

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



The **Murdoch**
Commission

Full Report | 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. In keeping with its commitment to the local community Murdoch has two satellite campuses in Rockingham and Mandurah in addition to its main Perth campus. With a strong focus on international collaboration, particularly in the Indo-Pacific region, Murdoch also has Study Centres in Singapore and Dubai, and close ties to Indonesia, Malaysia and China.

Murdoch's reputation for excellence in teaching is fuelled by a commitment to excellence in research and the dissemination of new knowledge for the benefit of our communities, both locally and abroad. The University 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.

Murdoch's research efforts focus on key areas of national and international significance. Strengths include 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 community and industry based partnerships that are complemented by strong international collaborations.

The University is home to a number of highly respected and internationally renowned research institutes that are aligned to its areas of research strength. These include:

The Asia Research Centre

Established in 1991, the Asia Research Centre is an international leader in the study of East and Southeast Asia, undertaking fundamental disciplinary and interdisciplinary research examining a range of social, political and economic forces and developments within this dynamic region. Highlights of the Centre's recent research projects include studies of the political economy of aid effectiveness, populist Islam in Indonesia and the Middle East, and several investigations of the politics of the poor, state-building, representation and political regimes in Southeast Asia.

The Western Australia State Agricultural Biotechnology Centre (SABC)

The SABC is the major research Centre for R&D in agricultural and veterinary biotechnology in Western Australia. It is a resource centre that provides laboratory space, platform technologies and world class equipment and facilities for R&D in agricultural biotechnology to researchers from universities, the State Government (Department of Agriculture and Food WA) and industry. The SABC underpins R&D in biosecurity and food security, crop pre-breeding, transgenic crops, and molecular biology for about 150 researchers, and plays a major role in training Honours and PhD students in a multi-disciplinary environment. Research undertaken focuses on molecular activities (e.g. genomics, gene discovery and functional genomics, marker-assisted breeding, proteomics, molecular diagnostics, genetic manipulation; incubation of start-up companies and commercialisation) that involve or promote primary production of crop plants, commercial livestock, or microbes, or their subsequent processing for added value.

Sir Walter Murdoch School of Public Policy and International Affairs

Taking advantage of Murdoch University's long engagement with practical policy questions and deep expertise on Australia, Asia and the Indian Ocean region, the Sir Walter Murdoch School is an ambitious new venture in graduate education in public policy and international affairs. Masters coursework degrees are offered in Public Policy and Management, International Affairs and Development Studies, with each course specifically designed to enable high-achieving, globally-aware professionals to enhance their career trajectory by developing disciplinary expertise, professional skills and policy knowledge. Each degree concludes with a 'capstone' experience, enabling students to apply their learning to a practical issue through a policy case study project, a professional internship, or a supervised research thesis.

MURDOCH UNIVERSITY: AN OVERVIEW

Food Production and Biosecurity

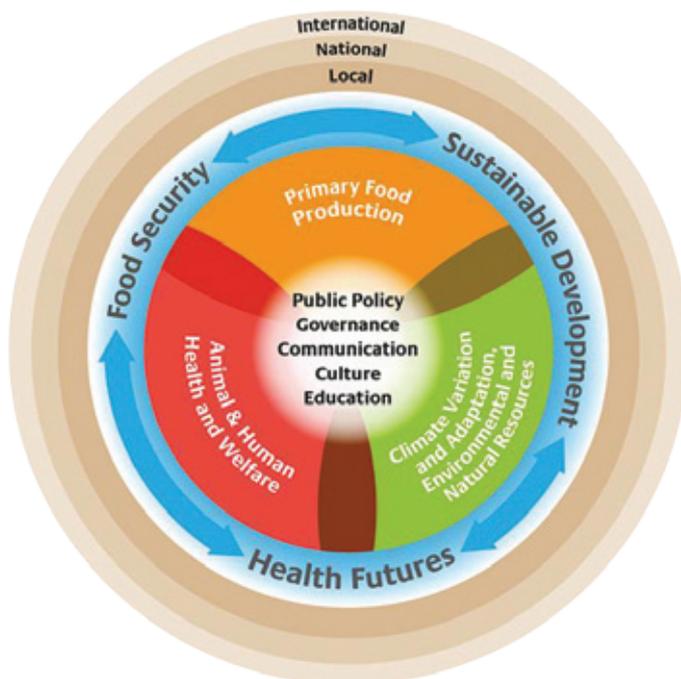
Murdoch's researchers are working with international collaborators to develop strategies, tools and technologies to produce food in a sustainable manner, protect it from loss, and provide it to communities in a biosecure manner. As a core partner in the national Plant Biosecurity Cooperative Research Centre, Murdoch is working to safeguard Australia from invasive plant pests and diseases, and to improve post-harvest food security by developing technologies that protect stored food from pests and pathogens. Two recently established initiatives in China include the Australia-China Joint Centre for the Management and Eradication of Exotic Invasive Species and the Australia-China Joint Research and Training Centre for Veterinary Epidemiology. Together these initiatives aim to improve human, animal and environmental health by undertaking research and training in epidemiology, biosecurity, disease surveillance and risk assessment in crops and livestock.

In 2012, the University partnered with researchers from the Chinese Academy of Agricultural Sciences to establish the Australia-China Centre for Wheat Quality. This genome sequencing initiative has the potential to assist grain growers by identifying disease resistant proteins that are able to tolerate a wider range of climates, as well as quality traits such as those for colour, texture and taste. Murdoch is the only university in Australia to offer the postgraduate Master of Food Security and Master of Plant Biosecurity qualifications, which are supported by on-going research and development linkages with industry bodies, government departments and academia.

Ecology, People and Environment

Exploring the complex interactions between humans and the environment, Murdoch's researchers are translating science into practical and effective management actions such as ecosystem restoration and biodiversity conservation in marine, freshwater and terrestrial environments. The University's trans-disciplinary approach has extended regional, national and international understanding of climate change effects on forest ecosystems, developing novel methods, risk assessment and decision-making frameworks to improve the capacity to sustain groundwater-dependent ecosystems in the presence of climate change. The University also participates in international processes such as lead authorship of the International Panel on Climate Change Assessment Reports.

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

Co-Chair's foreword

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.

EXECUTIVE SUMMARY

Asia has made significant progress towards reducing poverty and food insecurity, and many countries in the region have achieved food security in the short term. Eliminating food insecurity altogether is a long-term issue however, and there is growing concern regarding Asia's ability to provide adequate quantities of safe, nutritious and good quality food in the face of increasing population pressure, urbanisation, and environmental deficits.

The issue of food security as a complex, context-dependent and shared concern formed the starting point of the Second Murdoch Commission (SMC). A core task was to investigate how contemporary food security in Asia is embedded in increasingly interdependent food systems, and to answer the question **how best can Asia feed itself over the coming two decades?**

Against diverse national backgrounds of limited resources – including land, labour and capital, national economic and political concerns, and increasingly unstable weather conditions brought on by climate change – a central concern for the SMC was to investigate how developing multilateral and interdisciplinary regional frameworks and partnerships might help address food security challenges.

The membership and regional sittings of the Commission supported this endeavour. 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.

A distinctive feature of the Commission's work was a futures study entitled Food Security in Asia in 2035. The scenario study assisted Commission members to explore the foreseeable drivers of food security in the region leading up to 2035, which subsequently informed the development of this report and its recommendations.

The Commission was keen to develop a nuanced strategy that acknowledges the challenges associated with food security for each country, whilst registering avenues by which regional collaboration could help cultivate stable and resilient food systems in Asia. The Commission's geographical focus was the Association of South East Asian Nations and plus six (ASEAN+6) group of nations¹. Australia, as a member of this grouping, has a significant role to play in addressing regional food security, by virtue of its role as an exporter of high-quality agricultural commodities and through its significant scientific and technical capacities in the agri-food sector and related areas such as food safety and biosecurity. Western Australia's significant capacities in these areas are also an important part of the regional food security story.

The established architecture for regional cooperation has had mixed success in managing challenges to the regional food ecosystem suggesting that Asia needs a more strategic and holistic approach to create resilience within regional food systems, and ensure adequacy of supply, and sustainable access and utilisation.

Nevertheless, strengthening and deepening regional cooperation will be critical in managing food insecurities. It will require partnership building beyond inter-governmental frameworks that also brings in the wider range of stakeholder groups (private sector, civil society, academia and other relevant actors) to craft policies that advance a comprehensive food security agenda.

Given the trans-boundary nature of many food security challenges a resilient regional food ecosystem must also be developed in tandem with the rest of the global food production system.

Themes and recommendations

Food security is a vast field and a detailed analysis of all its aspects were beyond the scope of the Commission's inquiry. The Final Report and Recommendations address the main issues impacting food security as they have arisen during the Commission's research and consultations, and on the basis of where the combined expertise of the Commission could add the greatest value.

Similarly the scenario study was not designed as a quantitative, predictive study of Asia's food future. The scenarios provided a guide to the Commission's qualitative thinking about the inherent uncertainties in Asia's future, and what actions can be taken to mitigate some of the foreseeable risks to food security in the region in 2035. The hope is to make a helpful contribution to food security debates, and to encourage further positive action around the challenges and opportunities that the region collectively faces.

¹The 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.

Food Security: The Reality

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. 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. This chapter explores the issues that impact the four 'dimensions' of food security – availability, access, utilisation and stability and considers the consequences this has for growth and development in Asia. The recommendations address measures that could enhance the development of resilient regional food systems while giving consideration to the countries' need to follow the best development path for their circumstances.

RECOMMENDATION 2.1

Enhance efforts at improving food safety through the harmonisation 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.

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.

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.

Food System Productivity and Public Investment

Asia's diversity makes it difficult to speak of a single Asian model or approach to food production. In general terms, Asia's agricultural sector is dominated by smallholder farmers. 57 per cent of the region's population live in rural areas. 81 per cent of rural populations are dependent on agriculture for their livelihoods. Urbanisation and environmental deficits are placing downward pressure on agricultural productivity, and there is growing concern that the region's supply of food cannot keep pace with demand. This chapter explores the issues and risks that impact on the productivity of agricultural production systems, such as urbanisation, climate variation, and pests and diseases. It discusses the mechanisms that could help address these issues and makes recommendations for reforms that could support increased productivity.

RECOMMENDATION 3.1

Develop and 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.

RECOMMENDATION 3.2

Consider reforming land regulation including tenancy rights, land consolidation, safeguards for agricultural land and improved markets for natural resources such as water.

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.

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.

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.

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.

Trade Policies and Regional Frameworks in the Food Economy

Economies in the Asia region are developing and maturing at different rates and within different political settings and approaches to food security and trade. The challenge at hand is how best to set policies to improve food security now and in the future. This chapter considers the trends in food trade and pricing policies, and evaluates the existing regional architecture for its effectiveness in enhancing food security and trade in the region, particularly in the face of price volatility and shocks. It makes recommendations aimed at improving the region's capacity to create and maintain an efficient, stable, sustainable and resilient food ecosystem.

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.

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.

RECOMMENDATION 4.5

Review the ASEAN Plus Three Emergency Rice Reserve (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; and,
- Enabling the involvement of private sector operators to store and manage such reserves through public-private partnerships at the regional level.

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.

Innovation for Food Security

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 inputs 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. There is also a need for novel solutions that represent step changes in the capacity to ensure food security whilst working within environmental, climate and resources constraints. This chapter considers the role of education, research and innovation in regional food systems and makes recommendations for capacity building in this regard.

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.

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.

RECOMMENDATION 5.3

Communicate the merits of genetically modified (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.

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).

RECOMMENDATION 5.5

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

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.

1: INTRODUCTION

In late 2013 Murdoch University published the First Murdoch Commission report entitled *Western Australia and the evolving regional order: Challenges and opportunities*. As an independent and international inquiry, the Commission was charged with investigating how Western Australia is connected to the development patterns of the Asia region, and the challenges and opportunities involved in Asia's growing interdependence. Resource interdependence, particularly in relation to food security, emerged in the Commission's research consultations as a major concern. The impacts of the 2007/08 global food crisis loomed large in the minds of many regional actors. The Commission heard of growing concerns regarding the intensification of regional food security difficulties and Asia's ability to provide adequate quantities of safe, nutritious and good quality food in the face of increasing population pressure, urbanisation, and environmental deficits. The Commission reported:

The solution to Asia's resource crisis lies in a combination of two strategies. First, it is imperative to expand the production of minerals, food and energy in the region in ways that are economically sustainable. Second, it is essential to support and enhance resource trade and investment links between regional economies. The depth of regional interdependence ... means that resource security is a collective problem that cannot be addressed by individual governments alone.

The issue of food security in Asia entails both significant challenges and considerable opportunities. This reality formed the starting point of Murdoch University's second international inquiry. The core task of the Second Murdoch Commission was to investigate:

- How contemporary food security in Asia is embedded in increasingly interdependent food systems; and
- How Asia could best feed itself over the coming two decades.

The Commission examined challenges including technical, scientific, economic and policy issues. A central concern was to investigate how developing multilateral and interdisciplinary regional frameworks and partnerships might help address food security challenges, and what role Australia – and Western Australia – might play in advancing this agenda.

Approach

From the outset, the Commission agreed that it is unreasonable to propose that Australia, or Western Australia, could be the 'food bowl of Asia'. Nevertheless, Australia is an important contributor to regional food security because of its role as an exporter of high-quality agricultural commodities and through its significant scientific and technical capacities in the agri-food sector and related areas, such as biosecurity. Western Australia's significant capacities in these areas are also an important part of the regional food security story, which the Commission was keen to explore through its offshore consultations.

The framing of the Commission's inquiry and recruitment of Commissioners was undertaken in 2014. Commission members were recruited from government, business and academia from around the Asia region, as well as Australia and Western Australia. The initial full meeting of the Commission was held in Perth in October 2014. Regional consultations and field trips were undertaken in India, China, Vietnam and Indonesia over the following nine months, together with meetings and consultations within Australia. The Commission Secretariat at Murdoch University provided research and logistical support, and coordinated the drafting and production of the final report. A Western Australia Expert Advisory Group with members appointed from government, business, industry, academia and think-tanks provided valuable input during the Commission's research.

Often described as a 'think-tank in motion', the Commission's mode of operation can be outlined as follows:

- The Commission *is first and foremost a regional endeavour*. This is reflected in the Commission's membership, which includes leading experts and opinion leaders from major Asian economies, along with commissioners from Western Australia and Australia. The Commission also advanced this regional focus through its meetings and consultations undertaken in the region.
- The Commission *acts as an international and independent inquiry*. The business of the Commission was conducted on the basis of intellectual freedom and evidence-based analysis. While the Commission was initiated by Murdoch University, its proceedings and investigations were undertaken without constraint from the University or any other interested parties, such as government or business.

Aims

- 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

In what is a reasonably crowded space of research and policy reports, 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.

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. Commissioners heard how food security is experienced at the level of individuals in rural provincial communities (including issues of small farmers, microfinance, gender, and environmental degradation) through to experiences at the national and regional levels, together with how agri-food value chains are changing and transforming, and the role of innovation, trade and regional partnerships. Consultations conducted as part of the Commission's research 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 scope of the Commission's inquiry was focused on the ASEAN+6 group of nations². 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.

Food Security in Asia in 2035

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.

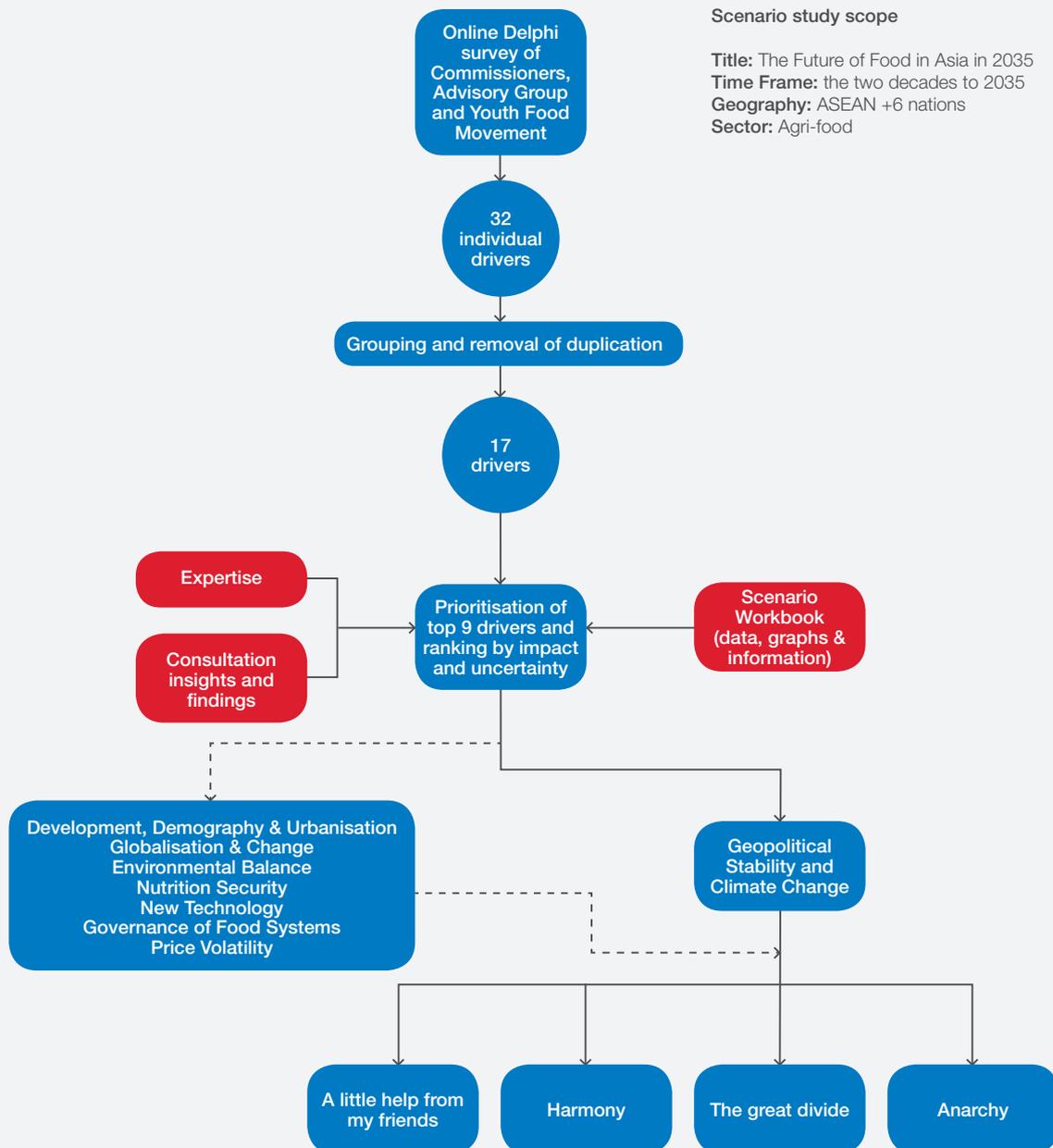
Food insecurities repeatedly and abruptly affect communities and interrupt food availability in various parts of Asia. These interruptions play out differently between the region's food exporters and the greater number of countries in Asia that are net importers of food. Being able to foresee and address insecurities before they result in critical vulnerabilities is therefore a primary challenge for national and regional policy makers alike.

In addressing the questions: **how can Asia feed itself, and how best can it do so**, it is inevitable that the region will require 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.

More importantly, 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 on 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 to 2035. Figure 1 outlines the Commission's scenario study methodology.

²The 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.

Figure 1- Food Security in Asia 2035 (scenario planning process)



In the initial stage of the scenario process the Commission Secretariat completed an online Delphi study with the Commissioners and Advisory Group members to elicit their views on the key drivers of change. The nine key drivers that emerged were ranked based on their importance and likely impact in 2035 (Table 1) and included:

- Development, demography and urbanisation;
- Geopolitical stability;
- Globalisation and change;
- Environmental balance;
- Climate change;
- Nutrition security;
- New technology;
- Governance of food systems; and
- Price volatility.

Table 1 – Key drivers of food security in 2035 – Ranked by impact

1 Development, demography and urbanisation

Continued economic and population growth in the region. Urbanisation impacting land use and availability for food production, together with rural-urban migration reducing the agricultural workforce. Consolidation of small farms into larger agribusiness enterprises and the development of efficient supply chains and infrastructure.

=2 Geopolitical stability

The stability of geopolitical relationships in the region in the context of growing inequalities, the exclusion of certain groups, and increasing extremes of wealth and poverty both within and between nations. The persistence of broader strategic tensions, historical legacies, and ongoing strategic rivalry compounded by the need to manage depleted domestic resources as well as trans boundary issues such as air pollution, infectious diseases and pests, watersheds, river basins and fisheries in a climate of growing scarcity and variation.

=2 Globalisation and change

Growing regional interconnectedness and international integration as a function of trade, transport, telecommunications and tourism. Changes to agricultural commodity markets as developing nations such as the CMLV³ group increase exports of rice and grains, and regional producers diversify to higher value added commodities. Protectionism versus market forces and the costs to governments of price support and food stockpiling.

=3 Environmental balance

Continued economic and population growth in the region. Urbanisation impacting land use and availability for food production, together with rural-urban migration reducing the agricultural workforce. Consolidation of small farms into larger agribusiness enterprises and the development of efficient supply chains and infrastructure.

=3 Climate change

Changing temperatures and rainfall patterns causing increased seasonal variation, altered pest and disease regimes, and shifts in the location of food production centres. More frequent and severe natural disasters and extreme weather events. Modified ocean currents impacting fish stocks. Coastline changes impacting coastal fisheries and agricultural land.

6 Nutrition security

Access to safe, high quality and nutritious food that can be effectively utilised to support an active, healthy life. Persistent malnutrition coupled with increasing obesity. Food standards, certification and traceability.

7 New technologies

New technological advances that improve yields and quality, reduce the need for external inputs and address issues of post-harvest loss and waste. Advances in biotechnology and genetically modified organism policy. Increased public and private investment in agricultural research and development. Professionalising agriculture and developing it as a career path for young people.

8 Governance of food systems

Improved monitoring, policy making and planning capacity to address issues of corruption and policy disruption by regional and other actors.

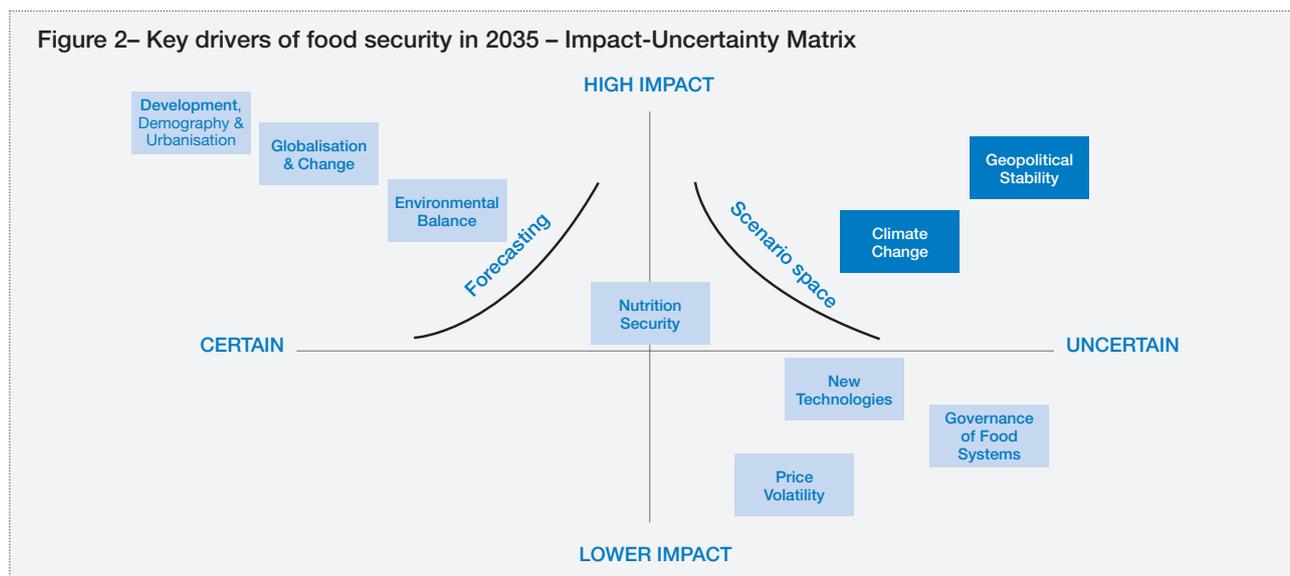
9 Price volatility

Market vulnerability to shocks and perturbations causing price spikes, particularly in rice, wheat, pulses, edible oils and protein (beef, pork, poultry and fish).

Note: 'impact' used in this ranking is relative. A driver considered to be of low impact in this study does not imply that it is unimportant, or that its impact is insignificant.

³Cambodia, Myanmar, Lao PDR and Vietnam

Following this initial ranking, the drivers were then ranked on the basis of their certainty. Where the outcomes of a high impact driver could be projected with reasonable accuracy from existing data (for example demographic change), it was considered to be comparatively certain and therefore to fall within the remit of forecasting (Figure 2). Where the impact of a driver was considered to be high but the outcome was not easily predictable, the driver was classed as being uncertain and therefore falling into the scenario zone. Geopolitical stability and climate change emerged as the most highly impactful and uncertain drivers of food security in Asia in 2035 and were used to develop a set of plausible scenarios for the future⁴.



Geopolitical Stability & Climate Change

Asia is characterised by a wide range of political traditions, development paths, cultures and ethnicities, as well as an inherently variable climate, so an initial step for creating the scenario stories was to identify appropriate parameters for geopolitical stability and climate change as they relate to Asia and food security.

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, 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 therefore the natural resources that support food production. Asia's already variable climate is compounded by 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. Their impacts on food security will vary across the region – for example, while as a whole Asia is expected to experience a decline in crop productivity, especially in relation to rice production, South Asia is also particularly vulnerable to significant reductions in sorghum and wheat yields arising from warming temperatures and changes in rainfall patterns. The extent of potential climate change impacts in the region will depend critically on the type and extent of mitigation and adaptation methods that may be implemented.

The Commission adopted an issues-based approach to develop the scenarios. It conceived of Asia's geopolitical goal as achieving a harmonious level of cohesion and commitment from 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 trans boundary environmental issues might, if poorly managed, have the capacity to exacerbate geopolitical instability in the region. Some of these issues could include

⁴ 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.

- 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.

In practice, geopolitical stability might range between low and high across the region, and these parameters were used to frame this Driver in the scenario stories.

A low-to-high scale was also adopted for the climate change driver. When developing the narrative of its scenario stories, the Commission was guided by 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). Where relevant data was available the Commission based its low climate change scenario stories around changes predicted under the IPCC's mitigation scenario RCP2.6. Climate change impacts envisaged in the high climate change scenarios were based on projections of the IPCC stabilisation scenario RCP6.0 (See Table 2).

The Commission drew on the IPCC RCP scenarios to 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. A storyboard of these scenarios is appended to this chapter. The Commission considered each scenario's implications for policy creation and enactment, and then used these insights to inform the development of the final report and its recommendations.

Table 2 - Projected change in key elements of the global climate system that impact food systems⁵

| | |
|--|---|
| Mean surface temperature change⁶ | 0.3°C – 0.7°C [RCP2.6] 0.3°C – 0.7°C [RCP6.0] |
| Ocean temperature⁷ | Ocean surface temperatures in tropical and sub-tropical parts of the region will warm under all RCP scenarios. An average increase of ~0.6°C is projected for RCP2.6. |
| Sea level rise | 0.26m – 0.55m [RCP2.6] 0.33m – 0.63m [RCP6.0] |
| Precipitation change | Under RCP2.6 an increase in precipitation is likely at higher latitudes in Asia by the mid-21st century. At lower latitudes changes to precipitation are not expected to exceed natural variability. Precipitation is likely to be more extreme near the centres of tropical cyclones that make landfall in the region. It is very likely that there will be an increase in precipitation extremes related to monsoon activity in eastern, south-eastern and southern Asia; an increase in the mean and extreme precipitation is expected in the Indian summer monsoon. |
| Ocean acidification [pH] | -0.06 to -0.07 [RCP2.6] -0.20 to -0.21 [RCP6.0] |
| Cumulative CO₂ emissions | 140 – 410 GtC [RCP2.6] 840 – 1250 GtC [RCP6.0] |

The scenario study made it clear to the Commission that for Asia to cope with a diverse range of possible futures in 2035 there is a growing 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).”

⁵ PCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T. F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

⁶ The global mean surface temperature change for the period 2016-2035 relative to 1986-2005 is similar for all four RCPs. The magnitude of projected climate change becomes substantially affected by choice of emissions scenario by the mid-21st century.

⁷ Measured in the upper 100 metres.

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. Resilience building can integrate short term humanitarian aid to relieve immediate impacts of the shocks with longer term development to mitigate the shocks and build capacity to anticipate, adapt, prepare for the shocks.

As was the case of the price spike in 2008, a negative market signal created issues that caused governments to take action that reinforced the negative signal. This is perhaps unsurprising given that in times of geopolitical stress it is challenging for governments to not become inwardly focused. In this situation the resilience of communities, particularly those engaged in food production, could be enhanced if they were able to understand how markets operate and correctly identify, interpret and respond to market signals. Alongside such stresses is the ability of the food production system to respond to weather and natural calamities. Given Asia's recent history with natural disasters, it is reasonable to suggest that resilience primarily relates to the dimension of food production and the shocks caused to its supply system. The price crisis of 2008 is a case in point. The actions taken by national governments to restore the system, albeit, which were not consistent across the region and hence took longer to fully play out, created a bounce-back effect - the effects of which have been evidenced since.

A resilient food system also requires environmental balance. The Commission views environmental balance as a long-term concern relating to how water, land and energy are used in the production system and the effects of their use over a sustained period of time.

Farming systems across the globe 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. Agricultural intensification has enabled food production to increase due to increases in productivity – an achievement based largely on the applications of science and technology. Advances in urban farming modes and agrotechnology are also critical, particularly for small urban city-states and net food-importing countries in Asia, such as Singapore (Teng & Escaler, 2010). However, the impact of food production on environment, the threat of climate change, and concerns related to the impacts of adaptation and mitigation measures on food systems have become real and pressing.

The demand for food will grow by virtue of population and income growth. For example, to support diet diversification the demand for grain as feedstock will increase. This increase in demand can only be met if productivity continues to increase. It is therefore important to understand the current state of natural resources and what the projected future state of these resources will look like. 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.

Figure 3: Resilience and environmental balance



ANNEX-FOOD SECURITY IN ASIA 2035

PLAUSIBLE SCENARIOS

Scenario 1 – High geopolitical stability and high climate change

‘A little help from my friends’: This scenario is a story about how Asia is able to leverage cooperation between harmonious regional groupings to ensure food security in the face of ‘high’ levels of climate change. In this Asia, 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.

Long-standing territorial disputes have been diplomatically resolved and development processes are largely complete, significantly reducing developmental disparities 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. Rising sea levels, warmer temperatures and increased frequency and severity of extreme weather events severely impact food security along the entire food value chain. Agriculture and fishery production centres experience changes in yield, location or, in some instances, are lost completely. Biodiversity is heavily reduced and, in response to altered selection pressures, new bio-threats emerge that challenge food security, public health and trade. Infrastructure is affected and coastal communities and delta regions experience increased flooding, storm surges and salt water intrusion, adding to pressure on increasingly scarce surface and groundwater resources.

Nevertheless, the region is characterised by stable governments and equitable and inclusive societies that are resilient and therefore better equipped to safeguard food security in this challenging context. High levels of intergovernmental collaboration and cooperation create a more balanced regional approach to developing, adopting and applying 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. Increased investments in infrastructure and food system innovations reduce food loss and waste to a fraction of 2015 levels. 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 a region that is characterised by politically insular governments with an emphasis on policies that strengthen sovereignty and food self-sufficiency. These suboptimal 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 disputes have arisen. Examples include new disputes over shared water resources and the illegal trade of livestock, plants, 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 funding for agricultural research and development mean that some countries have been able to implement technologies and innovations that allow them to experience far greater food and nutrition security than others.

Countries might share research and technology advances with their trusted partners, but 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’: This is a story of an Asia that is not only geopolitically unstable, but that 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. The often-quoted critical challenge of feeding nine billion people in 2050 can overshadow the more important realisation that this challenge is not just about increasing numbers. Growing prosperity is equally important, particularly in relation to changes in demand, consumer expectations and the widening of inequalities in a broader context of critical environmental and climate pressures.

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 paradox⁸;
- A highly variable climate; and
- The region's intrinsic susceptibility to natural disasters and extreme weather events.

This chapter explores the current realities of food security in Asia and the issues that impact:

- The dimensions of availability (production, imports and reserves for a differentiated and changing food basket);
- Access (physical and economic);
- Utilisation (food absorption, public health and nutritional security following Teng and Escaler, 2014), and
- Stability (of food supply and prices).

The recommendations address measures that could enhance the development of resilient regional food systems while giving consideration to the countries' need to follow the best development path for their circumstances.

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, Scoet 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 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.

⁸ 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.

Food loss and wastage

Addressing the issue of food losses is another critical element in ensuring the availability of affordable food. Food losses are defined as the decrease in food available for consumption resulting from constraints and limitations during production, post-harvest or processing activities. 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 loss of food 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). This results in the direct physical loss of food during supply chain activities, or losses through the action of pests and weather causing spoilage. Consequently, 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 quantity of additional food available to the region. For example, rice production in Association of Southeast Asian Nations (ASEAN) countries experiences post-harvest losses 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 like Indonesia, Malaysia, the Philippines, Thailand and Vietnam (Alavi et al., 2012). Some countries in the region are attempting to address such shortcomings. In Vietnam post-harvest losses range between 13 per cent and 15 per cent, due mostly to infrastructure and logistical challenges. Vietnam 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. Addressing production-based limitations that give rise to food losses will benefit from sustained research, development, and further advancements in infrastructure and technologies, as well as investment in value adding along the food chain.

Consumer-based food waste is of growing concern, although levels in Asia generally remain below those of most other regions and below levels experienced in 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). Industrialised parts of Asia are food wastage 'hot spots' for cereals, fruit and vegetables where consumer-based waste levels in these countries are approximately 80kg per capita (FAO, 2013). In South and South East Asia wastage levels of cereals, fruit and vegetables is much lower at 15kg per capita per year (FAO, 2013). 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, including 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). The overarching issue of the region's nutritional security thus continues to be a challenge, with a number of constraints often at play. For example, nutrition policies do not adequately address the root causes of malnutrition, including the lack of effective health services and adequate maternal and infant care. Limited financial resources and national capacity (such as community health workers and nurses) are also key constraints.

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.

A further complexity of the food and nutrition security problem is the double burden imposed by malnutrition on one hand and obesity, particularly in children, on the other. In 2014, 41 per cent of the world's overweight and obese children lived in Asia (Fan, 2014). In Indonesia, for example, the prevalence of under nutrition significantly declined from 20 per cent in 1999-2001 to 9.1 per cent in 2011-13 while the proportion of overweight and obese individuals was on the rise, estimated at 20.8 per cent in 2013. Whilst the underlying causal factors giving rise to obesity are many, complex and in some instances, hotly contested, the link between obesity and food security is acknowledged and a growing concern. In many instances obesity results from easier access to processed foods high in salt, sugar and fats. However elsewhere, particularly in remote or rural areas that lack adequate food production capacity to meet individual needs, processed foods may be all that is available due to infrastructure and logistical constraints impeding the availability of fresh, nutritious food, or significantly inflating costs for fresh foods that then preclude economic access to a nutritious diet.

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 benefits to the food system, including the potential for safer food to be available to markets, the trade and marketisation of food commodities has increased the movement of products and associated biosecurity threats, highlighting the need for improved biosecurity measures and quality control systems. The role of biosecurity in food and agriculture has been recognised for some time. It is defined by the FAO (2003) in the following terms:

Biosecurity covers the introduction of plant and animal pests and diseases (including zoonoses), the introduction and release of genetically modified organisms (GMOs) and their products, and the introduction and management of invasive alien species and genotypes. As a holistic concept biosecurity addresses the sustainability of agriculture (including productivity and profitability), food safety, and the protection of the environment; it is thus a key element of food security and has a number of benefits, particularly in relation to trade.

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.

Wildlife farms also pose particular problems. Vietnam has between 5,000 and 6,000 farms that produce a variety of wildlife species, such as civet, for human consumption. These farms do not adopt the same regulatory framework as conventional livestock production systems and consequently have major implications for food safety and disease control. Consumption of wildlife has also resulted in large and unsustainable biodiversity loss, which in turn has limited the inherent capacity of natural systems to regulate the spread of pests and diseases.

Across Asia, as is the case in other regions, there are significant differences between the ways in which countries manage biosecurity issues. Terms and concepts are often defined and understood differently between sectors, organisations and groups. This situation can become compounded by the diversity of languages and dialects in the Asia region. Despite the fact that pest and disease problems for animals and plants demonstrate significant epidemiological and economic similarities, similar prevention and control systems and similar drivers of risk, such as trade and transport a harmonised approach is yet to be put in place. Plant and animal biosecurity issues are typically managed by national governments on a sector-by-sector basis. Government bodies tend to manage discrete elements such as food safety laws, animal and plant quarantine laws and procedures, and pesticide regulations across separate departments and regulatory bodies.

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. In broader context, "agriculture-nutrition-health linkages" should be followed as a development paradigm. This approach requires interlinkages of development framework between agriculture, health, and related sectors.

RECOMMENDATION 2.1

Enhance efforts at improving food safety through the harmonisation of food standards across Asia. These standards could 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 (Table 1). 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.

Table 3: Categories of major uncertainties and risks facing agricultural supply chains*

| Type of Uncertainty | Examples |
|---|--|
| Weather-related | Periodic deficit and/or excess rainfall or temperature, hail storms, strong winds |
| Natural disasters (including extreme weather events) | Major floods and droughts, hurricanes, cyclones, typhoons, earthquakes, volcanic activity |
| Biology and environmental | Crop and livestock pests and diseases, contamination related to poor sanitation, human contamination and illnesses, contamination affecting food safety, contamination and degradation of natural resources and environment, contamination and degradation of production and processing |
| Type of Uncertainty | Examples |
| Market-related risks | Changes in supply and/or demand that impact domestic and/or international prices of inputs and/or outputs, changes in market demands for quantity and/or quality attributes, changes in food safety requirements, changes in market demands for timing of product delivery, changes in enterprise/supply chain reputation and dependability. |
| Logistical and infrastructural risks | Changes in transport, communication, energy costs, degraded and/or undependable transport, communication, energy infrastructure, physical destruction, conflicts, labour disputes affecting transport, communications, energy infrastructure and services. |
| Management and operational risks | Poor management decisions in asset allocation and livelihood/enterprise selection, poor decision making in use of inputs, poor quality control, forecast and planning errors, breakdowns in farm or firm equipment, unwillingness to change product, process, markets, inability to adapt to changes in cash and labour flows, etc. |
| Policy and institutional risks | Changing and/or uncertain monetary, fiscal, tax, financial (credit, savings, insurance), regulatory and legal, trade and market, land and tenure system policies; governance related uncertainty (e.g. corruption), weak institutional capacity to implement regulatory mandates. |
| Political risks | Security-related risks and uncertainty (e.g. threats to property and/or life) associated with politico-social instability within a country or in neighbouring countries. Interruption of trade due to disputes with other countries. Nationalisation/confiscation of assets, especially for foreign investors. |

*Adapted from Jaffe, Siegel and Andrews, 'Rapid Agricultural Supply Chain Risk Assessment: A Conceptual Framework', p. 10

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. The "food riots" around the world following the food price crisis of 2008 serve as a reminder that such realities are not just confined to history books. It has been argued that food, or lack of access to it, was an important spark in what is now dubbed the "Arab Spring" (Economist, 17 Mar 2012). State and political systems are therefore still central to food security.

In 2013 the Indian government legislated food security guaranteeing every Indian citizen a “right to food”. While welcomed by many, ensuring the success of such laws means that India could be required to pay out more than US\$20 billion per year in subsidies, and might be in violation of India’s legal obligations under the World Trade Organisation. Those realities have led India’s new government to reconsider the initiative, and to instead look to more efficient social safety nets to ensure food security (Joshi, 2015).

In Indonesia the Ministry of Agriculture’s (2014) strategic goal for agricultural development includes self-sufficiency in rice, maize, and soybean, and increased 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 to biosecurity issues. A regional approach 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. Waage and Mumford (2008) provide some helpful suggestions to increase international cooperation, including:

- identifying key pathways for threat introduction and directing international attention to these;
- improving international warning networks;
- introducing international eradication programmes for animal diseases;
- building biosecurity into all aspects of international cooperation; and
- harmonising standards between nations and regions.

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. Although, countries such as India are working towards 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 10 MW plant on the outskirts of Vadodara city began generating power in November 2014 and is built across 3.6 km of irrigation canal, with 33,800 solar panels mounted on steel scaffolding. The Gujarat government estimates the plant 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, which has affected water resources. There has also been frequent conflict between increasing agricultural production and environmental protection policies and programmes. Agriculture and aquaculture expansion have also been a major contributor to deforestation and biodiversity loss. The intensification of food production systems to achieve food security has also contributed to:

- the excessive use of chemicals;
- pollution and soil fertility problems;
- conversion of forestland;
- carbon and nutrient losses;
- impacts on biodiversity; and
- declining water quality.

The challenges are more pressing for areas of sub-optimal land such as rain-fed dry land, and swampland. These types of ecologies are prone to natural shocks, including drought, waterlogging, landslides and the impacts of climate change.

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 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.

A key step in addressing climate change impact is to encourage regional cooperation in mainstreaming climate adaptation at national and regional levels. By encouraging the region's governments to mainstream climate adaptation, ASEAN and the other regional frameworks would be able to address the needs of vulnerable communities through the provision of adequate knowledge and technology. Regional programmes targeted at improving developing countries' access to climate-smart technologies would help them mitigate the impact of climate change.

Efforts are also being directed towards implementing sustainable agricultural intensification processes or systems, by which yields could be increased without adverse environmental impact or the cultivation of more land. Successful development and implementation of these approaches would require technology, policy, and institutions that are collectively geared towards building sustainable and resilient food production systems.

ASEAN, APEC and SAARC have been working towards a variety of mechanisms and approaches that address climate change and food security. APEC has made a range of declarations and statements to this effect. The 2014 Xiamen Declaration identified key areas of collaboration, which included the role of the ocean on food-security and food trade. An ASEAN Joint Statement on Climate Change was also released in 2014, which encouraged ASEAN member states to, among other things, develop an ASEAN Climate Change Initiative and promote and facilitate information exchange and knowledge development activities relating to scientific research and development, technology transfer, and adoption of best practices relating to adaptation and mitigation measures.

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

Brief country overview



| | |
|------------------------|---------------|
| Population - present | 1,267,401,849 |
| Population - est. 2035 | 1,525,369,000 |



| | |
|-------------------------|-------|
| Gini Index | 33.6 |
| Human Development Index | 0.586 |



| | |
|--|------|
| Public investment in agricultural R&D (million 2005 PPP dollars) | 2121 |
|--|------|



| | |
|--|------|
| Prevalence of under nutrition (% of population) | 15% |
| Prevalence of over nutrition (% of population over 15) | 1.9% |



| | |
|---|----|
| Ranking on Global Hunger Index (2014 ranking) | 55 |
|---|----|



| | |
|------------------------|-------------|
| Number of farms | 137,757,000 |
| Average farm size (ha) | 1.3 |



| | |
|--|---------------|
| Biocapacity deficit/reserve (gha per capita) | 0.5 (deficit) |
|--|---------------|

Population
1,267,401,849

GDP per capita of
US\$
1,630.80

Overview

India has a GDP of \$2,066,902,397,333.3 and, with a population of 1,267,401,849, in 2014 had a GDP per capita of \$1,630.80 (US Dollars, official single year exchange rate for 2014). Agriculture makes a significant contribution of 17% to its overall total GDP. Its agriculture production is diverse, with major products including: rice; wheat; oilseed; cotton; jute; tea; sugarcane; lentils; onions; potatoes; dairy products; sheep; goats; poultry and fish. Over the last seven decades, Between 1951 and 2014, India multiplied its wheat production by almost 15 times (from 6.5 mt to 96 mt), rice by 5 times (from 20.6 mt to 106.5 mt), maize by more than 14 times, milk by 8 times, fish by 12 times and potatoes by 26 times. It is today the largest producer of milk and the second largest producer of fruits and vegetables, rice, wheat and sugar in the world. More importantly, it is now a net exporter of food, the largest exporter of rice in the world and the second largest of beef (buffalo). This dramatic change in agri-fortunes was a result of a combination of public policies involving the introduction of a bio-chemical technology package backed by public extension services, and a supportive agricultural (pricing) policy involving use of subsidised inputs, implementation of minimum support prices, public procurement of cereals and some other food items, and substantial buffer-stocking operations.



Food security challenges

- Today India is a food secure nation; yet household level food security remains a serious challenge. Over 40 per cent of its population under 5 suffers from malnutrition, and micronutrient deficiency, including anaemia, and protein deficiency is widespread among its adult population. Around 25 per cent of India's population is living below the most basic food (energy-adequacy) poverty line. National self-sufficiency and improved food availability has not translated into nutritional security for all people across the country. Indeed, the challenge of improving economic access to adequate food remains a serious one.
- As India launches and consolidates the second green revolution in the eastern region of the country, it needs to review and restructure the agriculture and food security policy on multiple fronts. Subsidies to support food production and consumption are crowding out public investments in irrigations, farm extension services, marketing and food processing infrastructure.
- Agriculture remains the least reformed sector of the economy, thus preventing significant efficiency gains from open agriculture markets to contribute to food security in the country. Above all there is a need to improve labour productivity in agriculture by shifting the excess labour from the sector to non-farm activities to improve economic access to adequate food at the individual level.
- Indiscriminate use of certain input subsidies is a major factor in giving rise to environmental problems of land degradation, water scarcity and soil contamination, resulting in stagnation of yields and adverse implications for long-term food security.
- A country that can ill-afford wastage, as per some estimates, has about 30 per cent post-harvest loss. Food subsidies for consumers suffer from significant leakages, mis-targeting and diversion, making the country's public distribution system and its buffer stocking operations a major drain on scarce public resources.



Opportunities in relation to food security

- The Public Distribution System currently only covers a small range of crops. Procuring a broader range of crops could allow better supply response for crops like pulses (lentils) and oil seeds, which provide the principal source of proteins and fats for a majority of households, promote agricultural diversification in areas of dry-land farming and nutritional security.
- Although the Public Distribution System based on public procurement and buffer-stocking has contributed to India's food security and is needed to address the nutritional security needs of the people in the medium-term, there is a significant scope to improve its efficiency by cutting down leakages, corruption and food wastage by rapidly deploying the biometric identity platform (AADHAR) to manage its targeting, distribution and stocking operations.
- The agricultural pricing policies that evolved in the mid-1960s and 1970s to create food surplus in the country need to be reviewed and perhaps restructured in order to address the current realities of India's food economy, such as by supporting production and consumption of nutrient rich crops and encouraging diversification into non-cereal foods.
- Shifting perceptions and policies in favour of exporting food could potentially increase agricultural efficiencies and food security. The system should be more market-driven.
- Greater utilisation of post-harvest technology provides an opportunity for India to reduce post-harvest waste due to infrastructure deficits regarding transport, storage etc.

- India should pursue opportunities regarding product delivery and research extension. Agricultural R&D often reaches the product development stage but lacks large-scale delivery of these products to farmers.
- Policy induced environmental concerns need to be addressed and a sustainable use of land and water resources for agricultural production encouraged.



Possibilities for enhanced relations with Australia and Western Australia

- Whilst India has the largest dairy industry in the world, productivity is low. There are opportunities for collaboration in the dairy sector that could help to transfer Australian dairy knowledge and technical expertise and increase capacity in the Indian dairy industry.
- India's research to support productivity improvements in dry-land farming crops could benefit from Australian agriculture research capacity and farm practices.
- Australia could evolve as a major source of lentils/pulses (which typically are not water intensive crops) that form an important part of Indian diets and where India continues to depend on imports to bridge the gap in domestic production and demand.
- There is scope to develop farmer exchange programs where Indian farmers can visit overseas farms for study tours and training, which could include visits to Australian farms.



COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN CHINA

Brief country overview



Population - present 1,364,270,000

Population - est. 2035 1,407,087,000



Gini Index 37

Human Development Index 0.719



**Public investment in agricultural R&D
(million 2005 PPP dollars)**

4048



**Prevalence of under nutrition
(% of population)** 11%

**Prevalence of over nutrition
(% of population over 15)** 5.7%



**Ranking on Global Hunger Index
(2014 ranking)**

5



Number of farms 200,555,000

Average farm size (ha) 0.7



**Biocapacity deficit/reserve
(gha per capita)**

1.6 (deficit)

Overview

As part of its efforts to meet Millennium Development Goal targets, China successfully lifted approximately 500 million people out of extreme poverty, and is considered to be food secure at the national level in the short-term. China has a GDP of US\$10,360,105,247,908.30 and, with a population of 1,364,270,000, in 2014 had a GDP per capita of US\$7,593.80. Agriculture contributes 9.2% to its overall total GDP. China's main agricultural products are: rice; wheat; potatoes; corn; peanuts; tea; millet; barley; apples; cotton; oilseed; poultry; pork and fish. In 2012, a third of the labour force (33.6%) was engaged in agriculture, and arable land comprises 11.3% of the total land area. In 2014 the Ministry of Agriculture (MOA) implemented a new strategy aimed at transforming production modes and adjusting agriculture structures. This is the most significant reform in China's approach to food production and food security since 1978, and aims to address environmental and resources degradation, land reform, mechanisation, sustainable agricultural practices and the professionalization of agriculture. There is a growing focus on nutritional security in China, and increasing rates of obesity and non-communicable diseases are causing growing concern.

Population
1,364,270,000

GDP per capita of
US\$
7,593.80



Food security challenges

- Despite immense progress approximately 150 million Chinese people remain below the poverty line and some are without access to sufficient and nutritious food, particularly in remote, rural areas and ethnic minorities. In some cases, food insecurity can also be seasonal, but growing inequalities in wealth between rural and urban populations will increasingly require targeted interventions at the micro-level to ensure rural Chinese achieve food and nutrition security targets. Rural populations are increasingly made up of women, children and the aged (or infirm) who have been left behind following the migration of other family members to urban centres. Facilitating women's participation in agriculture through education, access to finance and land, will be an important factor in helping to lift remote rural communities from poverty and food insecurity. Some provincial governments are making positive steps in this regard. The Sunshine Project is an initiative of the Sichuan Provincial Government to support women in response to the urban migration of men. Women who develop a business in farming or agriculture are provided with subsidies and training by the government to support ongoing business development.
- Medium- to long-term food security in China will be challenged by increasing labour costs; an ageing farming workforce; significant increases in rents for farming; severe environmental and resource degradation (particularly soil and water); greater climate variance; and shifts in diet towards increased consumption of meat and dairy products. Whilst China still needs a level of urbanisation in order to facilitate appropriate economic development, a growing challenge for the government is to balance this with the need to preserve land for agricultural production and address the needs of the Chinese population still living in poverty.
- Government price support in China helps to even out income distributions, and is an important social cohesion measure. However this policy has led to price distortions that cannot be maintained in the medium- to long-term and that need to be resolved urgently towards a position where prices are market-driven.



Opportunities in relation to food security

- The Chinese Ministry of Agriculture's new 'Sustainable Agricultural Strategy' entails significant reform in China's approach to food production and security. Amongst other things, the strategy aims to address China's agricultural technological deficit and professionalise agriculture through an increase in land-holding size, increased mechanisation, and land reform.
- There has been a shift towards greater openness and transparency in conversations with the Chinese government about agricultural problems and environmental issues impacting food security such as water and soil degradation. There is a greater willingness to consider the adoption of solutions that have developed overseas. This development has accompanied a change in the debate about genetically modified organisms; there is a more open recognition that GMOs are a new technology with benefits for food security that should be explored through further research.
- Food safety and quality are major concerns in China following a series of incidents including, for example, cadmium in rice. In the public consciousness this has undermined China's ability to produce safe food for its people, many of whom now tend to have more trust in products that have been processed as far as possible along the value chain before entering China. The Chinese government has initiated a number of activities aimed at addressing both issues, ranging from the establishment of specific institutes, committees and working groups under the MOA (but comprised of representatives from numerous ministries), to the revision of food safety regulations and consumer protection legislation. Provincial governments also have mechanisms for addressing these concerns.



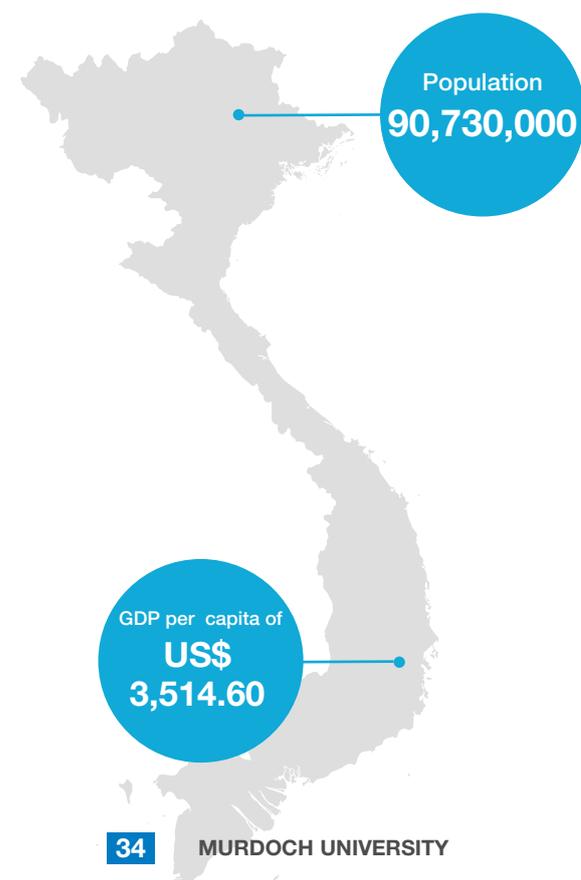
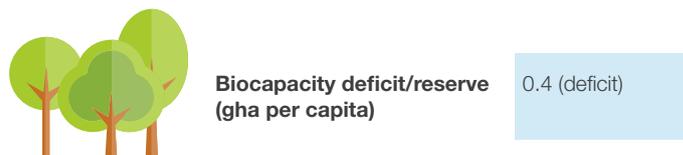
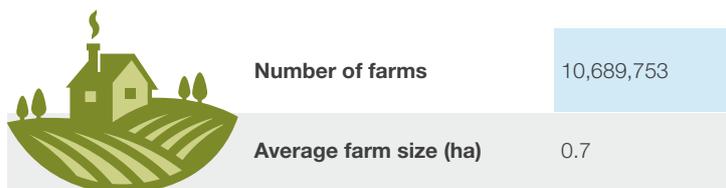
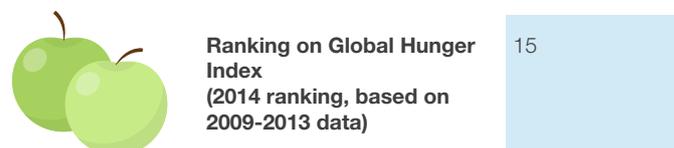
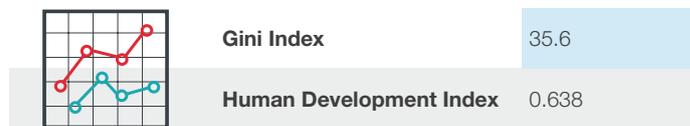
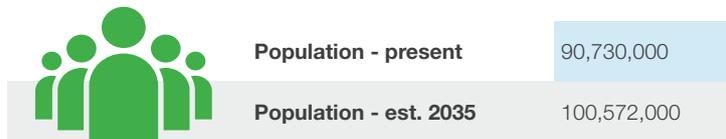
Possibilities for enhanced relations with Australia and Western Australia

- There are many opportunities for research and collaboration based on Australia's reputation and expertise in both the production of safe, clean food, and agri-food service provision along the value chain. China requires the full spectrum of research and innovation interventions ranging from nutrient supplements for livestock, to more sophisticated e-commerce options to help with market development. Collaborative research and innovation can help adapt Australian expertise and processes to the Chinese situation. Bilateral industry-to-industry partnerships are also important, and cooperation between the Australian Dairy Corporation and Tasmanian Cherry Growers with their respective Chinese counterparts has been successful in this space.
- Australian researchers have undertaken a lot of work with Chinese colleagues to improve herd quality and lift productivity in the wool and dairy industries. The live cattle trade is a growing area of interest and a strong possibility for further trade relationships. Key enablers will include the development of appropriate export protocols and that requisite supply chain elements are in place.
- The area of food loss presents significant opportunities for collaboration and engagement between Australia (and Western Australia) and China. The amount of Chinese grain wasted during harvest, post-harvest and the transport process is larger than the entire Australian wheat harvest. Part of this story is about sharing expertise and knowledge in production, biosecurity and supply chain development; enhancing Chinese scientific and technical capacity is also an important prerequisite to ensuring ongoing reductions in food losses, and gains in food safety and quality improving nutritional security and opening new markets for Chinese produce.



COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN VIETNAM

Brief country overview



Overview

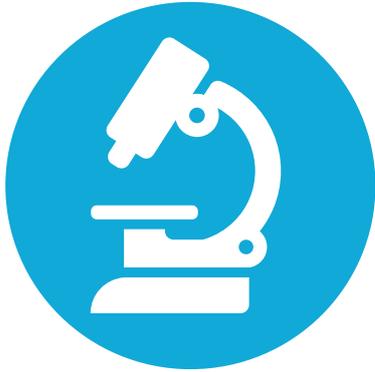
Vietnam is widely considered to be a food security success story. This success is largely due to a series of reforms commencing in the 1980s that, together with a series of intervening policy changes, have moved the Vietnamese economy towards greater market orientation and fostered strong economic growth. In turn this has reduced poverty and undernourishment and today Vietnam is ranked 3rd for food security in Asia and 55th in the world. Vietnam has a GDP of \$186,204,652,922.30 and, with a population of 90,730,000, in 2014 had a GDP per capita of US\$3,514.60. Agriculture contributes 18.1 per cent to its overall total GDP with the country's main agricultural products including rice; coffee; rubber; tea; pepper; cashews; poultry; fruit; catfish (basa); seafood, and wood furniture. In 2012, just under half its population (48 per cent) was engaged in agriculture; arable land comprises 20.6 per cent of its overall total land area. Vietnam and Thailand are the two leading export countries in ASEAN, especially in relation to rice. Vietnam is also a leader in high value aquaculture, where 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. The agriculture policies of Vietnam focus on trade liberalisation with almost no direct subsidies.



Food security challenges

- Although the Vietnamese people are largely food secure, localised (and sometimes seasonal) food insecurity exists in remote rural and mountainous regions, and ethnic minorities. Nutritional security remains a significant issue both in terms of the quality and nutritional composition of diets. Compared to regional neighbours the price for meat and eggs is low in Vietnam; however individuals lack sufficient nutritional knowledge to support the consumption of balanced diets including these products, particularly adequate diets for children. 32 per cent of children are malnourished, underweight, and suffer micro-nutrient deficiencies, especially in vitamin A and calcium. In rural and mountainous areas milk is considered an expensive supplement and this limits its inclusion in daily diets. In other instances, the rapid transformation from self-production to purchasing from markets has led to a loss of individual knowledge about the nutritional value of certain foods and how to create balanced meals.
- Certain policies may be contributing to Vietnam's food security challenges. An example is Vietnam's land policy, which formalised the protection of 3.8 million hectares of land exclusively for rice production. This protection was designed to secure the production of 42-45 million tonnes of rice, covering domestic consumption, export and stockpile requirements. In practice the policy has recently become more flexible due to the government's priorities of enhancing production efficiency and improving farmer income, so that land area cultivated for rice can be reduced in line with planting seasons. Farmers are also able to switch from cultivating rice to other crops with greater value.
- Food safety is a significant challenge and there is a lack of traceability throughout the entire agricultural system. Small-scale wildlife farms are largely unregulated and there is widespread poor management of pesticide and fertiliser use. This is in contrast to the tremendous amount of food safety work that has supported the development of Vietnam's aquaculture industry, enabling it to participate in the global fisheries market.
- Vietnam is very susceptible to climate change and there is a sense that the country needs to start thinking now about how to increase rice productivity and also how to diversify agricultural production under a changing climate. Food production centres in coastal areas are already experiencing seasonal changes, and salinity levels in the Mekong Delta are rising. Vietnam is also susceptible to El Nino/La Nina climate oscillations, which will be exacerbated by climate change. Scenario studies suggest that Vietnam will maintain sufficient rice production levels to remain food secure domestically, but projected reductions in surplus will impact economic growth and development.





Opportunities in relation to food security

- Vietnam's National Nutrition Strategy has been devised to address nutritional security, improve the diets of people (in terms of quality and nutritional balance) and to address child malnutrition and stunting. This new emphasis demonstrates a shift from conceptualising food security in terms of rice to diversifying agricultural production to address broader nutritional security issues.
- The Vietnamese government has released a policy to expand farm size for market production. If implemented this policy will provide an opportunity for large-scale farming cooperatives and enhanced efficiencies.
- Ho Chi Minh has a 40 kilometre high tech agricultural zone funded largely by private companies, and hopes to establish seven such zones in the next five years. A 300 hectare biotechnology zone is included in the plan. Enhanced research and development flowing from such projects can contribute to food security and there are opportunities to collaborate in these initiatives via investment and research partnerships.
- Vietnam could contribute to mobilising ASEAN countries to develop:
 - An emergency food system;
 - An information system addressing stocks, prices and technology;
 - Breeds and breeding;
 - Foreign storage/warehouses systems; and
 - International cooperation through technology exchanges; methods and policies for rice production; on regional planning approaches based on comparative advantage and complementarity; and R&D.



Possibilities for enhanced relations with Australia and Western Australia

- There is the potential for collaboration with Western Australia in areas such as investment along the food value chain based on countries' comparative advantages, and strengthening small and medium enterprise (SME) capabilities to enable their participation in value chains.
- Western Australia can support efforts of the Vietnam where improving biosecurity, natural resource management, and climate change adaptation efforts are concerned.
- Vietnam is keen to contribute to regional partnerships and collaborations addressing food safety, food supply monitoring systems, and economic modelling.
- Vietnamese agricultural experts are very strong in fieldwork skills and expertise. This can be partnered with Australian expertise in technology (seed production and inspection), intellectual property and infrastructure development, to help enhance agricultural capacity in Vietnam.
- Increased bilateral training efforts in scientific, technical and policy roles relating to agriculture can further aspirations of South-South collaboration.

COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN INDONESIA

Brief country overview



Population - present 252,812,245

Population - est. 2035 303,382,000



Gini Index 38.1

Human Development Index 0.684



Public investment in agricultural R&D
(million 2005 PPP dollars) 379



Prevalence of under nutrition (% of population) 9%

Prevalence of over nutrition (% of population over 15) 4.8%



Ranking on Global Hunger Index
(2014 ranking) 22



Number of farms 24,868,675

Average farm size (ha) 0.8



Biocapacity deficit/reserve
(gha per capita) 0.1 (deficit)

GDP per capita of
US\$
3,491.9

Population
252,812,245

Overview

Indonesia is the world's fourth most populous country and the tenth largest agricultural producer, just behind Turkey and France and ahead of Germany and Argentina (OECD, 2012). It is the world's largest producer of palm oil, the second-largest producer of natural rubber, and the third-largest producer and consumer of rice after China and India. The country is scarce in agricultural land, at one-third of the world average in per capita terms, but relatively abundant in water resources. The contribution of agriculture to Indonesia's GDP has fallen from 19 per cent in 1990 to 10 per cent in 2014 and its share in total employment has also reduced from 56 per cent to 30 per cent in the same period. Palm oil and rubber account for 60 per cent of total agro-food exports, and contribute to a significant surplus in agro-food trade.

Indonesian agriculture is characterized by smallholder farming, particularly in food crop production. Overall, there are 25.8 million family farms, with average size of 0.8 hectares, and 14.2 million (55.2 per cent) are smallholder farms (*petani gurem*) with land holding of less than 0.5 hectares (CBS 2014). While smallholders are also important producers of perennial crops, large private and state-owned farms occupy about 15 per cent of the total crop area, and engage in the production of palm oil and rubber on farms that have an average size of 2,600 hectares.

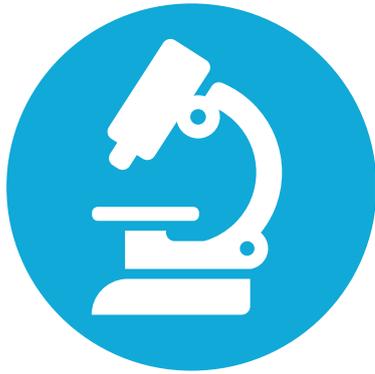
In the context of food security, the government puts high priority on accelerating production of strategic commodities, namely rice, maize, soybean, sugar, and beef. To a lesser extent, production of shallot, chilli and potato is also promoted. Rice attracts priority attention in policy, research, and development budgets. Despite a decline in production growth from 2.5 per cent per annum (2000-2010) to 1.63 per cent per annum in 2014, Indonesia has largely achieved sufficiency in rice production, although in some years may still import rice to strengthen domestic stocks for stabilization purposes.

Dietary diversification arising from macroeconomic transformation has reduced demand for staple crops and increased that for nutrition-rich food such as legumes, vegetables, fruits, and livestock products. In 2010 vegetable consumption was 120 per cent of that of 1999 levels. Likewise, the consumption of fruits reached 125 per cent. The largest increase was observed for consumption of meat, eggs, and milk, which reached more than 200 per cent in 2010.



Food security challenges

- Indonesia has recently begun to strengthen its food sovereignty narrative, couching it within a broader security context by making strong linkages between food security (particularly rice self-sufficiency) and national security. The use of personnel from the military's civic mission in an agricultural extension capacity has been met with some criticism and is not universally supported.
- Land tenure issues pose a challenge to food security as they limit investment, infrastructure development and agricultural production capacity, as well as farmer's ability to adapt to climate change. In the absence of reform Indonesia's large number of smallholder farmers will be limited in their ability to capitalise on economies of scale. This will continue to impede household economic opportunity, hamper development and, with 19 million households with an average landholding size of 0.4 hectares, necessitate micro-level climate adaptation interventions.
- There is the sense that investment in agriculture and rural development is limited by the government's entrenched self-sufficiency ideology, bureaucracy, and mistrust of markets. Indonesia attempts to do everything well rather than taking a more strategic approach that will maximise value-adding in certain areas of comparative advantage.
- Innovation, research and development is hampered by a lack of connectivity between researchers and commercial enterprise. Commercial enterprises have great ideas but lack the research capacity to develop them, and conversely researchers with technical capacity are unable to connect with commercial ventures that can support product development and commercialisation activities.
- Food handling and safety issues are a persistent and significant concern, with frequent outbreaks of air and water borne diseases impacting food production. There is a need for increased public awareness-raising around this issue and that of broader food loss and waste.



Opportunities in relation to food security

- Despite the political emphasis on rice in Indonesia, the use of land for rice cultivation is frequently inefficient, although this is not widely appreciated. The diversification of food production presents an opportunity for Indonesia to enhance production efficiency and reduce its dependency on rice by producing higher value horticultural and perennial crops. There are also opportunities relating to the growing demand of increasingly prosperous Indonesians for wheat-based products such as bread and pasta.
- There is the sense that the impacts on agriculture of Indonesia's structural transformation need to be addressed, and that this will require the development of a new definition of food security and the metrics used to measure it. The current focus on food production needs to be expanded to a more holistic definition of food security that encompasses security, nutrition and health. These changes will better enable Indonesia to measure food security and take advantage of opportunities across the entire food value chain.
- KADIN, the Indonesian Chamber of Commerce, is helping to inform policy by making recommendations from the private sector to government. This enhanced collaboration is a promising development, allowing the private sector to share insights and lessons learned from its projects with a broader audience of policy makers.
- Education as a key enabler of productivity growth is emerging as an area of opportunity for food security in Indonesia. The Partnership for Indonesia's Sustainable Agriculture (PISAgro) was jointly established three years ago by KADIN, the Ministry of Agriculture and Ministry of Trade. Its vision is to increase yield and farmer income by 20 per cent and decrease emissions by 20 per cent. A successful pilot in nine crop areas saw yields increase at the smallholder level from 15-80 per cent. Smallholders who were previously producing 5 tonnes of rice per hectare were able to increase production to 8 tonnes per ha through the PISAgro initiative.
- A political commitment by Indonesia to a food reserve system for products such as wheat would be a welcome development. Similarly Indonesia should actively contribute to the ASEAN Food Security Information System and the ASEAN + 3 Macroeconomic Research Office.





Possibilities for enhanced relations with Australia and Western Australia

- There is considerable potential for Australia to help deliver biosecurity and public health education and training to enhance Indonesia's capacity to prevent the outbreak and transmission of air and water borne diseases.
- Indonesia's aim to become an exporter of beef to the region, particularly the Muslim market, could be enhanced by partnerships with Australian business and industries to help the sector grow and develop over the long term. There is also potential for Australia and Indonesia to advocate third party opportunities, whereby Australia's expertise in breeding could be coupled with Indonesian expertise in slaughter and packaging.
- Western Australia and Indonesia could benefit from collaboration in wheat and grain production and processing. Indonesia's world-class flour milling industry could be coupled with Western Australian wheat production to take advantage of significant growth in flour-milled products such as noodles.
- Changing diets in Indonesia are driving demand for alternative products such as vegetables and luxury produce, creating export opportunities for Western Australia. Whilst WA already supplies carrots and potato seed to Indonesia, some logistical challenges regarding airfreight and permits need to be resolved. The new economic policy package released in September 2015 responded to some of these issues. Similarly, tariffs on wine of 150 per cent have resulted in some markets – for example, Margaret River red wine – becoming unviable. As Indonesian tropical fruit growers begin to enter the Australian market, the facilitation of two-way trade should be explored allowing Australian and WA producers' greater access to the Indonesian market.
- There are opportunities for Australian companies to partner with Indonesian enterprises in food processing. For example, Indofood aims to process 125,000 tonnes of potatoes in country. Indonesia's domestic potato production is presently 30,000 tonnes, meaning unprocessed potatoes will need to be imported from other countries to meet demand in the short to medium term.



3: FOOD SYSTEM PRODUCTIVITY AND PUBLIC INVESTMENT

Agricultural systems have evolved from early methods of hunting and gathering food to the more complex processes of cultivating and processing food into commodities and products that can be marketed and traded. In modern agricultural practice, farming systems are classified into:

- traditional subsistence farming;
- partially commercialised farming;
- semi-commercialised farming; and
- highly commercialised farming systems.

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.

Production diversification depends on the state of agricultural production systems. Subsistence farming or smallholder agriculture cultivates agricultural products sufficient to feed a household. Surplus harvests, which are often very limited, are sold or traded. This method is most widely applied in rural poor areas.

Partially commercialised farming systems, predominantly adopted in South Asia and South-East Asia, employ more optimal methods of growing crops but the share of the sold harvest is less than half of the gross returns. Semi-commercialised farms have similar cultivation of cash crops but with a higher percentage of sales (50 to 75 per cent of gross returns), whereas in highly commercialised farming or large agro-holdings, food is produced to generate profit requiring higher levels of capital investment (Ruthenberg, 1971).

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).

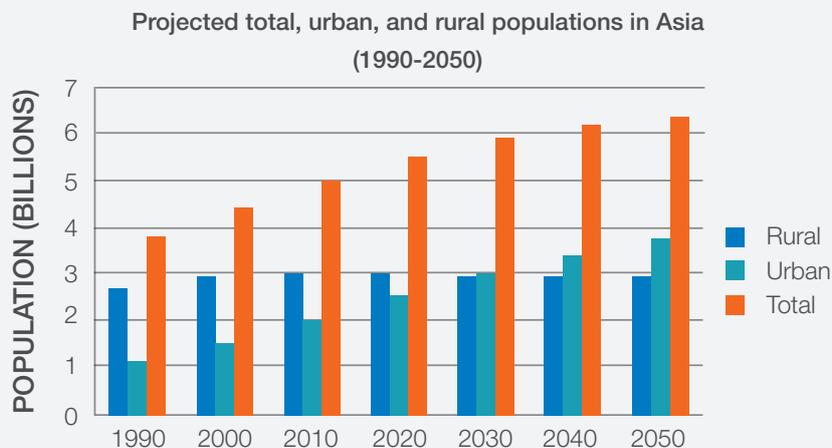
Overall, agricultural intensification has enabled food production to increase from growth in productivity, an achievement based largely on applying science and technology. Agricultural development strategies should be focused on transforming subsistent smallholder farms to commercial farms (Fan, Brzeska, Keryzer, Halsema 2013). The specific intervention will depend on the typology of farms. For instance, commercial farms need better technologies and entrepreneurship support, while subsistence farms needs safety net programs and input subsidy for own food production (Hazell and Rahman, 2014). With this constant evolution of agricultural systems it is also important to consider the changes impacting the state of natural resources which is vital to sustain production.

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. While Brazil has only a five per cent share of the world's agricultural area with 261 million hectares, it is the only country that has almost doubled its agricultural area since 1961 (Lowder, Scoet and Singh 2014). 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. For example, 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.

Figure 4: Projected total, urban, and rural populations in Asia (1990–2050)



Source: The World Bank Database

The loss of cultivated land creates major constraints on agricultural production and significantly affects food supply and availability. For example, in China and Vietnam the Commission heard that efforts to ring fence agricultural land was 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.

Table 4: Total factor productivity growth rate (%)

| Total factor productivity growth rate (%) | | | | | | | | |
|---|--------|-------|-------|--------|-------|--------|--------|-----------------|
| Country | Year | | | | | | | 10 year average |
| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | |
| Australia | -0.014 | 0.021 | 0.034 | 0.038 | 0.022 | 0.045 | -0.032 | 0.0105 |
| Bangladesh | 0.018 | 0.036 | 0.051 | 0.054 | 0.018 | 0.007 | -0.012 | 0.0227 |
| Cambodia | 0.047 | 0.068 | 0.066 | 0.074 | 0.052 | 0.062 | 0.061 | 0.0538 |
| China | 0.02 | 0.03 | 0.037 | 0.029 | 0.029 | 0.025 | 0.04 | 0.0272 |
| India | 0.027 | 0.033 | 0.036 | 0.027 | 0.026 | 0.027 | 0.029 | 0.0244 |
| Indonesia | 0.035 | 0.043 | 0.012 | 0.03 | 0.011 | 0.021 | 0.016 | 0.0274 |
| Japan | 0.025 | 0 | 0.021 | 0.042 | 0.019 | -0.005 | 0.041 | 0.0208 |
| Korea, Rep. | 0.024 | 0.07 | 0.001 | 0.062 | 0.017 | 0.005 | 0.022 | 0.0221 |
| Lao PDR | 0.022 | 0.016 | 0.036 | -0.011 | 0.024 | 0.034 | 0.048 | 0.0233 |

Total factor productivity growth rate (%)

| Country | Year | | | | | | | |
|-------------|--------|--------|--------|-------|-------|-------|--------|-----------------|
| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 10 year average |
| Malaysia | 0.049 | 0.035 | 0.027 | 0.046 | 0.015 | 0.017 | 0.027 | 0.0333 |
| Mongolia | 0.057 | -0.069 | 0.052 | 0.037 | 0.05 | 0.026 | 0.025 | 0.0039 |
| Myanmar | 0.082 | 0.052 | 0.033 | 0.048 | 0.025 | 0.005 | 0.007 | 0.0461 |
| Pakistan | 0.002 | -0.003 | 0.03 | 0.012 | 0 | 0.016 | 0.009 | 0.0073 |
| Philippines | 0.04 | 0.028 | 0.013 | 0.018 | 0.01 | 0.017 | 0.022 | 0.0222 |
| Singapore | -0.061 | -0.107 | 0.022 | 0.05 | 0.17 | 0.079 | -0.047 | -0.04 |
| Taiwan | 0.023 | 0.001 | -0.007 | 0.042 | 0.008 | 0 | 0.035 | 0.0113 |
| Thailand | 0.024 | 0.017 | 0.015 | 0.032 | 0.021 | 0.021 | 0.033 | 0.0211 |
| Vietnam | 0.019 | 0.028 | 0.032 | 0.038 | 0.025 | 0.02 | 0.029 | 0.0277 |

Source: The United States Department of Agriculture Economic Research Service

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. A well-documented example is the 2001 outbreak of foot and mouth disease in the United Kingdom, which resulted in the destruction of approximately 10 million animals and an overall economic impact estimated at US\$14 billion. 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. Estimates suggest that the total cost of pests and pathogens that have been transported globally to date lies in the vicinity of five per cent of the world gross national product (Pimentel et al., 2007). Exotic invasive species are estimated to cause US\$1.4 trillion in losses per year globally on an ongoing basis. These losses are much higher in developing countries that lack effective biosecurity systems to safeguard their plant, and terrestrial and aquatic animal industries from pests and diseases. The 2003/04 outbreak of avian influenza in Asia severely impacted the poultry sector, particularly in Vietnam, Thailand, Cambodia, China, Laos, and Malaysia. The cost to Vietnam has been estimated to be between US\$76 and US\$450 million, with smallholder farmers experiencing the greatest relative impact. One study from the FAO found that the loss of birds, 2.3 months of production, and loss of consumption were estimated to cost between US\$69 and US\$108 per affected household. This represents a comparatively large sum when measured against an income of less than US\$2 per person per day. Indonesia lost or destroyed 16.2 million poultry at a cost between US\$16.2 and US\$32.4 million.

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.

Table 5: Estimated regional crop losses due to pathogens

| Region | Wheat \$billion | Rice \$billion | Maize \$billion | Wheat % | Rice % | Maize % |
|---------------|--------------------|-------------------|--------------------|------------|-----------|------------|
| Asia | 5.6 | 16.3 | 3.8 | 14 | 12 | 13 |
| North America | 2.0 | 0.1 | 3.4 | 14 | 7 | 8 |
| Latin America | 0.6 | 0.9 | 2.2 | 13 | 14 | 13 |
| Europe | 3.7 | 0.1 | 1.2 | 12 | 9 | 10 |
| Africa | 0.4 | 0.7 | 1.7 | 12 | 14 | 16 |
| Oceania | 0.6 | 0.01 | 0.01 | 14 | 7 | 8 |
| World | 12.9 | 18.1 | 12.3 | 13 | 11 | 11 |

Source: Adapted from Orke (2006)

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

Develop and 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.

Crop insurance: Climate risk mitigation strategy in production and incomes for farmers

The impacts of climate change on the severity and prevalence of biosecurity threats is a growing concern. Impacts are expected to include changes in pest/pathogen geographical incidence, distribution and virulence. Other threats include changes in temporal patterns of crop production where pest and pathogen ranges are expanded or seasonal variation in activity is reduced. Under these circumstances pests of negligible or minor importance in their indigenous range could become highly problematic under changing climate conditions and/or in their new (or expanded) range. Of greatest concern are the potential impacts of diseases arising from new or unknown disease agents emerging under changing climatic conditions.

Agriculture is therefore a risky business, especially for farmers with small land holdings. In addition to biosecurity threats, smallholder farmers in rain-fed areas could have incomes that fluctuate from year to year, and the possibility of catastrophic losses always looms large. It impacts the stability, access, and resilience of food systems, among others, and results in volatility in farm incomes. Farmers, being typically risk-averse, attempt to stabilise their incomes by resorting to a variety of measures, including crop diversification, inter-cropping, and share-cropping arrangements.

Governments in developed and developing countries when concerned with their farming communities' welfare have either encouraged or directly participated in establishing risk-mitigating or risk-sharing institutions. Crop insurance has been seen as a means to address the instability of farm incomes when existing risk management practices fail to protect household consumption stability and erodes their ability to support a production rebound in subsequent farming cycles.

A major motivation for extending crop credit insurance by institutional lenders, public and private, has been to spread risks, curtail costs, and maintain loan turnover over time. An assessment of crop insurance initiatives across countries suggests mixed results in terms of overall welfare gains in some countries, and good outcomes that meet the stated objectives of the initiatives in others. The benefits of crop insurance are highly crop and location specific, as the risks and costs of insurance varies between domestic production centres.

Since 1985, India has been implementing the National Agricultural Insurance Scheme (NAIS)⁹. The NAIS was developed to support India's large majority of smallholder agricultural producers dependent on rain-fed agriculture, and has gradually expanded in its coverage. The scheme is based on the area approach and covers five crops: rice, wheat, millets, oilseeds, and pulses. It is restricted to borrowers of crop loans from cooperative credit societies, commercial banks, and regional rural banks. The NAIS serves at least three policy goals:

- to provide support to the farmers who are vulnerable to severe crop failures;
- to improve rural credit institutions' ability to manage commercial risk, which is important for farmers to access finance; and
- to control the government's peak and average fiscal exposure during disaster years.

The scheme is a mix of voluntary and compulsory participation. Voluntarism exists at the provincial level with regard to specific crops and areas to be covered. It becomes compulsory in selected areas for farmers growing designated crops and taking loans from rural financial institutions. The NAIS provides cover primarily against yield risk and consequently income fluctuations arising from yield variations.

Although not strictly an alternative to the NAIS, weather-based insurance was introduced in India in 2003 by a private insurance company with technical assistance from the World Bank. The insurance was introduced for groundnut and castor farmers of Mahbubnagar district in Andhra Pradesh, a region characterised by varied rain patterns, poor irrigation systems, and poor soil quality. Weather-based insurance provides farmers with compensation when specific weather events cause reduced crop yields. A weather index is developed in which specific weather events and the range of possible values between minimum and maximum variation are correlated to calculate losses. The insurance product specifies a threshold and a limit and farmers are compensated based on where the weather event that affected their crop falls within the weather index, rather than actual crop losses.

Weather-based insurance is less cumbersome in practice and therefore easier to implement than alternative crop insurance schemes that pay indemnity based on yield determination. The pilot schemes offered by the private sector have been followed by the public sector insurer's rainfall insurance. The scheme targets risks particularly around inadequate rainfall during important stages of the crop development and sowing failure. The rapid expansion of weather-based schemes in a short time span suggests that it is popular and meeting its objectives. Unlike the traditional yield insurance scheme, weather insurance is market-based and financially sustainable with the potential to transform the lives of poor agricultural households by addressing output risk.

It is important to remember that crop insurance is not the most appropriate solution where income variability is primarily due to price fluctuations in output and inputs, or due to untimely or irregular supply of inputs and information. Improving the distribution network for the supply of inputs, agriculture pricing policies involving the announcement of support/procurement prices for output, and improvement in the agricultural extension system would be more helpful to mitigate risks arising from those factors. For coping with natural risks however, crop insurance is perhaps the only mechanism available. It is an instrument that protects agriculturists against the uncertainties of crop production that are beyond their control. It is important that similar approaches be explored in other important production industries such as livestock and fish farming.

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.

⁹ Formerly known as the Comprehensive Crop Insurance Scheme

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.

In farming, markets for water use need to be further developed to provide greater input resource certainty for farmers. The absence of tenure rights, particularly for land and water resources, makes it difficult for farmers to access credit. Across Asia, current regulations prohibiting the sale of farmland are yet another constraint. As wages rise the scope for mechanisation to improve labour productivity can be exploited. Farmland consolidation is required to enable farm machinery to be used more efficiently. Policy settings in Asia need to transition away from smallholder farms towards greater emphasis on the development of cooperatives and contract farming. Agricultural development strategies, including public investment in roads and transport infrastructure, should be formulated to address the needs of smallholder farmers and larger farms with the goal of raising net returns for producers while lowering the price of food for consumers. India's Operation Flood provides a good example of an effective cooperative model that achieved both these goals (Box 3.2).

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 reforming land regulation including tenancy rights, land consolidation, safeguards for agricultural land and improved markets for natural resources such as water.

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.

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 production it is of comparatively low quality. Indonesia might deal with volatility better if it had better performing and more efficient logistics and transport systems. Farmers in Myanmar may be able to increase production with better access to finance that can fund productivity-boosting farming activities. Despite such challenges, these emerging producers are entering international markets and competing with established producers such as Vietnam. This 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.

Extending from this regional comparative advantage approach, if the private sectors of food importing and exporting countries enhance cooperation such as establishing a storage system in line with a reserve system – and can quickly mobilise supplementary production, then food import and export countries might develop policies that support cooperation between private organisations.

Private sector investment needs to continue and be 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.

Trends in food trade and pricing policies

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. In China, the government has set up a special local bank account for each household and an annual allocation is made to each account from the Agricultural Financial Subsidy Fund just prior to the planting season. This measure is used to reduce social tensions in rural areas for instance, when farm incomes are falling behind urban incomes. This allows China to avoid introducing the economically costly agricultural protection measures used by higher-income countries. (Huang, Wang & Rozelle (2013)).

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.

As emerging economies industrialise and urbanise, those not well endowed in agricultural land per capita have tended to move from being net exporters to net importers of farm products and, over the long term, they have tended to switch from taxing to subsidising farming. Indeed, some key emerging economies are showing signs of going down the agricultural protection path that earlier-industrialising economies took. In the case of China and Indonesia, for example, the rates of government assistance to their farmers now exceed the average for high-income countries.

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?

Governments use various market price-distorting measures including trade measures to address food security related issues such as poverty. Such price-distorting trade measures tend to reduce aggregate national income, but they also redistribute income as between households that are net buyers versus net sellers of food. If the trade measure lowers the price food producers are paid and so discourages farming, then the demand for farm labour falls as well. If the farming sector uses unskilled labour and the majority of the country's workforce is unskilled, then the trade measure will lower unskilled workers' wages, not only in farm jobs but also in non-farm jobs. This is even more so in agrarian economies (countries where majority large share of the workforce is in agriculture) and where the market for unskilled labour is more flexible. Price-distorting trade policies in developing countries can also raise the return to relatively scarce human and non-farm capital (Stolper and Samuelson 1941), and thereby potentially increase income and wealth inequality. While a measure that reduces domestic food prices might benefit poor households' expenditure, their earnings could be harmed if they are sellers of unskilled labour and/or food, thereby making the economic welfare effects uncertain. What is critical, therefore, is not only whether the poor are predominantly net buyers or net sellers of food, but also the extent to which their income depends on the demand for farm labour.

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, to introduce 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)¹⁰. 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.org)):

- increase production;
- reduce postharvest losses;
- promote markets and trade for agricultural commodities and inputs;
- increase stability of supplies;
- promote availability of and accessibility to agricultural 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.

¹⁰ 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>)

ASEAN Plus Three Emergency Rice Reserve

APTERR was conceived after the 2008 food price crisis¹¹ 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 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 65.1 kilograms per person per year and flour consumption in the form of bread, pastries and noodles etc. was at 33.6 kilograms per person per year (highest since 2006). Similar trends are being witnessed in other parts of Asia, for example noodle consumption in Indonesia (second biggest wheat importer) lifted wheat demand by about 60 per cent since 2005 to about eight million tonnes annually; wheat consumption in India (second biggest wheat grower) is projected to surpass output by more than five million tonnes annually; and Bangladesh is set to import four million tonnes to meet local demand of three 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.

¹¹ASEAN Plus Three Emergency Rice Reserve Agreement (2011). Jakarta, Indonesia, 7 October. Available at (<http://www.scribd.com/doc/97411992/APTERR-Agreement>)

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 states¹². 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).

Countries in the region also need to actively address interlinking issues that impact food security, such as poverty. For example, China has achieved the first phase of its United Nations Millennium Development Goals and is currently working on the second phase of absolute poverty reduction. To minimise income discrepancy between people in urban and rural areas, agricultural and industrial sectors in China are learning from the Japanese policy experience of the mid-1960s when the country established factories in rural areas, thereby allowing farmers to work in factories while continuing to live in the countryside. These types of rural-urban development policy experiences are best exchanged through regional forums. ASEAN countries need to adopt such policy sharing approaches.

¹² 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.

Improving regional connectivity however, requires a huge amount of resources, investments and sustained commitment from different stakeholders. This is where multilateral public-private partnerships would be critical to improving the connectivity needs of many countries in the region.

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.

In a similar vein, 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 the associated concerns, an independent and regional coordinating body could be a mechanism by which heightened levels of engagement and collaboration can be created. This body could facilitate multiple activities including, but not limited to, information on pricing and climate predictions, and help with depoliticising the interpretation of information. This approach could also enable the creation of a harmonised data collection and management strategy for the region. To encompass a holistic regional strategy that spans the value chain, concerns relating to food loss, food waste management, food safety and nutritional security must also form part of its mandate.

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

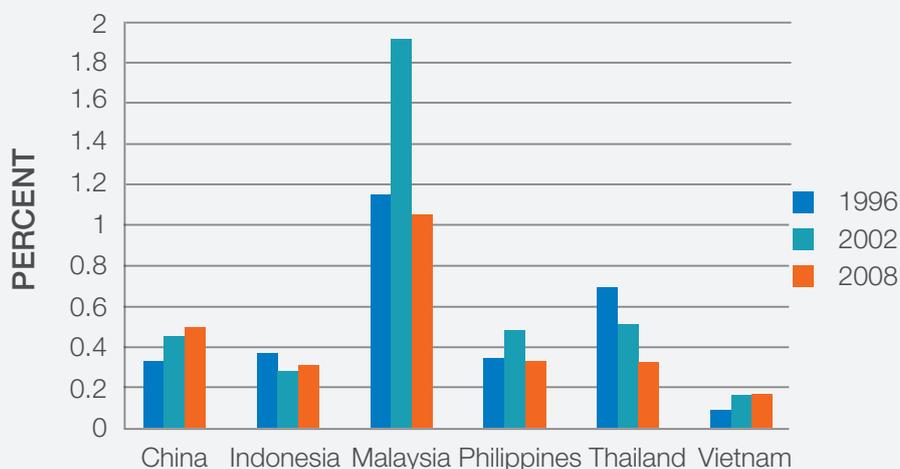
Over the past 60 years, innovation enabled the United States to increase its agricultural output by 250 per cent for the same amount of inputs (Simmons 2015). There are many gains to be achieved by helping developing countries in Asia to access, adapt and develop their own context-specific innovations 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) dollars¹³. The main drivers of this growth were China and India, which accounted for nearly 70 per cent of the total. China's agricultural research and development spending increased from 1.6 to 4.0 billion 2005 PPP dollars over the same period. India's level of investment also increased substantially during this time due to increased government commitment to agricultural research and development, spending 2.3 billion 2005 PPP dollars in 2008 (Beintema and Stads, 2010).

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.

Figure 6: Public expenditure on agricultural research and development as a percentage of agricultural GDP



Source of raw data: Flaherty, Stads and Srinivasacharyulu (2013).

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.

¹³ 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>

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.

In India a consequence of this trend over the past decade has been a rapid decline in the number of farmers, from 69 per cent to 49 per cent. An accompanying trend has been the increase in the average age of farmers; more than 55 per cent of farmers are over 55 years of age. This ageing trend has implications for the implementation of new farming approaches and technologies, particularly those based in the use of information and communication technologies, which older farmers tend to engage with less than younger and more innovative people.

Parents increasingly insist that children register for degree programmes with good employment opportunities and job security and in rural households it is often the least employable child that goes into agriculture. 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 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. While some of the guidance to farmers is provided at the municipal level, extension service workers are also required to advise on cropping issues and emergency response matters, and sometimes to deliver other related front-line services.

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. These people need to be trained in a range of disciplines including agricultural, animal, veterinary, environmental, nutrition, economics and social sciences. 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 well-recognised support system for farmers as far as accessing new information on farming practices, access to piloting seed technology and other similar efforts. From a regional perspective, these efforts are vital as far as transferring information from the regional knowledge base to farmers and educating them about how to make better decisions is concerned.

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. This is in spite of the agricultural sector's contribution to gross domestic product being in decline. This increase in the agricultural workforce is likely to require new skills and capabilities in order to take advantage of advanced agricultural modes of operation. Public facilitation of extension systems will need to continue, especially for small farmers. The higher-level extension systems might become privatised for advanced technology transfer.

Investments in extension services could improve agricultural productivity and increase farmers' incomes, especially in developing economies where more than 90 per cent of the world's almost one million extension workers are located (World Bank). The impacts of extension are usually greatest in the early stages of new technology dissemination, when information imbalance is at its greatest. Extension departments form the centrepiece in many countries' agriculture ministries in terms of employee numbers. For example, there are an estimated 100,000 extension agents in India.

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 of automatic planting machines for rice 30 years ago. This invention is only recently finding its way to countries like India, China and parts of South East Asia.

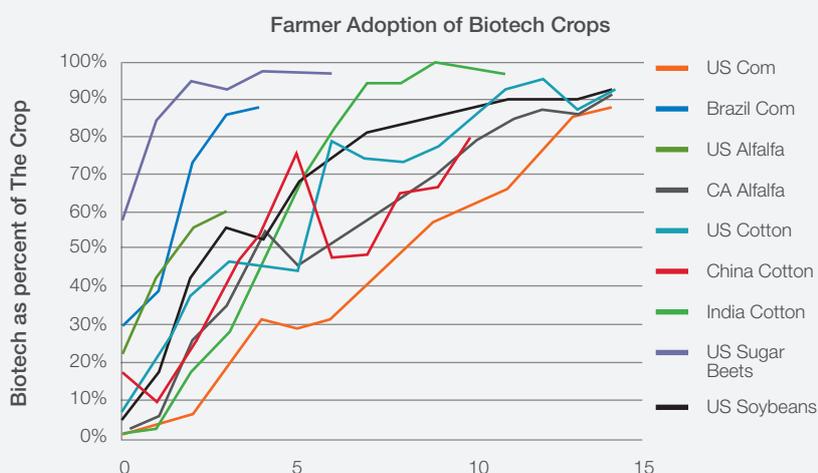
An area of research that could benefit Asia is in the development and deployment of genetically modified (GM) crops. Research shows that agricultural biotechnologies – especially transgenic crops – could boost food security by lifting farmer incomes,

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).

Figure 7: Farmer adoption of biotech crops



Source: Savage, S. (2015) Who controls the food supply? Based on data from the Context Network, USDA-NASS and FAOSTats.

In Malaysia, the formulation of the National Biotechnology Policy and the Bioeconomy Malaysia agenda laid the foundation for the Malaysia Biotech Corporation. The organisation today focuses on better use of renewable biological resources and innovative bio-based technologies in the production of chemicals, materials, food and feed. By helping bio-based small to medium enterprises to move up the value-chain, Malaysia is setting itself up to advance in the global market (GFIA 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 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.

Box 5.3 Aero-Green in Singapore

Aeroponics is defined as the culture of whole plants and/or tissues with their roots or the whole tissue fed by an air or water fog (as opposed to immersion in/on water, soil, nutrient agar or other substrates), which contains a nutrient solution to provide water and nutrients to the plant/tissue. (Weathers, P.J.)

Aeroponics in Singapore was initiated based on research undertaken by the National Institute of Education, Nanyang Technological University, Singapore. The research resulted in the establishment of Singapore's only aeroponics company – Aero-Green (Singapore). Through the sales of aeroponically grown vegetables, the 5.7 hectares company is valued at S\$12 million.

The vegetable most commonly grown in Singapore using aeroponics is the lettuce (*Lactuca sativa*). Lettuce seeds are usually obtained from a commercial seed producer in Holland as lettuce does not grow naturally in the tropics. After germination, seedlings with open cotyledons are transplanted into polyurethane cubes soaked in water and placed in trays. The seedlings are allowed to grow in the trays for two days before being transferred into the aeroponics system. The top of the aeroponics system is insulated with polystyrene foam planks, on which the lettuce plants are anchored. One plant is slotted into a provided hole in the top planks and the roots suspended in the air below. A nutrient solution is applied to the roots of the plants in the form of a mist for 30 seconds at 30 second intervals. The box is sealed to prevent evaporation and to keep the surroundings dark to encourage root growth and prevent algae forming.

The Singapore aeroponics system has been used for the commercial production of several high value vegetables. Most such vegetables have their natural habitat in temperate and subtropical regions but are able to grow successfully year-round in Singapore as the aeroponics system allows the cooling of the roots while the aerial portions are subjected to hot fluctuating temperatures.

Source: Teng (2015)

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.

Financial management of farms is important for farmers. While determining ways of adding value within the farm gate is necessary, further thought and action need to be given to innovations along the supply chain. In Australia, it is known that the supply chain takes up 30 per cent of the production cost. Production volatility and uncertainty can cause high fluctuations in supply chain costs, particularly relating to the storage, handling, transportation, logistics and similar aspects in getting food from the paddock to the plate. If the supply chain takes up a third of the cost, then it is plain to see how negating supply chain inefficiencies and innovating could achieve productivity dividends.

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 has been the Principal Investigator of the RSIS Centre for NTS Studies' projects for the MacArthur Foundation Asia Security Initiative (ASI), where she led and directed the research programme on Internal and Cross-border Conflict Challenges, and advised the Health and Human Security programme. 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 has 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 (ECTAD) in Beijing. He is a member of AustCham Beijing, the Executive Committee of the Western Australia Branch of the Australia China Business Council (ACBC) and former Chair of its Education Committee. Before his term at Murdoch University he was Regional Coordinator for the World Organisation for Animal Health (OIE) Southeast Asia Foot and Mouth Disease Campaign and based in Thailand for 3 years. He was Chief Veterinary Officer for Western Australia from 1993-2001. Professor Edwards has considerable experience in training, research and consulting in the fields of animal health, public health, epidemiology, biosecurity and food safety and has been active in most Asian countries.



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.

Prof. Teng was formerly also Professor and Department Chair, Plant Pathology, University of Hawaii, U.S.A. and Professor of Plant Pathology, University of Minnesota, U.S.A. His current service appointments include being 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. Prof Teng has published over 250 technical papers and eight books and won awards such as the Eriksson Prize in Plant Pathology and the 2001 CGIAR Excellence in Science Award for Outstanding Scientific Article. Professor Teng has generated substantial funding from multiple national and international sources in support of R&D in his many roles. He is a Fellow of The World Academy of Sciences (TWAS) and Fellow, American Phytopathological Society. Professor Teng is a graduate from Lincoln College, University of Canterbury, New Zealand. Paul is also a licensed marine fish farmer.



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

Professor Kym 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, where he has been affiliated since 1984. Previously he was a Research Fellow in Economics at ANU's Research School of Pacific and Asian Studies (1977-83), following undergraduate studies at the University of New England in Armidale (1967-70), part-time Masters studies at the University of Adelaide (1971-74) while working in the S.A. Department of Agriculture in Adelaide, and doctoral studies at the University of Chicago and Stanford University (1974-77). 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. He was awarded an Honorary Doctorate of Economics from the University of Adelaide in 2014.

Professor Anderson has spent periods of leave at Korea's Rural Economics Institute (1980-81 as Ford Foundation Visiting Fellow), the Australian Department of Trade (1983), Stockholm University's Institute for International Economic Studies (1988), the GATT (now WTO) Secretariat in Geneva (1990-92), and the Research Group of the World Bank in Washington DC (2004-07). 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.

He has served on several dispute settlement and arbitration panels at the World Trade Organization since 1996 (the first economist to do so), and on a panel advising the Ministers for Foreign Affairs and Trade in their preparation of Australia's first White Paper on Foreign and Trade Policy (1997). Corporate Board positions include as a non-executive Director of Australia's Grape and Wine R&D Corporation (2000-05), as a Trustee of Adelaide's Institute for International Trade (since 2003), as a Commissioner of the ACIAR Commission of the Australian Centre for International Agricultural Research (since 2011), and as a Trustee of the Washington DC-based International Food Policy Research Institute (since 2010, and as Chair from January 2015). 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 (IPSARD), 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). Prior to this, he was invited by the World Bank as a consultant for the Shanghai Global Conference on Scaling up Poverty Reduction 2003-2005. 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 wide range of water management, rural development and poverty reduction issues in China, as well as in many countries of Africa and Southeast Asia. He has broad working experiences at the World Bank (WB), the African Development Bank (AfDB), International Fund for Agricultural Development (IFAD), the World Food Programme (WFP) as a consultant. He is a project leader/coordinator of internationally-financed projects by the World Bank and the United Nations Environment Programme (UNEP). These projects include natural resource management, climate change, trade & environment, agricultural policy, poverty reduction, micro-finance, environmental /rural policy evaluations on international, national and regional levels. Dr. Zhang won the Robert S. McNamara Fellowships of the World Bank Institute in 2001, and remarkably in 2004 he won two Spot Awards by the World Bank in recognition of his contribution to the success of the Shanghai Global Conference on Scaling Up Poverty Reduction.

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).



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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 the following themes:

- 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
- 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. From 2002 to 2008, he was employed at UN office of the High Commissioner for Human Rights in Geneva, where he contributed to operationalization of the Right to Development mandate. He also conceptualized and led the work on development of human rights indicators. 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. Rajeev has published on methodological issues in estimation of poverty, human development, human rights indicators, right to development, fiscal policy and specific issues on Indian economy.



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 has 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.

During his career, he has also served as lecturer and research supervisor in both undergraduate and graduate programs of several universities. As an official of the Ministry of Agriculture, he participated as delegate in WTO negotiations, as well as various committees and council meetings at the G20, FAO, UN-ESCAP, ASEAN forum, and other bilateral meetings. As a senior scientist with broad managerial experience he has served as chairman or member of various committees or working groups dealing with strategic policy issues, development programs or research projects. 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 more than 100 articles published as book chapters, referred journals, conference proceedings, and articles in mass media. Thirty two (32) articles are written related to rice economy on various subjects, namely: the economics of irrigation, input use efficiency, technology impact assessment, market and trade, income and employment, supply-demand, policy analysis, and development model. Dr. Sudaryanto 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 joined ANZ's Natural Resources team in April 2005, and in 2008 took up the relationship coverage for clients across a diverse portfolio of industry segments. Prior to joining ANZ, Paul was with Westpac Banking Corporation for 8 years as a part of the Resources and Infrastructure team, and held roles in both account management and research & credit analysis.

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. He holds a B.Sc. Agric. (Hons) and PhD (Soil Science), from the University of Western Australia.

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. This includes new approaches that enhance environmental co-benefits particularly in relation to soil and water management where there are many long-standing, intractable problems. The impacts of carbon mitigation on food security and the extension of market-based approaches to other environmental problems have also been investigated.

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. Christopher Vas is Academic Director of the Executive Education Centre at Murdoch University. The Centre is a knowledge hub incorporating executive education, research activity and industry engagement. It promotes academic leadership of cross-cutting issues as they relate to people, strategy and innovation.

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. As Program Director at the HC Coombs Policy Forum (ANU) - a joint think tank between the Australian Government and the ANU - he directed the Productivity & Competitiveness and Policy Futures Policy Research Programs. In addition to serving with various agencies in the Australian Government for many years, he also served as Academic Registrar at the Australian Federal Police College.

Dr Vas was also Engagement Director for Executive Education at the globally renowned Indian School of Business (ISB). Through the course of his professional experiences, he has designed and delivered leadership, strategy and management programs for public and private sector clients including Oil & Natural Gas Corporation (ONGC), Areva Energy, Maersk Ltd (Denmark), Indian Ministry of Home Affairs, Coca Cola, Vodafone and many others.

Dr Vas' expertise lies in innovation and productivity policy, human capital development, industry trade policy linking global value chains and public management issues. His research interests particularly span 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 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.



**Ms. Catherine Bevan-Jones, Research Coordinator,
Vice Chancellor's Office, Murdoch University**

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.

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