient in rice due to its political importance as a barometer of government performance. To achieve this it has re-directed resources to research and development efforts and direct farm-level interventions.

Similar to realising benefits in production matters, regional frameworks also provide a vehicle to integrate the region's plant, animal, environmental and agricultural biosecurity and create an integrated, scientific, systems-based proactive approach that can enable the comparison of threats across sectors and draw on a shared toolbox of best practices for measuring risk and evaluating the costs and benefits of prevention, eradication and control. It is timely to consider shifting away from sector-based approaches to biosecurity issues, and towards more of a multi-sectoral collaboration, as well as from a national to an international approach.

A first and helpful step towards this regional approach would be to evaluate whether, given the region's developmental diversity and the differences in the scientific and technical capacity of each nation, this harmonisation could be achieved via common tools and procedures alone, or whether it requires governments to integrate the different bodies responsible for biosecurity (plant, animal, agriculture and environment), as has been done in Australia and New Zealand under the One Biosecurity approach.

A more regional approach to biosecurity could also be a key enabler for fostering resilient food systems. The reality of increasingly interconnected global food trade and transport systems brings an increased likelihood of more pests and diseases being transported to a greater range of countries (and areas within countries). Regional fora could provide opportunities to collaboratively consider how to best manage this problem in a way that improves the resilience of food systems and the environment in the face of increasing biosecurity risks.

## **RECOMMENDATION 2.2**

Build regional capacity for the identification and management of biosecurity threats consequently creating a uniform approach and consistent standards to be adopted.

### **Environment and Climate change**

Asia is one of the most climate related disaster-prone regions in the world (Escaler and Teng, 2010). Floods are a normal occurrence for the people of South Asia, where some of the worst monsoon flooding in recent memory affected more than 50 million people in India, Bangladesh, Pakistan and Nepal. The floods destroyed croplands, livestock and property and raised fears of new health crises in this densely populated region. Despite its propensity for flooding, South Asia is reaching alarming levels of water scarcity and the situation is likely to worsen as a result of climate change. South Asia's 95 per cent share of total water consumption for agriculture (compared to the world average of 70 per cent) presents a critical situation and countries such as India are progressing innovative solutions that will help reduce agricultural water consumption. Vadodara District in the state of Gujarat is installing solar panels atop irrigation canals in an effort to reduce evaporative water loss and increase land use efficiency, whilst generating clean energy. The Gujarat government estimates the project will save 90 million litres of water from evaporative loss per year.

The quest for higher agricultural productivity has resulted in a heavy environmental footprint through higher use of chemicals and fertilisers, water degradation, deforestation and biodiversity loss.

Regional cooperation to improve adaptive capacity, especially among vulnerable groups of people, would help to build national and regional resilience. Adaptation strategies would help reduce the effects of projected climate changes on food security in the region. Most countries in ASEAN however, are yet to produce coherent climate change strategies.

There are some exceptions. Vietnam for example has introduced a Restructuring of Rice Programme – to 2030 – taking into account climate change and its likely impact on the Mekong Delta, and food, nutritional and energy security issues. The key tenets of this programme include:

- the need to increase contract farming with private enterprise linking farmers to financing options;
- the introduction of new seeds and measures to improve soil quality (particularly salinity intrusion) to shift production to higher quality varieties of rice;
- decreasing the use of fertiliser, pesticide and water;
- fostering behavioural change in farmers; and
- strengthening capacities of rice organisations.

Similarly, China has introduced a strategy of ‘transforming production and adjusting agriculture structures’, which is the country’s most significant reform in food production and security since 1978. This strategy includes recognising the importance of environmental and resource depletion in China. It also aims to professionalise agriculture through increases in land-holding size, mechanisation and land reform, and the adoption of various new technologies.

### **RECOMMENDATION 2.3**

Mainstream climate adaptation strategies, particularly those that relate to enhancing food security. These adaptation strategies should be effectively coordinated across the various regional bodies through information dissemination, knowledge capitalisation and technology transfer approaches.

# COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN INDIA

## 主要因素



人口—目前 1,267,401,849

人口—2035年估计 1,525,369,000



基尼指数 33.6

人类发展指数 0.586



农业研发公共投资  
(2005年购买力平价百万美元) 2121



营养不良率  
(占人口百分比) 15%

营养过剩率  
(占15岁以上人口的百分比) 1.9%



全球饥饿指数排名  
(2014年排名, 基于2009-2013  
年之数据) 55

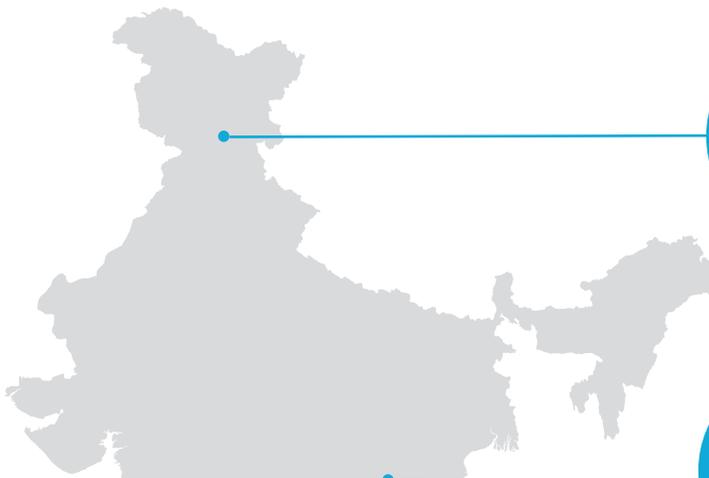


农场数 137,757,000

平均农场面积(公顷)  
(截至2010年前十年间) 1.3



生物承载力不足 / 储备  
(人均全球公顷) 0.5 (不足)



人口  
1,267,401,849

人均国内生产总值为  
US\$  
1,630.80

## 国家概况

于2014年，印度国内生产总值为2,066,902,397,333.3美元，人口基数为1,267,401,849，人均国内生产总值为1,630.80美元（按2014年的官方美元单一年度汇率换算）。其中农业贡献尤为突出，占整体国内生产总值的17%。印度农产品种类繁多，其主要产品包括大米、小麦、油籽、棉花、黄麻、茶叶、甘蔗、扁豆、洋葱、土豆、乳制品、绵羊、山羊、家禽和鱼类。在过去的七十年里，即1951年至2014年间，印度小麦产量翻了近15倍（从650万吨增至9600万吨），大米、玉米、牛奶、鱼类及土豆的产量分别翻了5倍（从2060万吨增至1065万吨）、14倍以上、8倍、12倍及26倍。如今，印度已成为世界上最大的牛奶生产国及第二大果蔬、大米、小麦及糖生产国。更为重要的是，印度目前为食品净出口国、世界最大的大米出口国及第二大牛肉（水牛）出口国。农业上的重大改变是公共政策（涉及引入由公共推广服务做支撑的生物化学技术方案）与扶持性农业（定价）政策（涉及使用补贴投入、实施最低扶持价格、公共采购谷物和部分其他食品及大量缓冲库存运作）相结合的结果。



## 咨询结果—食品安全问题

- 虽然目前印度为具食品安全保障的国家，但家庭粮食安全问题仍面临重大挑战。印度5岁以下人口中，40%以上存在营养不良现象，和微量元素缺乏的问题（包括贫血及缺乏蛋白质）在成年人口中蔓延。印度约25%的人口生活在最基本的食物（能量充足）贫困线以下。国家粮食生产的自给自足及有所改善的食品供给并未在全国范围内为所有人带来营养安全保障。事实上，通过改善经济获得充足的粮食仍是印度面临的一项重大挑战。
- 由于印度在该国东部地区发起并巩固第二次绿色革命，需要从多个层面对农业及食品安全政策进行审查及重新调整。政府对食品生产以及消费的扶持性补贴令灌溉、农业推广服务、市场营销及食品加工基础设施建设方面的公众投资不断缩水。
- 农业仍为经济改革中最落后的产业，因此印度无法利用由自开放农业市场所取得的巨大效能收益，投放到国家食品安全建设。最重要的是，农业劳动生产力亟待提升，有必要通过将农业的剩余劳动力转移到其他非农业活动，以从个人层面增加获得充足食物的经济渠道。

- 滥用某些投入补贴是造成土地退化、水资源短缺及土壤污染等环境问题的主要因素，由此导致收益停滞，并对长期食品安全造成不利影响。
- 印度是一个无法承受浪费的国家，据一些人士估计，其产后贮藏损失率约达30%。对消费者的食品补贴亦存在重大漏洞、目标错误及转移等问题，使得国家的公共分销系统及其缓冲库存运作成为对稀缺公共资源的主要损耗。



### 咨询结果—有关食品安全的机遇

- 公共分销系统目前仅覆盖小范围的农作物。扩大农作物的覆盖范围将会更好地获得豆类（扁豆）及油籽（为大部分家庭蛋白质及脂肪的主要来源）一类农产品的供给，从而可提升旱地农业地区农作物的多样性以及营养安全性。
- 尽管以公共采购和缓冲库存为基础的公共分销系统对印度食品安全建设作出了贡献，且对解决人们中期营养安全需求来说属必要，但其效率的提升仍存在很大空间，可通过迅速搭建生物识别平台（AADHAR）来减少漏洞、贪污及食品浪费问题，以对其定位、分销及库存运作进行管理。
- 为解决印度食品经济目前面临的实际问题，须对20世纪60年代中期及20世纪70年代为国家创造食品贸易顺差的农业定价政策进行审核或调整，可采取诸如扶持营养丰富作物的生产及消费以及鼓励非谷物类食品的多样化等措施。
- 转变鼓励出口食品的观念及政策可能同时提升农业效能及食品安全。该系统应更多地以市场为导向。
- 采用更为先进的产后贮藏技术将会有效减少印度因运输、贮藏等方面基础设施欠缺而造成的贮藏浪费。

- 印度应寻求与产品交付及研究延伸有关的机会。尽管农业研发经常可达到产品开发阶段，但却无法大规模地将这些产品运送至农民手中。
- 引发环境问题的政策须进一步解决，同时鼓励为农业生产而可持续使用的土地和水资源。



### 咨询结果—加强与澳大利亚 / 西澳大利亚州关系的可能性

- 尽管印度拥有世界上最大的乳制品产业，但其生产力水平低下。乳制品行业间存在合作机会，有助于将澳大利亚的乳制品知识以及专业技术传给印度，从而提升印度乳制品行业产能。
- 印度为提升旱地农作物生产率提供支持的研究将从澳大利亚农业科研能力及农业实践中获益。
- 澳大利亚可发展成为扁豆 / 豆类（常见的非高需水作物，为印度饮食中的重要组成部分）的主要输出国，而印度则继续依靠进口来填补国内生产和需求之间的空缺；
- 印度可发展农民交流项目，由此印度农民可以考察及培训为目的参观海外农场，其中包括参观澳大利亚农场。



# COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN CHINA

## 主要因素



人口—目前 1,364,270,000  
人口—2035年估计 1,407,087,000



基尼指数 37  
人类发展指数 0.719



农业研发公共投资  
(2005年购买力平价百万美元) 4048



营养不良率  
(占人口百分比) 11%  
营养过剩率  
(占15岁以上人口的百分比) 5.7%



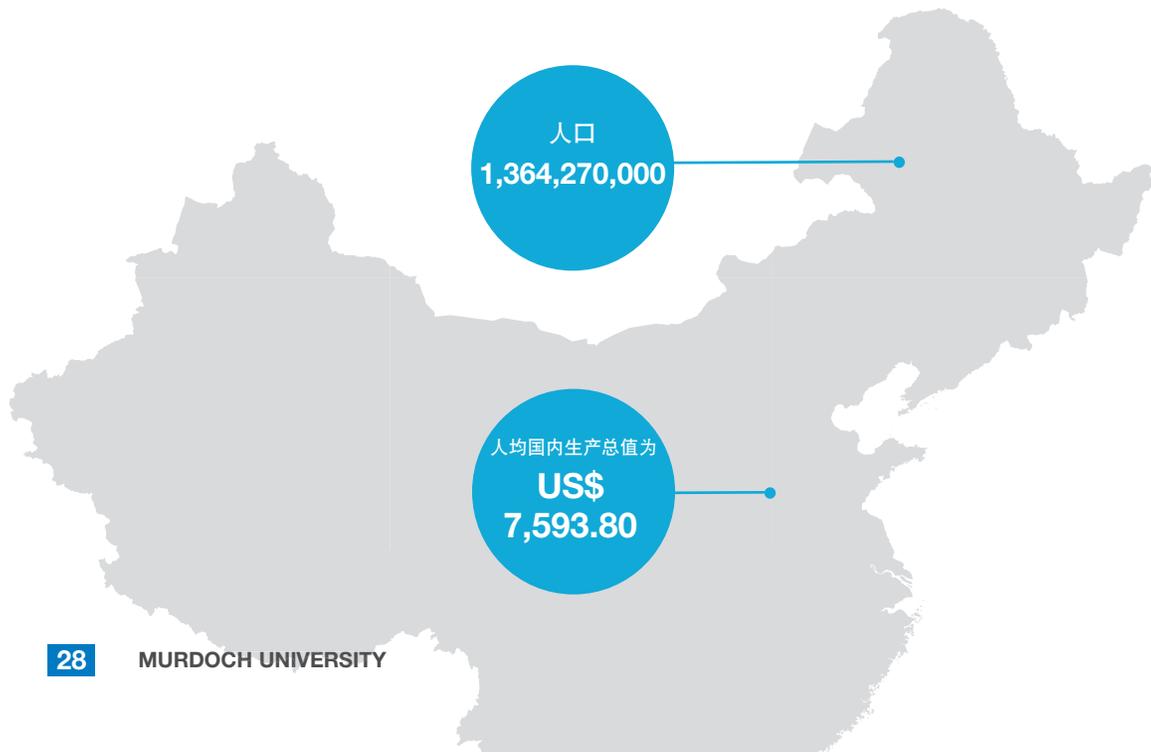
全球饥饿指数排名  
(2014年排名, 基于2009-2013  
年之数据) 5



农场数 200,555,000  
平均农场面积(公顷)  
(截至2010年前十年间) 0.7



生物承载力不足 / 储备  
(人均全球公顷) 1.6 (不足)



## 国家概况

为实现千年发展目标，中国已成功地使5亿人口脱离极端贫困，从国家层面其被视为短期内食品安全。于2014年，中国国内生产总值为10,360,105,247,908.30美元，人口基数为1,364,270,000，人均国内生产总值为7,593.80美元。农业占整体国内生产总值的9.2%。中国的主要农产品为水稻、小麦、土豆、玉米、花生、茶叶、小米、大麦、苹果、棉花、油籽、家禽、猪肉及鱼类。于2012年，三分之一（33.6%）的劳动力从事农业生产，可耕种土地占土地总面积的11.3%。于2014年，农业部实施一项新战略，旨在改变生产模式和调整农业结构。这是中国自1978年以来粮食生产和食品安全方面的最重大改革，目的在于解决环境问题和资源消耗、土地改革、机械化、可持续农业耕作及农业专业化等问题。中国越来越关注营养安全，不断上升的肥胖及非传染性疾病也引起越来越多的关注。



## 食品安全问题

- 尽管取得了巨大进步，但中国仍有约1.5亿人口处于贫困线以下，其中有些人无法取得足够和有营养的食物，特别是在偏远农村地区和少数民族地区。在一些情况下，粮食不安全也可能是季节性的，农村人口和城市人口贫富悬殊，需要不断从微观上针对性地干预以确保中国农村地区实现食品及营养安全目标。农村人口大多为其他家庭成员到城市中心发展后的留守妇女、儿童及老人（或无劳动力的人）。通过教育、接触财务及土地促使妇女参与农业生产将成为帮助偏远农村社区脱离贫困和食品不安全的重要因素。某些省政府积极推行相关措施。阳光工程是四川省政府为应对男人到城市发展向妇女提供支持的重要举措。发展养种植业或农业经济的妇女可获政府提供补贴及培训，从而支持农业的持续发展。
- 劳动力成本增加、农村劳动力老龄化、农业租金大幅上涨、环境问题恶化及资源退化（特别是土壤和水）、气候变化加剧以及肉制品和奶制品消耗增加导致饮食习惯的转变令中国在中长期内面临食品安全的挑战。同时，为了促使合适的经济发展，中国仍需要进行城市化。对政府而言，怎样平衡为农业生产保护土地的需求与满足仍生活在贫困中的中国人口的需求将成为越来越大的挑战。



- 中国政府价格扶持有助于收入分配，是一项重大的和谐社会关系的措施。然而价格扶持政策导致价格扭曲，中长期内无法维持下去，因此急需通过市场引导价格来解决。

### 有关食品安全的机遇

- 中国农业部提出的新“农业可持续发展战略”引起中国应对粮食生产和安全方面的重大改革，其中包括对旨在通过增加土地拥有面积、提高机械化程度和土地改革来解决中国农业技术匮乏问题及促进农业专业化策略的改革。
- 就有关影响食品安全的农业问题及环境问题（如水资源和土壤的退化），与中国政府的对话变得更为公开和透明。更多人愿意考虑采用海外的先进解决方案。这一发展伴随着人们对转基因生物争论的变化，更多人士认识到转基因生物是一项新技术，有利于食品安全，应进行进一步研究开发。
- 经过一系列事件（如大米镉超标）后，食品安全和质量问题成为中国关注的主要问题。此问题在公众看来已逐渐削弱中国为其公民生产安全食品的能力，许多人士如今更倾向于信赖在进入中国前尽可能远离价值链进行加工的产品。中国政府已采取一系列旨在解决以上两大问题的措施，有关措施包括在农业部下设特殊机构、委员会及工作小组（但由多个不同部门代表组成）、修改食品安全条例及消费者保护法等。省政府也有设立解决有关问题的机制。



## 加强与澳大利亚 / 西澳大利亚州关系的可能性

- 鉴于澳大利亚在安全、干净食品生产及价值链鲜活农产品服务供应方面享有的盛誉以及拥有的专业知识，中国与澳大利亚存在许多研究及合作机遇。从牲畜的营养补充到有利于市场发展的更为成熟的电子方案，中国需要全方位的研究及创新干预。合作研究和创新有利于澳大利亚的专业知识和工艺流程适应中国国情。两国行业与行业之间的合作关系同样重要，澳大利亚乳品公司和塔斯马尼亚樱桃种植园与其各自中国同行就此建立的合作关系已取得成功。
- 澳大利亚研究人员与中国同仁开展大量工作，以改善牲畜质量及提高羊毛和乳品业的生产力。活牛贸易越来越受到青睐，极有可能进一步发展贸易关系，主要因为适当出口协议的制定以及供应链所需因素的存在。
- 食品损失为澳大利亚（及西澳大利亚）和中国的合作与参与创造良机。中国谷物在收割、储存及运输环节的损失量远远大于整个澳大利亚的小麦收割量。部分合作涉及分享生产、生物安全及供应链发展过程中的专业技术与知识，提高中国科学与技术能力亦是确保持续减少食品损失的重要前提，食品安全与质量提升亦将提升营养安全并为中国农产品打开新市场。



# COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN VIETNAM

## 主要因素



人口—目前

90,730,000

人口—2035年估计

100,572,000



基尼指数

35.6

人类发展指数

0.638



农业研发公共投资  
(2005年购买力平价百万美元)

86



营养不良率  
(占人口百分比)

13%

营养过剩率  
(占15岁以上人口的百分比)

1.7%



全球饥饿指数排名  
(2014年排名, 基于2009-2013  
年之数据)

15



农场数

10,689,753

平均农场面积(公顷)  
(截至2010年前十年间)

0.7



生物承载力不足 / 储备  
(人均全球公顷)

0.4(不足)



人口  
90,730,000

人均国内生产总值为  
**US\$**  
3,514.60

## 概览

越南广泛的被认为是食品安全成功的例子。这种成功很大程度上因为自20世纪80年代开始的一系列改革，连同一系列干预政策的变动，促使越南经济更多的以市场为导向，刺激经济强劲增长。以上原因减少了贫困与营养不良的问题。如今越南食品安全跃居亚洲第三位和世界第五十五位。2014年，越南国内生产总值为186,204,652,922.30美元，人口为90,730,000人，人均国内生产总值为3,514.60美元。农业占其国内生产总值的18.1%，该国主要农产品包括水稻、咖啡、橡胶、茶叶、胡椒、腰果、家禽、水果、鲶鱼（波沙）、海产品及木制家具。2012年，越南几乎一半的人口（48%）从事农业生产，可耕种土地占其整体土地总面积的20.6%。越南和泰国是东盟的两个主要出口国，尤以大米为主。越南亦领导着高价值水产养殖，自1944年生产少量的鲶鱼（巨鲶属）到2009年主导全球产量（1.2百万吨），赶超中国、印尼及美国。越南农业政策聚焦于贸易自由化，几乎没有直接补贴。



## 食品安全问题

- 尽管越南如此注重食品安全，在偏远的农村地区和山区以及少数民族地区仍存在地区化（及季节性）食品不安全问题。就其饮食质量和营养组成来看，营养安全仍是重大问题。与邻国相比，越南的肉类和蛋类价格较低，然而，个体缺乏足够的营养知识（包括对有关产品的知识）以形成营养均衡的饮食习惯保障平衡饮食消费，尤其是儿童饮食缺乏营养均衡。32%的儿童营养不良、体重偏轻且缺乏微量元素，尤其是维生素A与钙元素。在农村与山区，牛奶被认为是昂贵的补品，因此被排除在日常饮食之外。在其他情况下，由自产快速转变为向市场购买导致个体对若干食品的营养价值以及如何平衡膳食的知识缺乏。
- 某些政策可能给越南食品安全带来挑战。以越南的土地政策为例，有关政策保护380万公顷土地专门作为水稻生产。此项保护措施意在确保42-25百万吨（包括国内消费量、出口量和储备需求量）水稻的生产。由于政府优先提升生产效率和增加农民收入，最近实施的政策更加灵活，因此可根据种植季节相应减少种植水稻的土地面积。农民亦可以从种植水稻转为种植其他更有价值的作物。

- 食品安全问题对于整个农业体系是一个重大挑战且缺乏追溯性。小型野生动物农场基本上不受监管，农药和化肥的使用存在广泛管理不善的问题。这与大量的食品安全工作相悖，食品安全工作支持越南水产养殖业的发展，使其参与到全球水产品市场中。
- 越南易受气候变化的影响，有观点认为越南现在需要思考在不断变化的气候环境下如何增加水稻产量以及 如何多样化农业生产。沿海地区的食品生产中心正经历着季节性变化，湄公河三角洲的盐度水平在不断上升。越南同样易受厄尔尼诺/拉尼娜气候现象的影响，而这一气候现象会因气候变化而加剧。问题研究表明，越南将维持足够的水稻生产水平，以确保国内食品安全，但贸易顺差的预期减少将影响经济的增长和发展。



### 与食品安全相关的机遇

- 越南的国家营养战略意在解决营养安全问题、改善人民饮食（就质量和营养均衡而言）以及解决儿童营养不良和发育不良问题。这一新重心表明就水稻而言的概念化食品安全已转向农产品的多样化，从而解决更广泛的营养安全问题。
- 就市场生产而言，越南政府出台一项政策扩大农场规模。倘实施该项政策，将为大规模农业合作提供机会并提高效率。
- 胡志明市拥有40公里的高科技农业区域，主要由私营企业资助，并希望在未来五年建立七个类似的区域，此项计划包含建立300公顷的生物技术区。有关项目经改良的研发流程将改善食品安全问题，且通过投资和建立研究合作伙伴关系将有机会在有关项目中建立合作关系。
- 越南将动员东盟国家发展：
  - 应急食品系统；
  - 解决储存、价格及技术的信息系统；
  - 育种和养殖；

- 海外储存/仓储系统；及
- 通过技术交流合作；水稻生产方法与政策；基于比较优势和互补性的区域规划方法；及研发。



### 加强与澳大利亚及西澳大利亚州关系的可能性

- 可根据各国的相对优势在食品价值链投资领域与西澳大利亚州建立合作关系，并加强中小企业的力量，从而使其参与到价值链中；
- 西澳大利亚州可支持越南，努力提高生物安全、自然资源管理，以及适应气候变化的能力。
- 越南拟建立区域性合作伙伴关系及合作，以解决食品安全、食品供应监管系统及经济建模等问题。
- 越南农业专家掌握丰富的田地工作技能及专业知识。越南可将这些与澳大利亚在技术（种子生产及检验）、知识产权及基础设施建设方面的专业知识结合起来，帮助越南提高农业生产能力。
- 在有关农业的科学、技术及政策培训工作方面投入更多精力将进一步促进南南合作。



# COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN INDONESIA

## 主要因素



人口—目前 252,812,245

人口—2035年估计 303,382,000



基尼指数 38.1

人类发展指数 0.684



农业研发公共投资  
(2005年购买力平价百万美元) 379



营养不良率  
(占人口百分比) 9%

营养过剩率  
(占15岁以上人口的百分比) 4.8%



全球饥饿指数排名  
(2014年排名, 基于2009-2013  
年之数据) 22



农场数 24,868,675

平均农场面积(公顷)  
(截至2010年前十年间) 0.8



生物承载力不足 / 储备  
(人均全球公顷) 0.1(不足)

人均国内生产总值为

**US\$  
3,491.9**

人口

**252,812,245**

## 国家概况

印尼为世界上人口第四大国家和第十大农业生产国，仅次于土耳其和法国而位居德国和阿根廷之前（2012年经合组织资料）。印尼为世界上最大的棕榈油生产国、第二大天然橡胶生产国以及仅次于中国及印度的第三大水稻生产和消费国家。印尼缺乏农业用地，就人均面积而言，为世界平均水平的三分之一，但其水资源相对比较充足。农业对印尼国内生产总值的贡献率由1990年的19%降至2014年的10%，而其同期就业总人数的占比亦从56%降至30%。棕榈油及橡胶占农产品总出口量的60%，形成巨大的农业贸易顺差。

印尼农业以小农作业为主，主要生产粮食作物。该国共有2,580万个家庭农场，平均面积为0.8公顷，其中1,420万(55.2%)为小农农场(petani gurem)，面积不足0.5公顷(CBS 2014)。同时，小农亦为多年生作物的主要生产者，大型私人及国有农场占总作物面积的约15%，从事棕榈油及橡胶生产，其农场平均面积达2,600公顷。

就食品安全而言，印尼政府优先加速生产战略性物品，即水稻、玉米、大豆、糖和牛肉。就较低层次而言，印尼政府亦提倡生产青葱、辣椒和土豆等作物。国家在政策及研发预算方面对水稻给予优先考虑。尽管大米生产年增长率由2.5%（2000年至2010年）降至2014年的1.63%，印尼水稻产量基本实现充足水平，尽管在某些年度仍须进口大米加强国内储备，以维持稳定。

宏观经济转型所导致的饮食多样化令主要作物需求减少，而对豆类、蔬菜、水果和牲畜产品等营养丰富食品的需求增加。于2010年，蔬菜消费量为1999年水平的120%。同时，水果消费量为1999年水平的125%。肉类、蛋类和牛奶的消费量增幅最大，于2010年超过200%。



## 食品安全问题

- 印尼近年来开始加强其食品主权意识，通过将食品安全（尤其是大米的自足性）与国家安全强有力的联系起来，从而赋予食品安全更广泛的安全涵义。利用军队人员的公民使命加大农业推广力度遭到批评并未获得普遍支持。
- 土地所有制问题因其对投资、基建发展和农业产能的限制，而引起食品安全问题，同时亦为农民适应环境变化的能力带来挑战。如不进行改革，印尼大量小农户利用规模经济的能力将受到限制。土地所有制问题将继续限制家庭谋生机会并

妨碍发展，1,900万家庭所拥有土地的平均面积仅为0.4公顷，因此需要对微观气候适应进行干预。

- 农业投资及农村发展受到政府根深蒂固的自给自足观念、官僚主义和市场的不信任所限制。印尼政府放弃采取可最大化若干优势领域附加值的更具策略性的方针，而试图在所有方面做到尽善尽美。
- 科研人员与企业之间缺乏连通性，令创新及研发受阻。即使企业构想出可行的方案，但缺乏研发能力，相反，科研人员具备技术能力却无法联系投资公司支持产品开发及商业化活动。
- 影响食品生产的空气和水源疾病的频繁爆发，令食品加工及安全问题成为持续性的重大问题，因此需要加强大众对食品损失和食品浪费问题的意识。



### 食品安全机遇

- 尽管印尼政府在政策上对水稻发展予以重视，但由于种植水稻土地经常不足，导致政策不被广泛认同。食品生产的多样性，为印尼提高生产效率带来机遇。生产具有较高价值的园艺作物及多年生植物可降低其对水稻的依赖。印尼人对麦制品（如面包和意大利面）需求的日益增长亦为其带来机遇。
- 印尼结构性的转变对农业的影响有待解决，此将要求重新界定食品安全定义及其衡量标准。当前食品生产的重心须扩大至包含安全、营养及健康在内的更具广泛含义的食品安全问题。有关转变将令印尼更好地衡量食品安全问题及利用食品价值链上所产生的机遇。
- 印尼工商会（KADIN）通过向政府提供私营企业的建议协助政府制定政策。此次加强合作具有发展前景，令私营企业可与更多政策制定者分享其见解以及自其项目中吸取的教训。

- 作为生产力增长的主要促进者，教育事业正为印尼的食品安全带来机遇。三年前，KADIN、农业部及贸易部共同达成印尼可持续农业伙伴关系(PISAgro)，旨在将农业产量及农民收入增加20%，并将排放量减少20%。PISAgro计划在九个作物区成功试行，该等区域的小农收益增长率介于15%至80%之间。通过实施PISAgro计划，之前每公顷生产5吨大米的小农现已增产至每公顷8吨。
- 印尼政府对诸如小麦等产品的粮食储备体系所给予的政策支持将形成良好的发展。同时，印尼应积极发展东盟粮食安全信息系统及东盟+3宏观经济研究办公室。



### 加强与澳大利亚和 西澳大利亚州合作的可能性

- 澳大利亚很可能会提供生物安全及公共卫生教育及培训，以提升印尼防止空气及水源疾病爆发及传播的能力。
- 印尼计划成为地区内（尤其为穆斯林市场）的牛肉出口国的目标可通过与澳大利亚工商业建立合作伙伴关系得以加强，从而协助该行业的长期增长及发展。澳大利亚和印尼亦有可



能发展第三方机会，即由澳大利亚在育种方面的专业知识与印尼在屠宰及包装方面的专业技能相结合。

- 西澳大利亚州及印尼将可从小麦及谷物生产及加工的合作中获益。印尼顶级的制粉工业可与西澳大利亚州的小麦生产整合，从而利用面粉产品（如面条）需求大幅增长带来的机遇。
- 印尼饮食的改变推动对替代产品（如蔬菜及奢侈品）的需求，从而为西澳大利亚州创造出口商机。西澳大利亚州已向印尼提供胡萝卜和马铃薯种薯，然而所面临的有关空运物流问题以及许可问题有待解决。2015年9月颁布的新经济政策已解决了部分问题。同样，150%的酒类关税已导致部分市场（如玛格丽特河红葡萄酒）无法生存。由于印尼热带水果种植者开始进入澳大利亚市场，因此应促进双边贸易，从而令澳大利亚及西澳大利亚州生产商具备更多机会进入印尼市场。
- 澳大利亚公司拥有很多机会可与印尼企业在食品加工方面建立合作伙伴关系。如，Indofood计划在国内加工125,000吨土豆，而印尼目前的国内土豆产量为30,000吨，意味着印尼须从其他国家进口大量未加工土豆以满足中短期的需求。



# 3: FOOD SYSTEM PRODUCTIVITY AND PUBLIC INVESTMENT

Asia's diversity makes it difficult to speak of a single Asian model or approach to food production. Most of the poorest people in the Asia region are farmers that tend to be net purchasers of food and net sellers of things such as cash crops and livestock products. To achieve food security, farmer incomes need to rise. However with so many Asian countries being densely populated and having low natural resources per capita, the region is becoming increasingly resource poor. One way of achieving increased incomes in this context is through production diversification to higher-value crops.

Farming systems have evolved in response to major social and economic changes as well as to the prevalence of food supply chains for modern food retail systems such as supermarkets (Teng & Escaler, 2014). Other farming approaches have also started to take hold, such as organic farming, which promotes low external inputs and stringent measures against the use of chemical fertilisers that might not be considered safe or to yield products of high nutritional value (Pender, 2008).

## Loss of cropland to urbanisation

While the world's population approximately doubled between 1961 and 2010, the land area devoted to food production showed only a nine per cent increase from 4.460 billion hectares in 1961 to 4.889 billion hectares in 2010. Of these areas, China, Australia, and the United States have the largest agricultural zones of 525 million, 456 million, and 414 million hectares respectively. Projections from the FAO show a wide gap between the declining rural populations and increasingly swelling urban populations across the globe. A similar trend is observed in the Asia region. This shift from rural to urban is prompting land conversion to non-agricultural uses, infrastructure expansion, and land-use readjustments, all of which reduce the land area available to the sector (Regmi, 2014).

Asia's agricultural setting is dominated by smallholders. In Indonesia the Agriculture Census of 2013 showed that the structure of the farm sector consisted of 26.1 million (72.1 per cent) family farms, 4.2 million (11.6 per cent) corporate farms, and 5.9 million (16.3 per cent) other types of farms. Large commercial farms represent a small proportion of land holdings. About 30 per cent of the land in perennial crops is owned by approximately 2,300 large private or state-owned enterprises (OECD, 2012). In the past two decades total agricultural land has contracted in Asia and farm size has reduced, partly due to inheritance fragmentation. With the majority of farms in the Asia region being less than two hectares, shrinking farm sizes are further threatened by natural risks such as soil erosion (Mukharjee, 2012). South Asia has no spare land for agricultural expansion. Here, about 45 per cent of land that has the potential for agricultural production is not in use due to human occupation. East Asia, on the other hand has about 130 million hectares of spare land but much of it lacks infrastructure and is either forested or under wetlands and should be protected for environmental reasons.

The loss of cultivated land creates major constraints on agricultural production and significantly affects food supply and availability. However, in China and Vietnam the Commission heard that efforts to ring fence agricultural land were not necessarily helpful unless land was preserved in the right areas for food production (and for the production of the most appropriate crops in that area). This links in with the comparative advantage approach – on the domestic scale – that regions should align their production centres with the crops that the local environment is best able to support, and land and water should be protected in line with this to help maximise production efficiency.

It is crucial therefore, to focus on policies that protect agricultural land area and water resources, and encourage the development of technologies that promote water and land-use efficiency. Relatively large consolidated farms have the capacity to be more efficient and productive by optimising mechanisation

and using modern technologies. Advances in urban farming modes and agro-technology are also critical, particularly for small urban city-states and net food-importing countries such as Singapore (Teng & Escaler, 2010).

### **Technology and productivity**

Agricultural total factor productivity (TFP) is a measure that factors in land, labour, capital, and material resources used as inputs in production and compares them with total crop and livestock output. Where the total output is growing faster to the inputs an improvement in TFP can be seen. While TFP is an important indicator of productivity in agricultural systems, equally important is the rate of growth in agricultural TFP as an indicator of the ability of food production systems to meet increasing demand. As evident in the table below, the TFP growth rates have been modest across most parts of developing Asia and reports of slowing productivity growth are now causing concern that the world's supply of food may not keep pace with demand.

The root cause of this weakening can be traced to environmental factors, the scarcity of resources, change in climate, and extreme weather conditions, all of which adversely affect production growth. Data on staple commodities show that crop yield growth has decelerated over the past decades, with associated declines in the percentage increase of harvested area and production quantity. During the same period, the world supply of fish has also dwindled due to unsustainable fishing activities. Projections on aquaculture production growth also indicate a slowing trend (Nellemann et al., 2009). At the same time, greater reliance on external inputs to sustain high agricultural productivity has emerged as a concern due to its unsustainability and danger to the environment (FAO, 1994). These scenarios suggest that threats to the global food supply are particularly important in the Asia region where most countries remain strongly dependent on the agriculture and fisheries sectors.

In response to these environmental and productivity concerns, more innovative approaches that lean towards minimal use of external inputs such as resource conservation measures, minimum tillage, and integrated pest management are needed (Pender, 2008). During the 1960s the Green revolution, technology innovations, scientific advances and research investments transformed and fuelled growth and development in the agricultural sector. New farming practices and high yielding crop varieties were particularly significant. Science and technology will continue to play a key role in innovating food production (Teng et al 2015).

It is also important to note that appropriate pest and disease controls protect biodiversity and the ecosystem services essential for productive and resilient agricultural systems. Maintaining effective biosecurity measures can contribute to enhancing TFP by reducing the application of inputs such pesticides and herbicides to crops, and antibiotics to livestock, and also by reducing food loss due to pests and diseases during the production and storage phases of the supply chain. Exotic invasive species are estimated to cause US\$1.4 trillion in losses per year globally on an ongoing basis. In the case of regional crop losses in staples such as wheat, rice and maize, in dollar terms, Asia sustains the greatest economic impact of loss arising from known pathogens.

With Asia expected to dominate global growth both in exports (7.2 per cent) and imports (7.0 per cent) over the coming two to three years, biosecurity risks associated with trade in the region are likely to grow. Additional challenges are presented through transnational dispersal through natural means such as wind or water, or specific actions outside of normal trade and transport pathways, such as military operations and the provision of food aid.

### **RECOMMENDATION 3.1**

Promote the adoption of new and improved environment-friendly technologies and practices to increase the productivity of the food production system. Programmatic interventions are required across Asia in order to inform and change farming practices e.g., via integrated pest management.

### **Productivity-related reforms within the production system**

Food production in Asia is predominantly conducted by smallholder farmers who therefore play a major role in food security, both in fulfilling their own food security needs and in supplying some portion of their food production to the market. Understanding the major characteristics and constraints of smallholder farming is therefore crucial when addressing an appropriate policy framework. The decentralisation of agricultural production systems, the formation of cooperatives, investment in agricultural research and development systems, rural infrastructure investment and the liberalisation of pricing and marketing systems have all been part of the agricultural reforms in parts of Asia. Making it easier for rural workers to access urban jobs and getting particular locales to focus on higher value-adding products can help reduce the income gap and increase the returns on public investment. Japan's "One Village, One Product" movement serves as a good benchmark.

#### **BOX 3.1: Japan's "One Village One Product" movement**

Originally called the "New Plum and Chestnut" movement in Oyama village in Japan's Oita Prefecture, the "One Village, One Product" movement started in 1961. Oyama village is not suited for rice production because of its location in the mountainous area of southern Japan. Therefore, the farmers planted perennial crops that are easy to harvest and highly profitable while also producing higher value-added processed products from plums and other fruits. Their famous catch phrase was, "Let's go to Hawaii by planting plums and chestnuts".

The then governor of Oita Prefecture Morihiko Hiramatsu was inspired by the success of this movement. Beginning in 1980, he embarked on a process of revitalising the rural economy by creating one special product in each village across the entire Oita Prefecture. The prefecture's local governments contributed capacity building and technical assistance to help local people voluntarily develop their own special products.

The products created by this movement include the shiitake mushroom, kabosu (a kind of citrus fruit), beef from the Bungo area, mackerel and horse mackerel from the Seki area, and shochua, a clear liquor distilled from buckwheat. Overall, more than 300 products were developed with a value of approximately US\$1.2 billion.

This movement has spread to other areas in Japan, as well as other Asian countries including Thailand and Vietnam through activities led by the Japan Overseas Cooperation Volunteers.

### Box 3.2: Operation Flood: India's Dairy Revolution through Cooperatives

Operation Flood was launched in 1970 under the aegis of India's National Dairy Development Board. It was the world's largest and perhaps one of the most successful dairy development programmes. It resulted in the white revolution that made India self-sufficient in milk production and established the nation as the world's largest milk producer, accounting for nearly 20 per cent of the global output at more than 140 million tonnes of milk in 2013/14.

The objectives of Operation Flood were to increase milk production, augment rural incomes, and ensure fair prices for urban consumers. Over the course of its three stages from 1970 to 1996, Operation Flood resulted in more than doubling the per capita availability and consumption of milk in India and made dairy farming the country's largest self-sustaining rural employment generator.

The bedrock of Operation Flood was village milk producers' cooperatives that procured milk and provided inputs and services such as modern management and technology to cooperative members. Unlike dairy industries in most parts of the world, India's dairy industry is built on a strong presence of the cooperatives in production, distribution and retailing of milk and milk products.

Operation Flood created a national milk grid linking millions of small-farm milk producers throughout the country with consumers in more than 700 cities and towns. While reducing seasonal and regional price variations for consumers by eliminating middlemen, it ensured that producers got a major share of the price that consumers paid. Operation Flood resulted not only in mass milk production, but also production by the rural population, which is an important and unique feature of India's dairy industry.

#### RECOMMENDATION 3.2

Consider improving property rights such as land regulation, land consolidation, safeguards for agricultural land and improved markets for natural resources such as water.

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#### RECOMMENDATION 3.3

Increase public investment in infrastructure and R&D, especially in countries where it is low relative to agricultural gross domestic product – and not just in food staples.

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#### RECOMMENDATION 3.4

Encourage smallholder farmers to become part of cooperatives so that economies of scale via farm size expansion and reduction in production costs can be achieved while also leveraging R&D benefits for local production.

Food security in Asia will not emerge from an insular focus. A resilient regional food system synchronised with climatic changes and environmental constraints must be developed in tandem with the broader global production system.

In Asia, positive steps towards feeding people well could include organising production systems on the basis of their comparative advantages, both within countries and between nations. The comparative advantage approach encourages countries to specialise in producing and exporting goods and services that it can produce more cheaply (at lower opportunity cost) than other goods and services, which it should import. Adopting this approach would enable countries to maximise the benefits of their endowments in factors of production such as land and labour, and foster the quality supply chains (and private investment) required for the production and marketing of the agricultural commodities they are best suited to produce and from which they can derive the highest income.

Vietnam has used the approach exceptionally well to increase its market share of global rice and aquaculture markets, such that it has gone from producing negligible quantities of catfish (pangasius) in 1994 to dominating global production in 2009 (1.2 million tons) ahead of China, Indonesia and the United States. Both Vietnam and Thailand are now reducing the production of commodities in which they have less competitive advantage, whereas the Philippines and Indonesia are putting more effort in self-reliance with the risk that in trying to produce enough of everything, they will spread their resources too thinly with the result that they will do nothing well.

As competition in rice production between ASEAN members intensifies, it is important to understand the internal structural constraints that limit emerging producers, such as access to finance or poor infrastructure. These constraints have a bearing on productivity and production quality such that although countries such as Cambodia, Lao PDR and Myanmar are increasing their rice it is of comparatively low quality. Farmers in Myanmar may be able to increase production with better access to finance that can fund productivity-boosting farming activities and competitive behaviour could be removed through a regional mechanism that recognises comparative advantages and allows more collaboration in terms of food reserve pricing.

### **RECOMMENDATION 3.5**

Promote the idea of regional food systems where production systems are defined according to comparative advantage. In doing so, regional economies must take into consideration the internal structural constraints of emerging producers such as Myanmar, Lao and Cambodia.

Private sector investment needs to continue and strengthened in partnership with the public sector. Large companies have for a long time sustained their investments in agriculture, however such action is mostly undertaken independent of farmers, small-medium enterprises, and even state-owned enterprises. The public and private sectors need to enable better linkage of supply chains by encouraging stakeholders to engage in business-to-business, government-to-government, and business-to-government settings. This task cannot be achieved by the private sector alone. Political commitment and leadership is also needed across the region. Once this has been established, countries would be comfortable aligning their production with a comparative advantage approach.

### **RECOMMENDATION 3.6**

Enable and promote private sector investment in the entire supply chain, including provision of inputs, transportation, processing, and distribution. This must be underpinned by political commitment to regional collaboration.

## 4: TRADE POLICIES AND REGIONAL FRAMEWORKS IN THE FOOD ECONOMY

After World War II agricultural protectionism grew in industrial economies while many developing countries taxed their exports of farm products. Those policies continued through to the 1980s, before both country groups began to reform them. The challenge at hand is how best to set policies so as to improve food security now and in the future.

### Trade and pricing

Free trade is good for food security because it allows food to flow from areas of surplus to areas of shortage. In times of crisis, each country's public sector copes differently. Among ASEAN members, countries such as the Philippines and Indonesia have followed a self-sufficiency agenda at a high cost, for example through import restrictions. Meanwhile, exporting countries such as Vietnam and Thailand at times of high prices have restricted their export volumes. Emerging rice-exporting countries such as Myanmar and Cambodia have aimed to target mature markets as opposed to niche markets. The resulting regional policy incoherence is inefficient and lowers regional food security.

Even if it does not benefit a country's poorest households directly, static and dynamic gains from trade openness are known to raise real national income. A gain in national income provides more leverage for the government to assist poor households indirectly. A fall in costs of transport and communication services increases trade and raises real incomes for the countries involved, as does a reduction in trade taxes or import quotas. Changes in government barriers to international trade are, however, less predictable. They have been used occasionally by the region's developing countries to reduce short-term domestic food price fluctuations. Examples include introducing or increasing export restrictions and lowering or suspending import tariffs when international food prices spike upwards, and the opposite when international prices slump.

In terms of altering the long-term trend of domestic food price levels, developing countries have tended to confine themselves to export restrictions if they are net food exporters, and to import restrictions if they are food import-dependent. Export restrictions lower the domestic consumer and producer prices of food, while import restrictions raise them.

Generally speaking, in the early stages of industrialisation governments devote and utilise their resources to create favourable conditions for the development of modern non-farm sectors. This also means fostering institutional reform such as privatisation of state-owned enterprises, encouraging the development of the private sector, and improving macro policy frameworks. Countries with a comparative advantage in agricultural production want to continue to encourage agriculture but, at the same time desire resources for developing non-farm sectors and the urban economy. How can that best be done without detracting from agriculture?

Demand for food is price inelastic. If there is a shortfall in food supplies, then the price will rise – especially for food staples such as grain. As a result of price increases, poor people spending a large share of their household budget on staples such as rice could starve. Such situations trigger responses that were evidenced in 2008, where, for example, the Indian government banned the export of rice to ensure that the domestic price remained lower than the international price. This resulted in panic buying in the Philippines because the household perception was that international stocks were limited. Japan, on the other hand, produces and consumes eight million tonnes of rice annually, and reserves one million tonnes for emergencies. When the international grain price more than doubled during this period in 2008, the consumer price index for food in Japan increased by only 2.6 per cent. This shows that Japanese consumers can afford to be indifferent to international price hikes of agricultural products because agricultural and fishery products including imported grain are nothing but 15% of the Japanese total food expenditures.

The 2008 spike eventually eased when the US supported Japan to export some of its imports under tariff rate quota to the Philippines. This information was enough to burst the speculative bubble. This shows that international agreements to address emergency situations can be helpful when physical reserves are in short supply globally. This also suggests that in the case of rice, which is an important commodity in Asia, a well-designed regional architecture in Asia is worth considering.

Communicating the merits of free trade arrangements is important. Efforts to do so by government, academia, think tanks and industry stakeholders can indirectly improve the participation of smallholder farmers in regional value chains and consequently improve their livelihoods. This will create pathways to raise national incomes while strengthening resilience in regional food systems.

#### **RECOMMENDATION 4.1**

Expedite free trade agreements and food market liberalisation regionally and globally.

#### **RECOMMENDATION 4.2**

Communicate the benefits of food trade liberalisation between countries in Asia by providing appropriate information to all stakeholder groups and raising awareness of benefits.

#### **RECOMMENDATION 4.3**

Commit to minimising price distortions and facilitate increased infrastructure investment by promoting private sector and foreign direct investment in food production systems.

There are a number of channels through which trade openness might boost national economic growth:

- by creating a more attractive investment climate;
- by bringing in new ideas and ways of producing, processing, distributing, marketing and financing; and
- by accelerating technological catch-up.

For these channels to be successfully tapped, governments need to demonstrate political willingness to open the economy and leadership in convincing citizens of its virtues and, if need be, of introducing measures to compensate key losers from such growth-enhancing reforms.

As far as the involvement from the private sector is concerned, in the absence of public stockholdings the private sector has the incentive to contribute to market stability by buying stocks and storing them in times of plenty when prices are relatively low, and selling down those stocks when prices are high. The profit motive is likely to result in the private sector doing this more efficiently and effectively than a public agency, and more so the clearer/less erratic is government stockholding globally. However, when global stocks are low, markets are very vulnerable to price spikes if there is an unexpected drop in production or a surge in consumption (Wright, 2011). Because of that, citizens and governments often take comfort in knowing they have access to public reserve stocks of staple foods. Such public stockholding might be more cost-effective if undertaken in collaboration with like-minded governments.

#### Box 4.1: Cooperative Bulk Handling and supply chain management

Cooperative Bulk Handling (CBH) is Western Australia's largest grain handler, which allows it to achieve some strong economies of scale. It is also WA's largest grain exporter. CBH bought a 50 per cent stake in Interflour Group in Indonesia in 2004. Although subject to some criticism at the time, CBH had the foresight to use Interflour's capability to alleviate long term supply chain inefficiencies, given that Interflour had subsidiary operations in Malaysia, Vietnam and Turkey. In 2013, CBH's share of Interflour profit totalled AU\$8 million. To further alleviate supply chain inefficiencies, CBH is part of a consortium that is building a new agricultural export terminal at the port of Newcastle in New South Wales.

In 2013, CBH rebated growers more than A\$4.75 million from the group's operations, marketing and investments to help offset grower handling and storage charges. CBH also invested A\$155 million to upgrade and maintain the network and receiving sites, plant and equipment, ports and rail operations. This investment will help CBH continue to deliver efficient storage and handling to its grower members in the future.

#### RECOMMENDATION 4.4

Develop policies to support lowering of trade-related transaction costs, creation of improved information systems, better marketing strategies and infrastructure such as storage, distribution and transportation systems for public and private institutions engaged in the food value chain.

#### **Mapping regional frameworks**

Asia has three regional organisations that work on a wide range of issues related to development and security. These are:

- the Association of Southeast Asian Nations (ASEAN), comprising the 10 countries in South-East Asia, namely Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, The Philippines, Singapore, Thailand and Vietnam;
- the ASEAN Plus Three (APT), which brings together the 10 ASEAN states with China, Japan and South Korea; and
- the East Asia Summit (EAS), which includes the 10 ASEAN Plus Three countries plus Australia, New Zealand, India, the United States and Russia.

The geographical footprint of all the EAS member countries presents a huge potential to address food security issues – from availability and access to affordability and utilisation. The track record of these regional organisations in responding to food security, however, is rather mixed. The region's experience with the 2008 food crisis compelled ASEAN members to create new and strengthen existing regional mechanisms to address the challenges posed by food insecurity. These regional mechanisms are built within the ASEAN Integrated Food Security (AIFS) Framework, which was established in 2009. AIFS aims to address the region's long-term food security by outlining the scope of joint approaches for cooperation among ASEAN member states.

The AIFS Framework is supported by the Strategic Plan of Action on Food Security (SPA-FS)<sup>5</sup>. The SPA-FS aims to 'ensure long-term food security and improve the livelihoods of farmers in the region', and has six objectives (Economic Research Institute for ASEAN and East Asia (ERIA)):

increase production;

- reduce postharvest losses;
- promote conducive market and trade for agricultural commodities and inputs;
- increase stability;
- promote availability and accessibility to agriculture inputs; and
- operationalise food emergency relief arrangements.

The effectiveness in addressing food security concerns of these comprehensive strategic frameworks has yet to be assessed. But it is helpful to examine the experiences of the ASEAN Plus Three Emergency Rice Reserve (APTERR) and ASEAN's Integrated Food Security Information Systems (AFSIS) as illustrations of the kinds of challenges that confront these types of regional arrangements.

### **ASEAN Plus Three Emergency Rice Reserve**

APTERR was conceived after the 2008 food price crisis<sup>6</sup> and was launched as an ASEAN Plus Three initiative in July 2012 with four principle aims; to make more rice available during emergencies; to stabilise the price of rice; to improve farmers' income and welfare; and to improve food security without distorting the international rice market.

APTERR is comprised of both earmarked pledges (commitments from national reserves) and physical pledges (rice exclusively allocated to APTERR). Earmarked pledges form the major part of the commitments, a total of 787,000 tonnes. The Plus Three countries account for 700,000 tonnes, while the ASEAN member countries have pledged a total of 87,000 tonnes. Under the APTERR arrangements, rice is made available through a three-tier system involving special commercial contracts, emergency grants and loans, and the delivery of donated rice in times of acute emergency.

While having regional rice reserves is a good strategy, more can be done to improve the current APTERR mechanism. Firstly, the contribution of each ASEAN country is quite low when considered in the context of their rice production and consumption capacities. National rice reserve strategies usually require at least one or two weeks of domestic consumption volume be set aside. Considering that some countries in South-East Asia are among the world's largest rice producers and consumers, there is room to increase ASEAN commitments. Secondly, there is scope for some ASEAN members to increase their financial commitment to APTERR.

There is also merit in expanding the APTERR membership to include other countries within the EAS framework, such as India and the United States. Both countries are major rice producers and each has the capacity to make a significant contribution to the regional rice reserve mechanism. Furthermore, to successfully progress the regional rice reserve arrangement, member countries should be encouraged to boost their voluntary contribution by earmarking a certain percentage of national production as a contribution to countries in the region that are in need. For example, Japan currently commits half a million tonnes of rice to countries in need, but it could increase this contribution. A strong political commitment by countries to strengthen APTERR would help stabilise markets in times of price volatility and food crises. For governments, the cost associated with earmarking reserves will not be high, as the market will factor

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<sup>5</sup>ASEAN Secretariat. (2011). ASEAN Integrated Food Security (AIFS) Framework and the Strategic Plan of Action on Food Security (SPA-FS) in the ASEAN region 2009-2013. Available at (<http://aseanfoodsecurity.asean.org/wp-content/uploads/2011/08/aifs.pdf>)

<sup>6</sup>ASEAN Plus Three Emergency Rice Reserve Agreement (2011). Jakarta, Indonesia, 7 October. Available at (<http://www.scribd.com/doc/97411992/APTERR-Agreement>)

in a commitment to tackle the shortage when such situations occur. Physical reserves may not even be needed as long as there is a political commitment and a willingness to step in and address regional food shortage issues. Agreeing to earmark a percentage of production as a contribution for emergency situations can also help countries in the region minimise future governmental expenditure that would otherwise be needed to respond to situations of food shortage or price spikes.

While these improvements are necessary for APTERR, it is also important to recognise the changing diet preferences across Asia. A trend is widely developing across Asia wherein countries are losing its appetite for rice in favour of wheat. South Korea is leading this trend where, in 2014 rice consumption was the lowest at 65.1kg per person per year and flour consumption in the form of bread, pastries and noodles etc. was at 33.6kg per person per year (highest since 2006). Similar trends are being witnessed in other parts of Asia e.g. noodle consumption in Indonesia (second biggest wheat importer) lifted wheat demand by about 60% since 2005 to about 8 million tonnes annually; wheat consumption in India (second biggest wheat grower) is projected to surpass output by more than 5 million tonnes annually; and Bangladesh is set to import 4 million tonnes to meet local demand of 3 million tonnes annually. Wheat is therefore becoming an important commodity across Asia as it sees 40 million tonnes being shipped in annually and occupying 25 per cent of the world's imports (Cho and Jang, 2015).

Improving and expanding a regional food reserve scheme as part of policies to stabilise food quantities and prices needs to be accompanied with reforming the national food reserve policy. Some countries in Asia (for example China and Indonesia) are implementing food reserve management policies that might prove to be ineffective and create a fiscal burden. Therefore, national governments need to transform their food stock policies to be in line with market-friendly stabilisation policies, such as a warehouse receipt system, futures markets and other alternatives.

#### **RECOMMENDATION 4.5**

Review the APTERR framework with a view to broadening its scope, particularly in terms of:

- Expansion of membership;
- Expanding the scope of regional rice reserves beyond natural disasters and emergency use to consistently stabilise the market;
- Inclusion of wheat within the APTERR framework;
- Enabling the involvement of private sector operators to store and manage such reserves through public-private partnerships at the regional level.

#### **Regional capacity building and information sharing**

Even though many countries might achieve food security for the short term, eliminating food insecurity altogether is a long-term issue. Creating a resilient global food ecosystem is a necessary prerequisite to address long-term challenges. To enable such a food ecosystem to operate efficiently, ongoing information exchange on national policy directions is required. Many have suggested that one of the reasons for the 2008 crisis was not necessarily the lack of food stocks, but rather the lack of confidence in the information on stocks at the national and regional levels. This is an indication of poor and disconnected information systems. To avoid such situations in the future, a wider-ranging information exchange, for example on stock-to-use ratios at the national, regional and global levels, could be put in place.

Information flow between ASEAN countries and other nations that play a critical role in the region – for example India, China and Japan – must be improved, particularly relating to issues impacting on

agricultural resources that are used for food production. Examples of such issues include land availability, water supply, soil conditions and salinity issues. Information on the pricing of such resources – for example land in different economies – would provide an improved understanding of the urbanisation rate of such scarce resources. This would help the region better understand what proportion of yield increases would be necessary to cope with the ongoing demand and deficiency of natural resources. Improved collection and dissemination of data would also help the private sector operate more efficiently through improved resource allocation, better storage, and optimal management and decision-making.

ASEAN's Integrated Food Security Information Systems (AFSIS) aims to forecast and monitor supplies and the uses of basic food commodities. Efforts to make AFSIS a credible regional information platform are hampered, however, by the lack of timely, reliable data from member states<sup>7</sup>. The issues of data quality and timeliness are dependent on the way member states manage data inflows. Information on agricultural production is often guarded as trade and/or national secrets.

Given the importance of regional information sharing and exchange, ASEAN needs to develop greater trust and transparency in order to help its member states – as well as other states in the wider region – address food security concerns. Information such as physical food stocks could be made more transparent, while changes in food policies and lessons learnt could be incorporated as part of the information-sharing exercise. These types of information sharing would help to engender trust and greater confidence among neighbours and help minimise volatility and panic in regional and international markets in food crisis situations.

### **Optimising the ASEAN Economic Community**

A significant development in one of the regional organisations in Asia is the establishment of an ASEAN Economic Community (AEC). One of the AEC's major objectives is to have a highly competitive economic region that promotes equitable economic development. Within the AEC framework, it is envisioned that food security – particularly food availability – could be improved through the promotion of closer trade. Improving regional trade would help sustain agricultural production in the lowest-cost locations while enhancing competitiveness through harmonising food quality and safety.

Despite current efforts to improve food availability through trade promotion, protectionist practises persist. National policy agendas grounded in self-sufficiency could be better calibrated with improved regional architecture. Learning and sharing between countries enables better national policies to be created, allowing them to be synchronised with regional concerns.

As the region moves ahead with realising the AEC, more concerted efforts should be made to address protectionist tendencies of member countries, as these could adversely impact the goals of food availability and access. Further improvements in trade facilitation could be achieved by strengthening current efforts in promoting physical and institutional connectivity. These include improving the speed, frequency and ease of transport, border clearance and transit services, and the expenses of wholesale and retail distribution. These measures would help address the region's inadequate and inefficient logistical services, which have led to excessive spoilage of perishable food products (Eria.org).

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<sup>7</sup>RSIS Centre for Non-Traditional Security (NTS) Studies. (2010). Report on Food Security Expert Group Meeting 'Food First: Ensuring Food and Nutrition for Urbanites'. 4–5 August. Singapore.

## **Forging partnerships and strengthening intra and inter-regional collaboration**

To further advance a comprehensive food security strategy, more efforts must be made to strengthen partnerships with other regional and international organisations and promote collaborative research and development. ASEAN with the Plus Three countries and the wider EAS framework could strengthen collaboration with international institutions, such as:

- Food and Agriculture Organisation (FAO);
- World Food Programme (WFP);
- International Fund for Agricultural Development (IFAD); and
- International Rice Research Institute (IRRI) and other research bodies.

The vast resources of international research and development institutions could help countries in the region with the multiple challenges they face concerning food security. In areas of food safety and nutritional security, developing countries need valuable assistance from the FAO. Similarly, in improving access to good nutritional food, the assistance of the WFP would be extremely helpful. Furthermore, in areas of improving production of different food commodities, strengthened partnerships with IRRI, IFAD, and other relevant bodies would engender closer collaboration in improving food security.

Information pooling and experience sharing among these agencies already exists. But for the region to tackle all of the interlinking and multi-faceted elements of food security optimally, a broader and more comprehensive Asian Partnership on Food Security must be established, championed by growing economic powerhouses such as India and China. While such developments may seem ambitious, with regional buy-in and political willingness the aspirations of such a partnership can be achieved.

Some would argue that food information has become politicised and that countries are making decisions about food security issues (and developing their food security strategies) on grounds that are largely political, and that may result in misrepresentation, policies and signals that cause panic within the entire regional (and global) food system grounded in politics rather than what is actually happening in food systems on the ground. To alleviate some of these concerns, an independent and regional coordinating body could be created. This body could facilitate multiple activities including, but not limited to, information on pricing and climate predictions, and help to depoliticise the interpretation of information. This approach could also facilitate the creation of a harmonised data collection and management strategy for the region, as well as a holistic regional strategy that spans the value chain, including concerns relating to food loss, food waste management, food safety and nutritional security.

### **RECOMMENDATION 4.6**

Consider the establishment of an independent pan-regional food security agency:

- To curate relevant information and datasets;
- Develop and implement a data management strategy;
- Agree upon datasets for release for information sharing and pooling, e.g., stock-to-use ratio;
- Deliver an annual regional food security outlook conference;
- Develop a coherent Asian Partnership on Food Security encompassing aspects of food safety and nutritional security;
- Develop a regional strategy to minimise food loss (e.g., technological advancements for post-harvest technologies) and communicate the importance of food waste management and minimisation.

# 5: INNOVATION FOR FOOD SECURITY

Over the past 60 years, innovation enabled the United States to increase its agricultural output by 250 per cent for the same amount of inputs (Simmons 2015). There are many gains to be achieved by helping developing countries in Asia to access, adapt and develop their own context-specific innovations to improve production systems. There are many innovations in production – for example better post-harvest technologies or higher yielding breeds – that are being used in developed countries but have yet to be applied in developing countries. An innovation system that is underpinned by research and development and support services could be linked to broader development once human capital is made more efficient.

## **Research and capacity development systems**

The benefits of agricultural research and development are known to far exceed its costs. Annual rates of return on R&D can range from 20 to 80 per cent (Alston, 2010). Asia has been home to some well-managed and funded research and development systems that have produced world-class research, particularly in China and India. For example, in India 23 per cent of patents are filed by the public sector in comparison to eight per cent in Australia and an average of six per cent in OECD countries. Between 1996 and 2008, agricultural research and development spending in the Asia-Pacific region increased by 50 per cent, from 8.2 to 12.3 billion in 2005 Purchasing Power Parity (PPP) dollars<sup>8</sup>. The main drivers of this growth were China and India, which accounted for nearly 70 per cent of the total.

From the mid-1980s to the mid-1990s in Asia, public and private sector agricultural research and development grew in real terms, however the rate remained too low to fill the gap needed to support the region's rapid growth in demand for agricultural products. The most important factor inducing this growth was the liberalisation of industrial policy, which enabled private and foreign firms to operate and expand in agricultural input industries.

For example, in India, private sector spending has more than quadrupled since the mid-1990s and in 2008/09 accounted for nearly one-fifth of India's total annual public and private agricultural research and development investments. Thus, increasing agricultural research and development spending is a strategy for Asian countries to pursue if they wish to reduce the rate of decline in their food self-sufficiency.

## **Agricultural careers in Asia**

No region in the world can match the size of Asia's agricultural workforce. Asia is home to almost 80 per cent (1 billion) of the world's (1.3 billion) agricultural workers, followed by 14.3 per cent in Africa, 3.6 per cent in Latin America and 3.7 per cent in the rest of the world (FAO, 1996a). China and India provide more than 60 per cent of the world's agricultural labour and 78 per cent of the total for Asia.

In developed and developing countries alike the agriculture sector tends to have a poor image. Agricultural jobs are frequently beset by poor wages, low productivity, underemployment, lack of social protection and exposure to a variety of risks, including weather patterns and volatile markets (IFAD). In the developing world the conceptualisation of agriculture as a vocation for the unskilled has augmented the urbanisation trend, with young males in rural areas migrating to cities in search of more sophisticated and better remunerated employment.

Consequently, the region is observing a declining level of enrolments in agricultural schools (Atchoarena and Holmes, 2005). In India graduates with agricultural qualifications prefer jobs in the public sector however insufficient employment opportunities have caused a decline in enrolments in agricultural universities. In

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<sup>8</sup>Purchasing Power Parity (PPP) is an economic theory that estimates the amount of adjustment needed on the exchange rate between countries in order for the exchange to be equivalent to each currency's purchasing power. <http://www.investopedia.com/terms/p/ppp.asp>

economies such as Malaysia and Thailand, competition from the better paying industrial sector is making the agricultural sector a less attractive employment option.

At the entry level, institutions need to produce graduates that understand and can operate within an integrated and holistic food system. Expanding agricultural science training to include learning opportunities that are integrated with social sciences, business, economics and other related fields broadens graduate skill sets and enhances employability. This would be particularly advantageous in countries in the region such as the Philippines and Malaysia where public extension service providers have more than one portfolio to manage across many levels of governance. This has created the need to maintain a core set of people well trained in agriculture through a mix of practical, technical and academic training. Agriculture will need well-trained people, not to only work on farms, but at all points of the supply chain, and to provide extension services and conduct research. This would require achieving an appropriate balance in postgraduate training for agricultural workers with higher degree research training for selected groups to carry out research and teaching.

Agricultural careers need to be promoted as successful and respectable career options. Farming is often portrayed as “masculine” despite growing recognition of female representation in and contribution to agricultural productivity. Empowering young women could therefore be particularly important. According to FAO, if women in developing countries had the same access to productive resources as men do, yields would increase between 2.5 and four per cent (IFAD). To ensure youth involvement in the agricultural sector, in August 2015 young agricultural leaders from across the world signed the Canberra Youth-Ag Declaration with a view to presenting it to the UN Committee on Food Security. Some of the themes identified in the declaration relate to promoting and enhancing the image of farmers, creating a global network of young agricultural innovators and encouraging responsible consumption through better education and use of resources (The Land 2015).

#### **RECOMMENDATION 5.1**

Maintain a balance between education programs that produce graduates with specialist skills, and programs that train generalists capable of systems level thinking and implementing solutions.

### **Extension and technology transfer systems**

Public extension systems are a support system for farmers allowing them to access information on new farming practices and technologies and have a vital role in transferring information from the regional knowledge base to farmers at the local level, supporting enhanced productivity and decision-making capacity.

In recent years, extension has been couched within a technology transfer process. In many Asian countries, research institutions have strengthened, but extension systems have not kept up. In Asia, most small farmers operate on farms less than two hectares in size and projections indicate that this trend is unlikely to change in the short to medium term. Despite the growing urbanisation trend, the proportion of agricultural labour to total employment is expected to remain high across most populous parts of the Asian region. The agricultural workforce will continue to need publicly facilitated extension systems, although some advanced technology transfer extension systems might become privatised.

Investments in extension services could improve agricultural productivity and increase farmers' incomes, especially in developing economies. The impacts of extension are usually greatest in the early stages of

new technology dissemination, when information imbalance is at its greatest and extension departments form the centrepiece in many countries' agriculture ministries in terms of employee numbers.

Existing publicly facilitated extension models in Asia are being challenged to look for less costly and more pluralistic systems that could be privatised or provided by non-government organisations (Antholt 1998 and Anderson 2007). In developed parts of Asia the private sector has stepped in to provide extension services. Box 5.1 provides an overview of the Lotus Rice experience in Vietnam, which has developed a new tri-partite model for the provision of extension services that involves farmers, the company and the local government.

### **Box 5.1: Lotus Rice in Vietnam**

The Lotus Rice factory is located in the Mekong Delta near the Cuu Long Rice Research Institute, Can Tho. The firm works with farmers, research institutes and the government to buy high quality seed. Ninety-nine per cent of harvesting in this region is carried out by machine. Lotus Rice buys paddies from farmers on a contract basis and provides technical assistance to farmers regarding rice health and use of inputs to help produce high quality rice.

Lotus Rice sees the new form of agribusiness consolidation in Vietnam as having a single farm of 2,000 hectare growing just one type of rice using standard approaches, with cooperation between farmers, the company and local government. As this approach starts to demonstrate benefits, it could be used to convince the government that such a scaling approach could be adopted. Farmers following these procedures and securing benefits demonstrates the benefits of working together. Over time, Lotus Rice hopes that this collaboration will build trust and create new opportunities.

The firm appreciates the need to work with farmers to reduce inputs before it can enable them to move to high value adding organic practices, as water and environmental considerations must be adhered to in order to secure organic certification. Marketing is a key element of its success. Lotus Rice believes that the transition from current production to organic products will take approximately five years. The company manages organic production as a separate project from its core business and it will maintain between 70 and 80 per cent of its current production of high-quality non-organic rice, transitioning to organic over time so that certification can be achieved for export to Europe. The firm has also started cooperation with Japan to diversify and produce sushi rice.

### **RECOMMENDATION 5.2**

Maintain traditional public sector extension systems to ensure small farmers continue to have access to new knowledge and technologies whilst encouraging the private sector to emphasise technology transfer systems aimed at expediting the adoption of new private sector technologies.

## **Technologies and regional research and development cooperation**

For farmers to move up the value chain, it is imperative that consideration be given to increasing farm productivity, as discussed in Chapter 3. Besides considerations such as farm size expansion, providing avenues for research application and technology uptake are critical. Small-scale farmers require access to research and development but perhaps not at the high-end level. High science and low cost technology

outlay is what small-scale farmers need. For example, Japan invented the technology automatic planting machine for rice 30 years ago. This invention is only recently finding its way to countries like India, China and parts of South East Asia.

An area of research that could benefit Asia is in the development and deployment of genetically modified (GM) crops. Research shows that agricultural biotechnologies – especially transgenic crops – could boost food security by lifting farmer incomes, lowering food prices and improving food quality (Anderson 2010). Although significant private and public sector research is taking place across the region, at present there are only four countries actively growing GM crops; Australia, China, India and the Philippines. In many ways miscommunication and uncertainty about the impacts of GM crops have been the primary factor precluding wide-scale uptake of genetically modified crops (Klumper and Qaim 2014).

The recent *Global status of commercialised biotech / GM crops* Report (ISAAA, 2014) confirmed significant multiple benefits of GM crops in the last 20 years. It noted that “on average GM technology adoption has reduced chemical pesticide use by 37 per cent, increased crop yields by 22 per cent and increased farmer profits by 68 per cent.” Provisional data for 1996 to 2013 showed that biotech crops contributed to food security, sustainability and environment/climate change by: increasing crop production valued at US\$133 billion, providing a better environment by saving approximately 500 million kilograms of pesticide use between 1996 and 2012 and conserving biodiversity by saving 132 million hectares of land between 1996 and 2013; and helping to alleviate poverty for more than 16.5 million small farmers and their families, a total of more than 65 million people, some of which are the poorest in the world (Biotech-Now).

Biotech crops are essential. Adherence to good farming practices, such as crop rotations and resistance management, is a must for biotech crops, as it is for conventional crops. Some of the new technologies will eventually filter down to smallholders, just as happened in India with insect resistant cotton, which revolutionised cotton production and increased income for small farmers. There is ample scope to increase production, improve human health, reduce losses and improve distribution. The Gates Foundation is investing heavily in new technologies for subsistence farmers in Central and West Africa – much of which is based on solving pest and disease problems by using a transgenic approach. Figure 7 shows the rate of farmer uptake of GM crops and reveals that it has taken less than 10 years for India’s cotton crop to become essentially 100 per cent GM, with most farmers being smallholders. As a result, India is now the world’s top cotton producer. Similarly, Pakistan took three years to go from zero to 100 per cent GM cotton (Jones 2015).

### **RECOMMENDATION 5.3**

Communicate the merits of GM products across the region, paving the way for increased private R&D investment. New biotechnologies are indispensable to provide the food production and productivity gains needed for Asia to feed itself and for food exporting countries to continue their exports.

To enhance production by adopting new technologies, regional research collaboration must be expanded. The Southeast Asian Regional Centre for Graduate Study and Research in Agriculture and the International Rice Research Institute (IRRI) are examples of regional collaborations. For example, IRRI’s market research team developed a new application ‘Investment Game Application (IGA)’, which could help farmers in South Asia and South-East Asia participate in an investment market for public rice breeding. Using the application, farmers select a preference for rice-breeding products that would impact on their livelihood while dealing with risk and cost trade-offs. The challenge for farmers is to use the small investment pool to create a 10-fold return by designing their ideal rice variety (Demont 2015). IRRI has also developed a ‘Crop

Manager app', a decision-making and advice tool that helps farmers increase their income by US\$100 per hectare per crop.

Such innovations help farmers to learn new technologies while improving their management and decision-making capabilities. The permeation of mobile technologies in some African countries has resulted in farmers being able to track real-time price movements in various food crops. Improved means of information pooling, technology exchange and research collaboration between institutions need to be followed up with technical cooperation across regional economies.

From a regional research capability and institutional perspective, the middle-income countries of Asia could lift their support and for investment in the Consultative Group for International Agricultural Research (CGIAR) and other international research agencies. This would provide a payoff to the region by extending the research outcomes into national agricultural research systems (NARS). The Australian Centre for International Agricultural Research (ACIAR) is a good example of how a competent national agricultural research centre can work with regional partners to enhance agricultural capacity building in Asia through focused projects aimed at addressing specific issues.

### Box 5.2 ACIAR – A Model For Project Partnerships

#### CIM/2013/011 – Indo-Australian project on root and establishment traits for greater water use efficiency in wheat 2

This project builds on previous work aiming at developing wheat with deeper, faster-growing roots that better exploit soil moisture and increase yields in rain-fed or minimally irrigated systems in India and Australia. The project was commissioned by the Australian CSIRO's Plant Industry Division and is being undertaken in collaboration with:

- the Directorate of Wheat Research, India;
- Indian Agricultural Research Institute;
- Agharkar Research Institute, India; and
- Banaras Hindu University, India.

It began on 1 August 2013 and is set to finish on 30 June 2017.

#### LPS/2008/048 – Sustainable livestock grazing systems on Chinese temperate grasslands

This project addresses the degradation of China's grasslands. It will provide evidence and grassland management options to help guide China's research and development agencies on how to alleviate poverty and reduce grassland degradation of by improving household incomes from livestock production while reducing grazing pressures. The project was commissioned by Charles Sturt University Australia, and is being undertaken in collaboration with:

- Gansu Agricultural University, China;
- Lanzhou University, China;
- Chinese Academy of Agricultural Sciences;
- Inner Mongolia Agricultural University, China; and
- China Agricultural University.

It began on 1 July 2011 and is set to finish on 31 December 2015.

#### **RECOMMENDATION 5.4**

Leverage the regional centres of expertise sharing capacities and R&D advancements through collaborative arrangements such as research/ training consortia and other regional forums. Middle-income countries should also continue to support the Consultative Group for International Agricultural Research (CGIAR) and other international research agencies, subsequently allowing the enhancement of national agricultural research systems (NARS).

Interdisciplinary research and development efforts across the entire value chain – including agriculture transportation, storage, processing and household utilisation and nutrition – should be promoted. Investing in new technologies – particularly those relating to minimising post-harvest food losses and the management of food waste – would benefit the region.

The role of education, research and innovation in biosecurity cannot be overstated. There is an urgent need to build scientific, technical and regulatory expertise in all areas relevant to biosecurity. In many countries expertise in the safe trade of animals, plants and aquaculture as well as pathology, epidemiology, risk analysis and public health is lacking. Sustained investment in these areas of the value chain would help offset increased food demand in the future.

New modes of agricultural production such as urban farming could be promoted through research and innovation. Research institutions and businesses should collaborate to enhance entrepreneurial initiatives. Regional governments must support such initiatives through appropriate policy mechanisms and encourage information sharing information on available technologies, including those that have been developed privately.

While countries might choose to outsource some related supply chain activities, to achieve a cohesive regional food security system some innovative capacity in education, research and technology transfer must be retained at the national level.

#### **RECOMMENDATION 5.5**

Strengthen institutional capacities to produce inter-disciplinary researchers, extension and technology transfer workers across the areas of the food value chain.

#### **Management capability**

In addition to encouraging technology uptake, the development of research systems and the improvement of management capability are important, as without efforts in these areas attempts to create innovation systems are likely to be futile.

In developing countries livestock manure is still used as compost for plants. Minimising the quantity of seeds sown to ease stress on the land and allowing nature to take its course to increase crop yield is another common practice. In such instances, enhancement of farmers' capabilities is important. This could be achieved by raising awareness, information sharing, providing advice and associated action that is needed to help farmers maximise efficiency and minimise input costs, such as those associated with excessive use of fertilisers, or even identifying more effective means of nitrogen capture for plants.

In creating an innovative agricultural production system, a balance needs to be achieved between innovative, industrialised and traditional methods. Farmers need new research and development efforts to consider how an ecologically sustainable method of intensive production could be implemented, matched with the opportunity to connect with consumers in new ways. The research and development sector needs to help farmers remain at the forefront of technology-driven production, while ensuring quality and safety in the way in which food is produced.

#### Box 5.4 Little Donkey Farm in Beijing, China

Little Donkey Farm was founded in 2008; its predecessor was a farmers' school called "Yan Yangchu's Rural Construction College (2003-2007), which was run by a group of university professors and students. In 2008, at the invitation of the Haidian District government, the school's management team initiated the sustainable Little Donkey Farm agriculture project in rural Beijing. Little Donkey Farm adopted Chinese traditional agriculture technology and now provides high quality vegetables, eggs, chickens and pork to local consumers.

Little Donkey Farm launched its community-supported agriculture (CSA) projects in 2009. Joining in the classic vegetable box scheme, members (consumers) subscribe for a box of seasonal vegetables every week. By prepaying, the members support the farming work and share the potential risks of agriculture. Besides the vegetable box, the farm provides planting plots to community members that have an interest in farming themselves. In 2013 more than 1,000 families joined in the vegetable box scheme, and nearly 500 families rent their planting plots on the farm.

Sustainability on the farm is measured in two ways. Environmental sustainability is maintained as the project operates under a chemical-free agriculture model; and economic sustainability is achieved with consumers prepaying for the vegetable box. Moreover, the CSA approach strengthens the relationship between producers and consumers. The involvement of consumers in the production process, as well as the transparency of the operation, builds mutual trust and generates social capital.

Nearly 70 per cent of local farmers and staff associated with Little Donkey Farm are female. As a prominent phenomenon evidenced in China, female farmers are becoming the main source of labour in the rural area when young male farmers leave the agricultural sector for work in urban areas as immigrant workers. This has improved the status of females at home and in the community.

Being the first CSA farm in China, Little Donkey Farm promoted the idea of sustainable farming and community-supported agriculture by sharing its technology and business model with the public.

Source: JieYing (2015)

Research shows that in Australia the average cost of employee turnover in the agribusiness sector can cost the farm as much as \$33,500 per employee. When extrapolated to the industry level this cost can balloon to as much as \$336 to \$364 million per year (NFF 2014). Management capability could be improved by:

- better product branding;
- work organisation and job design;
- establishing new agri-food technology-based cadetships;

- harmonising industry certifications and licencing standards using digital technologies where possible; and
- increasing the commercialisation efforts of new research and technological innovations between universities and agribusiness, subsequently creating new knowledge transfer models.

An important driver of production volatility and uncertainty is climate change. Ongoing research and development to improve the state of natural resources is therefore important. Developing a better understanding of the state of food production systems, assessing risks and vulnerability, and issues using early detection systems, including GIS and satellite technologies as used in Canada and Australia, could have benefits for developing economies across Asia. Regions like the Mekong Delta in Vietnam have started to experience the effects of climate change. Rising temperatures, natural disasters and uneven weather patterns are affecting the food production system. Efforts must be made to collect and analyse related data on changing weather patterns and the evolving state of the region's natural resources. With climate change set to have an impact on food production more related and applied research needs to be undertaken to advance new technologies, for example increased tolerance of seeds to changing weather patterns such as floods. With the rise in temperatures and weak cold storage technologies it is reasonable to assume that the amount of food wasted will also increase (Keefe 2015).

#### **RECOMMENDATION 5.6**

Foster, through sustained R&D efforts and public-private partnerships, the development of new business models and information and communication technologies. These innovations should be directed towards alleviating supply chain constraints, building skills and management capability and preparing for impacts of climate change.

# CONCLUDING REMARKS

In conclusion, this report outlines some of the pressing issues facing food security in the region, arising from the Commission's consultations and broader research. The analysis identified how growing resource constraints and climate variability are placing pressure on the region's food production capacities. The result is not only the need to produce more food for increasing (and increasingly prosperous) populations, but to be able to do so using finite land, water, and input resources more efficiently. Countries in the region also need to foster the value chains, organisations and institutions that can ensure that available food is nutritious, accessible and utilised effectively. Addressing these issues is not solely about increasing efficiencies in existing systems and practices, although this is an important part of the story. There is also a need for novel solutions that represent incremental changes in the capacity to ensure food security whilst working within environmental, climate and resources constraints. Regional frameworks are an avenue that will support efforts of achieving food security especially where harmonisation of approaches related to food production and management are concerned. Through political willingness and regional collaboration, sustained efforts along the food value chain will help create a resilient and environmentally balanced system.

# COMMISSIONER PROFILES



**Associate Professor Mely Caballero Anthony, Head, RSIS Centre for Non Traditional Security Studies; Rajaratnam School of International Studies, Nanyang Technological University, Singapore**

Dr Anthony is Associate Professor and Head of the Centre for Non-Traditional Security (NTS) Studies at the S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University, Singapore. She previously served as the Director of External Relations at the ASEAN Secretariat and currently serves in the UN Secretary-General's Advisory Board on Disarmament Matters and Security. She is also Secretary-General of the Consortium of Non-Traditional Security Studies in Asia (NTS-Asia) and is a member of the World Economic Forum (WEF) Global Agenda Council on Conflict Prevention. Dr Anthony led the RSIS Centre for NTS Studies' projects for the MacArthur Foundation Asia Security Initiative (ASI). Her current research focus takes on the broad theme of Governance and Non-traditional Security issues. She is also working on a project on Revisiting Regionalism in Asia.



**Professor John Edwards, Director, One Health Solutions**

Professor Edwards consults privately in Asia and Australia as the Director of One Health Solutions. He is an Emeritus Professor and former Dean of the School of Veterinary and Biomedical Sciences at Murdoch University. He recently returned from China, where he worked for the United Nations Food and Agriculture Organisation as the Senior Coordinator for the Emergency Centre for Transboundary Animal Diseases in Beijing. Before his term at Murdoch University he was Regional Coordinator for the World Organisation for Animal Health Southeast Asia Foot and Mouth Disease Campaign in Thailand for 3 years. He was Chief Veterinary Officer for Western Australia from 1993-2001.



**Professor Paul P. S. Teng, Principal Officer, Senior Fellow (Food Security), Rajaratnam School of International Studies, Nanyang Technological University, Singapore**

Paul Teng is currently Principal Officer, National Institute of Education and concurrently, Senior Fellow (Food Security), S. Rajaratnam School of International Studies, Nanyang Technological University, Singapore. He is also Chair, Asia BioBusiness Pte. Ltd. His professional interests are in new agri-technologies such as biotechnology, science-based entrepreneurship, sustainable development and food security. Professor Teng was previously at the WorldFish Center, Malaysia as Deputy Director-General (Research), and at the International Rice Research Institute (IRRI), Philippines as Program Leader for Cross-ecosystems Research. His current service appointments include Chair of the Board of the International Service for the Acquisition of Agri-biotech Applications (ISAAA); Chair, Genetic Modification Advisory Committee of Singapore, and member of the board, Singapore Science Centre, and Malaysian Biotechnology Information Centre.



**Professor Kym Anderson AC, Professor of Economics, Crawford School of Public Policy, ANU; George Gollin Professor of Economics, University of Adelaide**

Professor Anderson is the George Gollin Professor of Economics, foundation Executive Director of the Wine Economics Research Centre, and formerly foundation Executive Director of the Centre for International Economic Studies at the University of Adelaide. In 2012 he rejoined the Australian National University part-time as a Professor of Economics in the Arndt-Corden Department of Economics of ANU's Crawford School of Public Policy.

Professor Anderson is a Research Fellow of Europe's London-based Centre for Economic Policy Research, a Fellow of the Academy of Social Sciences in Australia, a Fellow of the American Agricultural and Applied Economics Association, a Distinguished Fellow (and former President) of the Australian Agricultural and Resource Economics Society, a Fellow (and Vice-President) of the American Association of Wine Economists, and a Fellow of the Australian Institute of Company Directors. Corporate Board positions include as a Commissioner of the ACIAR Commission of the Australian Centre for International Agricultural Research (since 2011), and as (since 2015) Chair of the Washington DC-based International Food Policy Research Institute. He has also recently been appointed a Member of the Expert Working Group for the Australian Council of Learned Academies' project on *Securing Australia's Agricultural Future*.



**Dr Dang Kim Son, former Director General, Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD), Vietnam**

Dr Dang Kim Son holds a PhD in Farming System Research from Vietnam Agricultural Science Institute, an MA in Development Economics from the Food Research Institute, Stanford University, and a BSc in Agronomy from Hanoi Agricultural University. He served with the Ministry of Agriculture and Rural Development from 1997-2000, when he became the Deputy Director-General of the Agriculture and Rural Development Policy Department, serving in this role until 2003. In 2004 Dr Dang Kim Son became the Acting Director of the Information Centre for Agriculture and Rural Development and then the Director in 2005. From 2005-2015 he served as the Director-General at the Institute of Policy and Strategy for Agriculture and Rural Development and concurrently as the Director, Centre of Agricultural Policy. Dr Dang Kim Son's expertise includes agricultural policy formulation and analysis, international integration policy and impact, poverty evaluation and rural development policy.



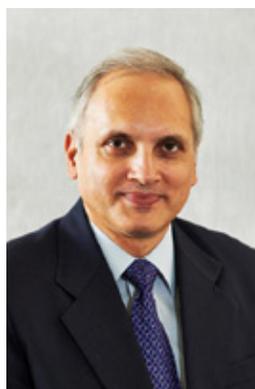
**Dr Zhang Lubiao, Deputy Director General, Department of International Cooperation, Ministry of Agriculture, People's Republic of China**

Prior to his current appointment, Dr Zhang was the Director General and Professor of the Department of International Cooperation in the Chinese Academy of Agricultural Sciences (CASS). Dr Zhang was the Deputy Director General of the *Institute of Agricultural Economics* of CAAS 2000-2005, and was appointed as Deputy Mayor of Chuzhou City of Anhui Province in 2009-2011. Dr. Zhang has over 15 years of professional experience in a range of water management, rural development and poverty reduction issues in China, Africa and Southeast Asia. He is a project leader/coordinator of internationally-financed projects by the World Bank and the United Nations Environment Programme (UNEP). Dr. Zhang has a M.A. in agricultural economics and a PhD in agricultural & environmental economics from Nanjing Agricultural University. He was a visiting Professor of *Wageningen University* and *Resources For the Future* (RFF).



**Dr Yamashita Kazuhito, Research Director, Canon Institute for Global Studies; Senior Fellow (Adjunct), Research Institute of Economy, Trade and Industry (RIETI), Japan**

Dr Kazuhito YAMASHITA is the Research Director at the Canon Institute for Global Studies and Adjunct Senior Fellow at the Research Institute of Economy, Trade and Industry Japan. His expertise covers food and agricultural policy, disadvantaged region issues, WTO agricultural negotiations, trade and the environment, trade and food safety, with his current research focusing on proposals for agricultural policy reform; improvement and reform of agricultural management; analysis of problems with Japan's economic policies by studying agricultural and healthcare policies; investigation and analysis of developments in WTO/TPP negotiations; and, forestry policy research.



**Professor Rajeev Malhotra, Executive Director, Centre for Development and Finance, OP Jindal Global University, India**

Rajeev Malhotra bridges the world of academics and policy making as a civil servant, both at national and international levels. A development economist with over 25 years of experience, Rajeev has worked with Government of India at the Planning Commission and at the Ministry of Finance, where until recently he was Economic Adviser to the Union Finance Minister. Rajeev has trained as macro-economist and has substantial experience of working on macro-econometric models, policy modelling, the formulation of Union Budget and planning process in India. He has been a consultant for Asian Productivity Organization, Tokyo(1994); Commonwealth Secretariat, UK(2002); UN Office of the High Commissioner for Human Rights, Geneva and Kathmandu, Nepal(post-2007); and UN Economic and Social Commission for Asia and Pacific, Bangkok (2009), on issues related to project evaluation, planning methodologies, macroeconomic developments, human rights monitoring and rights based approaches in development.



**Dr. Tahlim Sudaryanto, Senior Agricultural Economist at the Indonesian Center for Agriculture Socio Economic and Policy Studies (ICASEPS), Ministry of Agriculture, Republic of Indonesia**

Dr. Sudaryanto recently completed his term as Assistant Minister for International Cooperation in the Ministry of Agriculture. Prior to his current position, he held the following positions in the Ministry: Director, Indonesian Center for Agriculture Socio Economic and Policy Studies; Director, Bureau of Planning and Finance; Executive Secretary, Directorate General of Food Crop Production; Director for Agro Socio-Economic Research and Development; Executive Secretary, Agency for Agricultural Research and Development; Agricultural Economist, Center for Agro Socio-Economic Research and Development; and Research Assistant on Agricultural Economic Research, Center for Agro Socio-Economic Research. Since 2006 he has served as a member of Technical Committee of the United Nation-Center for the Alleviation of Poverty through Sustainable Agriculture (UNCAPSA). He has written extensively on the rice economy and holds a doctorate degree in economics from North Carolina State University, Raleigh, North Carolina, USA.



**Mr Paul Neesham, Director, International & Institutional Banking, ANZ**

Paul is a Director of International & Institutional Banking for ANZ, based in Perth, Western Australia. Paul is responsible for relationship coverage of ANZ's large and complex clients across several industry segments, including consumer, agribusiness, and diversified industries. Paul has over 15 years' experience in the banking industry, having worked in both Perth and Sydney for major Australian banks in fields as diverse as mining and metals, telecommunications, oil & gas, and manufacturing. He has active engagement with senior management of both the publicly listed and private companies that comprise the Institutional market segment, as well as key service providers to the bank and these companies. Paul holds a Bachelor of Commerce from the University of Western Australia, and a Master of Applied Finance from Macquarie University. Paul is also a Graduate Member of the Australian Institute of Company Directors.



**Professor Richard Harper, Chair in Sustainable Water Management, School of Veterinary and Life Sciences and Leader, Agriculture, Murdoch University**

Professor Harper is the Chair of Sustainable Water Management and Leader of the Agriculture Research Cluster at Murdoch University. Professor Harper has twenty years' experience with the Western Australian Government in programs addressing salinity, plantation and farm forestry and climate change mitigation in both science and policy roles. He joined Murdoch in 2009 and has developed a research program investigating the use of carbon mitigation investment to drive landscape scale change in soil and water management. Recent publications in collaboration with various authors have explored both the science and policy aspects of climate mitigation, using bioenergy, reforestation or soil amendments. Professor Harper is a lead author on the recent (2014) IPCC Fifth Assessment Report (WGIII) chapter on mitigation using Agriculture, Forestry and other Land-Uses (AFOLU), a visiting Professor with the Chinese Academy of Forestry, a member of the Australian Council of Agricultural Deans and a member of Murdoch's Academic Council.



**Dr Chris Vas, Academic Director, Executive Education, Murdoch University**

Dr. Vas is Academic Director of the Executive Education Centre at Murdoch University. His expertise lies in innovation and productivity policy, human capital development, industry trade policy linking global value chains and public management issues with a focus on South Asia and the Middle East. He is the 2014 recipient of the first Australian Government's Australia-India Education Collaboration (AIEC) Endeavour Research Fellowship.

Dr Vas was co-chair of the Trans-Pacific dialogue '*Creating a Productive Future: Social and Economic Challenges, Policy and Governance*' jointly hosted by the Crawford School of Public Policy (ANU) and Harvard Kennedy School (Harvard University). He co-authored '*Tackling Challenges of Productive Growth in Resource Dependent Countries: The Experience of Ghana and Indonesia*' and '*Demystifying Productivity for Better-Informed Policy*'. He has also published in leading journals such as the *Journal of Comparative Policy Analysis: Research and Practice*. Dr Vas holds a Doctorate in Public Policy from the ANU and a Master of Business Administration. He has held visiting positions at Stanford University, Harvard University and at the University of Wisconsin-Madison.



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Catherine Bevan-Jones is the Research Coordinator in the Vice Chancellor's Office at Murdoch University. She is the Research Coordinator and Project Manager for The Second Murdoch Commission, providing research and professional support to the Commission in the Secretariat. Catherine has eight years' experience in project management and research coordination in the public sector and higher education environment. Prior to this Catherine served in the Royal Australian Navy for a number of years. Catherine has a Master of Environmental Management and also holds postgraduate qualifications in Forensic Science.