Murdoch
UNIVERSITY

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

The **Murdoch** Commission

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

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MURDOCH UNIVERSITY: AN OVERVIEW

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

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

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

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

Murdoch Mandala

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

Professor David Morrison
Deputy Vice Chancellor, Research and Development

ACTING VICE CHANCELLOR'S FOREWORD: PROFESSOR ANDREW TAGGART

Professor Andrew Taggart

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

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

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

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

Professor Mely Caballero Anthony

Professor John Edwards

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

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

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

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

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

ACKNOWLEDGEMENTS

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

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

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

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

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

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

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

概要

アジアは貧困と食料不安の軽減に大きな進歩を遂げ、この地域の多くの国では短期間に食料安全保障を達成してきた。しかし、食料不安の完全な解消は長期的問題である。また、人口増加問題、都市化、自然環境不足に直面しているアジアには、安全で栄養があり、良質の食料を十分に供給できる能力があるかという懸念が高まっている。

この複雑で状況に依存する、共通の懸念である食料安全保障問題が、第二次マードック・コミッション（Second Murdoch Commission、以下SMC）の出発点となった。主要タスクは、アジアの現代の食料安全保障が、相互依存度を増す食料システムにどのように組み込まれているかを調査し、**アジアが今後20年間にわたり自給を続けていくための最善の方法**を見つけることであった。

各国の限られた資源の背景―例えば、土地、労働力、資本、国の政治経済問題、気候変動によりますます不安定になる気象条件など―は様々であるが、SMCの中心的課題は、発展を続ける、多国間、多分野にまたがる地域の様々な枠組みやパートナーシップが、どのように食料安全問題に寄与できるかを調査することであった。

SMCのメンバーシップと地域性が、このタスクに有利に働いた。広範にわたるリサーチに加え、SMCの会議や、インド、中国、ベトナム、インドネシアへの視察により、ベースとなる貴重な証拠や識見の元となる情報が集められ、最終レポートと提言がまとめられた。

SMCの主要な成果は、*Food Security in Asia in 2035*（2035年のアジア食料安全保障）と題する将来研究の報告書である。シナリオ研究を通して、SMCのメンバーは、2035年に至るまでのこの地域の食料安全保障の予測可能な因子を模索し、これを発展させたレポートと提言を報告した。

SMCは、各国の食料安全保障に関する課題を認識した上で、微細な戦略を発展させる努力をし、同時に、地域の協力によって、安定した、弾力性のあるアジアの食料システムを作るための道筋も記した。SMCが地理的に焦点を当てたのは、東南アジア連合諸国プラス6（ASEAN+6）の国々である[1]。オーストラリアはこのグループのメンバーとして、地域食料安全保障問題への取り組みに重大な役割を担っている。すなわち、良質の農産物の輸出国として、また、農産食品分野、その関連分野である食品安全や防疫対策における優れた科学技術能力を通しての役割である。西オーストラリア州の、これらの分野における多大な能力も、地域の食料安全保障の展開に大きな役割を果たしている。

現在までに確立されている地域協力体制は、地域の食料生態系の管理問題に、限定的な成功を収めてきた。これは、地域食料システム自体に回復力をつけ、十分な供給、持続可能な入手と利用をするためには、アジアでより戦略的、全体的なアプローチをとる必要があることを示唆するものである。

しかしながら、地域協力をさらに強化し深めることが、食料不安を管理するために一層重要となるだろう。これには、政府間の枠組みを超えたパートナーシップを確立し、より幅広いステークホルダー・グループ（民間セクター、市民社会、学界、その他関係者）を取り込み、総括的な食料安全保障計画を進めるための方針を策定する必要がある。

食料安全保障の課題は越境的な問題であることが多く、世界の他地域の食料生産システムと協力して弾力性のある地域食料生態系を発展させることも重要である。

[1] ASEAN+6とはすなわち、ブルネイ、カンボジア、インドネシア、ラオス、マレーシア、ミャンマー、フィリピン、シンガポール、タイ、ベトナムのASEAN諸国に、オーストラリア、中国、インド、日本、ニュージーランド、韓国を加えたものである（国名は英文ABC順）。

テーマと提言

食料安全保障は広範にわたっており、すべての面を詳細に分析することは、SMCの研究範囲を超える。最終レポートと提言は食料安全保障に影響を与える主な問題を取り上げている。これらの問題はSMCのリサーチや会議で提起されたもので、SMCのメンバーの専門知識を合わせて最大限の価値を加え、それをもとに検討している。

同様に、われわれが用いたシナリオ研究は、量的にアジアの食料事情の将来を予測する研究のためのものではない。シナリオは、アジアの将来におけるこの地域の不確実性や、2035年のアジアの食料安全保障問題に関して予測可能なリスクを避けるためにどのようなアクションが可能かといったことを質的に考察するための指針としたのである。食料安全保障データベースに有用な貢献をし、アジア全体が直面している課題や機会に更なる積極的行動を促すことを、SMCは期待している。

食料安全保障：現状

国家レベルの安全かつ保障された食料システムは、国内での食料生産を十分にして国のニーズを満たすだけでは達成できない。個人が良質の、安全な、栄養のある食料にアクセスできること、そして、その食料を活動的で健康的な生活を送るために効果的に利用できることも重要である。グローバルコミュニティーが直面している食料安全保障問題の多くは類似しており、共通の原因を抱えている。しかし、それらの問題がどのように展開するかは、国家、地域、地方、地場のレベルで大きく異なっている。この章では、食料安全保障の4つの「面」―供給、アクセス、利用、安定―に影響を与える問題を掘り下げ、これがアジアの成長、発展にもたらす結果を考察する。提言では、異なる環境で最適な発展方針を取るための各国のニーズを検討し、弾力性のある地域食料システムの発展を促進させる方法を提示する。

提言2.1

アジア全域で食品規格の調和を図り、食品の安全を改善する努力を促進する。これらの規格はバリューチェーンの全過程を通して作成、導入する必要がある。この努力はAPEC、ASEANなどの地域団体の協調によって最もよく実現することができる。

提言2.2

防疫に対する脅威を同定、管理する地域能力を確立し、統一アプローチと一貫性のある基準を作成、採用する。

提言2.3

気候適応戦略、特に食料安全保障を拡大するような戦略をも主流化させる。これらの気候適応戦略では、情報の普及、知識資本化、技術移転などのアプローチにおいて、様々な地域団体間で効果的な協力をする必要がある。

食料システムの生産性と公共投資

アジアは多様な地域であり、食料生産に関して画一的なアジアのモデルもしくはアプローチを述べることは難しい。概括的に言えば、アジアの農業セクターでは小自作農が大半を占める。アジアでは人口の57%は地方に居住している。地方人口の81%は農産で生計を立てている。都市化と環境的弱点が農業の生産

性に下降圧力をかけており、アジアの食料供給が需要に追いつかない懸念が高まっている。この章では、都市化、気候変動、害虫／害獣、病気など、農業生産システムの生産性に影響する問題とリスクについて考察する。これらの問題に取り組むためのメカニズムについて議論し、生産性向上をサポートする改革を提言する。

提言3.1

食料生産システムの生産性を向上させるための新しくより環境に配慮した技術と実践方法を開発し、その導入を促進する。農業での実践方法を伝授し、また変革するために、例えば統合害虫管理などで、アジア全域でのプログラムされた現場への介入が求められる。

提言3.2

土地規制の改革を検討する。これには、借地権、農地整備、農地保障、水などの天然資源の市場の改良を含む。

提言3.3

インフラと研究開発への公共投資を増やす。特に、国内農業総生産に対してこの公共投資が少ない国において増額する。主食に対する投資に限らない。

提言3.4

小自作農の組合への参加を奨励し、スケールメリットを活かして生産コストを削減し、同時に地場の農業生産に研究開発による恩恵を活かす。

提言3.5

生産システムは比較優位性によって定められるという地域食料システムの考え方を促進する。その際、地域経済は、ミャンマー、ラオス、カンボジアなどの新興生産国の国内の構造的な制約を考慮する必要がある。

提言3.6

供給、輸送、加工、流通を含む、サプライチェーン全体への民間からの投資を可能とし、それを促進する。これは、地域協力体制への政治的コミットメントをもって支持されなくてはならない。

食料経済における貿易方針と地域体制

アジア地域各国の経済の発達と成熟度は国により様々で、政治的背景や食料安全保障政策および貿易政策もそれぞれの国で異なる。課題は、現在そして将来の食料安全保障をより良くするためのどのように方針を定めるのが一番良いかということである。この章では、食料貿易の動向と価格政策を考察し、現行の地域的な様々な枠組みを、食料安全保障の強化や地域の貿易に有効であるかどうかの面から評価する。特に、価格が不安定だったり急変したりする場合の有効性を検証する。効率的な、安定した、持続可能で、逞しい食料生態系を、アジア地域において創造し、維持する能力を拡大することを目的とした提言を行っている。

提言4.1
自由貿易協定、食料市場の自由化を地域および世界規模で促進する。

提言4.2
適切な情報をすべてのステークホルダー・グループに提供し、利益を認識させることで、アジアの国同士での食料貿易の自由化による利益についてコミュニケーションを図る。

提言4.3
食料生産システムへの民間および外国からの直接投資を促進することによって、価格の歪みを最小限に抑えるように努め、より大きなインフラ投資を促進する。

提言4.4
貿易関連の取引費用を低減するための方針、より良い情報システムや市場戦略を作るための方針、食料バリューチェーンに関わる公共および民間組織の保管、配送、輸送システムなどのインフラをより良くするための方針を策定する。

提言4.5
APTERR（アセアン＋3緊急米備蓄）の構想を、その範囲を広げる目的で検証する。特に次の点に注目する:
- メンバーシップを拡大する。
- 地域の米備蓄の対象を、自然災害時や緊急用だけでなく、市場の安定性を保つ目的にも拡大する。
- APTERR構想に麦を含める。
- 民間セクターの事業者も、地域レベルの官民連携を通してこれらの備蓄を保管、管理できるようにする。

提言4.6
全地域を統括する、独立した食料安全保障機関の設立を検討する。この機関は以下を行う。
- 関連情報やデータベースを収集管理する。
- データ管理方策を策定し実施する。
- 例えば備蓄使用率などの情報の、共有や共同管理用のデータ開示を決定する。
- 地域の食料安全保障を展望する年次会議を開催する。
- 食品安全面と栄養保障面を含む、食料安全保障に関する一貫したアジア・パートナーシップを策定する。
- フードロスを最小化するための地域戦略（例えば、収穫後処理技術の向上）を策定する。食料廃棄を管理し、最小限にすることの重要性についてコミュニケーションを図る。

食料安全保障のための改革

ますます厳しくなる資源の制約と気候変動により、地域の食料生産能力は圧迫されている。その結果、増加を続ける（ますます豊かさも増す）人口のためにより多くの食料を生産しなくてはならないだけでなく、限

りある土地、水、資金をより効率的に使ってそれを可能にしなくてはならない。この地域の国々は、供給する食料が、栄養があり、アクセス可能で、効果的に利用されるようにするバリューチェーン、組織、制度を発展させる必要もある。これらの問題に取り組むには、単に現行のシステムや慣行で効率を上げるというだけでは不足である。食料安全保障を確実にする能力を段階的に増大するための新たなソリューションも必要である。これは、環境、気候、資源の制約のなかで機能するものでなくてはならない。この章では、地域の食料システムにおける教育、研究、改革の役割を考察し、この点において能力を育成するための提言をする。

提言5.1

専門技術を持つ卒業生を輩出する教育プログラムと、システムレベルの思考とソリューションの導入の能力を持つ万能型の人材を育成するプログラムのバランスを保つ。

提言5.2

従来の公共セクターによる農業拡張システムを維持し、小規模農家が新しい知識や技術に確実にアクセスできるようにする。民間セクターでは、新しい民間技術の導入促進を目的として技術移転システムに注力することを奨励する。

提言5.3

遺伝子組換作物のメリットについて地域全体でコミュニケーションを図り、民間の研究開発投資を増大させる道を開く。アジアでは、アジア内での食料消費と食料輸出国の輸出継続のために、食料生産および生産性の向上をもたらす新バイオテクノロジーは必須である。

提言5.4

研究／訓練提携やその他地域フォーラムを協力して開催するなど、能力や研究開発の進歩を共有する地域の専門技術センターを活用する。中所得国もCGIAR（Consultative Group for International Agricultural Research、国際農業研究グループ）やその他の国際研究機関をサポートし続け、NARS（national agricultural research systems、国立農業研究システム）の発展につなげる。

提言5.5

食料バリューチェーンの多分野において活躍できる学際的研究者、および技術移転に従事する人材を輩出することができる機関の能力を強化する。

提言5.6

持続的な研究開発の努力と官民提携を通して、新ビジネスモデル、情報および通信技術の発展を促進する。これらの改革は、サプライチェーンの制約を緩和し、スキルと管理能力を確立し、気候変動の影響に備える方向に向かうものでなくてはならない。

1: INTRODUCTION

How can Asia best feed itself in 2035?

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

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

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

The Commission's aims were:

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

Methodology

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

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

The themes of the Commission's deliberations included:

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

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

Conceptualising food security in Asia

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

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

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

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

Geopolitical stability, climate change and food security in 2035

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

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

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

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

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

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

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

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

Resilience and environmental balance

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

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

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

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

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

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

Figure 3: Resilience and environmental balance

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

ANNEX-FOOD SECURITY IN ASIA 2035 PLAUSIBLE SCENARIOS

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

Scenario 1 – High geopolitical stability and high climate change

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

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

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

Scenario 2 – High geopolitical stability and little climate change

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

Scenario 3 – Low geopolitical stability and little climate change

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

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

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

Scenario 4 – Low geopolitical stability and high climate change

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

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

2: FOOD SECURITY: THE REALITY

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

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

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

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

Food Availability

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

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

Farm size and production in Asia

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

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

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

Food loss and waste impacting food availability

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

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

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

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

Access to Food

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

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

Box 2.1: Access in India's food security challenges

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

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

Food Utilisation and nutritional security

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

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

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

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

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

Food safety and Biosecurity

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

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

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

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

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

Nutrition security

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

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

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

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

RECOMMENDATION 2.1

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

Stability and Risk Management for Food Security

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

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

Politics of Food Security

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

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

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

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

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

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

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

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

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

RECOMMENDATION 2.2
Build regional capacity for the identification and management of biosecurity threats consequently creating a uniform approach and consistent standards to be adopted.

Environment and Climate change

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

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

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

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

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

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

RECOMMENDATION 2.3

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

COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN INDIA

主要データ — インド

人口 — 現在	1,267,401,849
人口 — 2035年予測	1,525,369,000

ジニ係数	33.6
人間開発指数	0.586

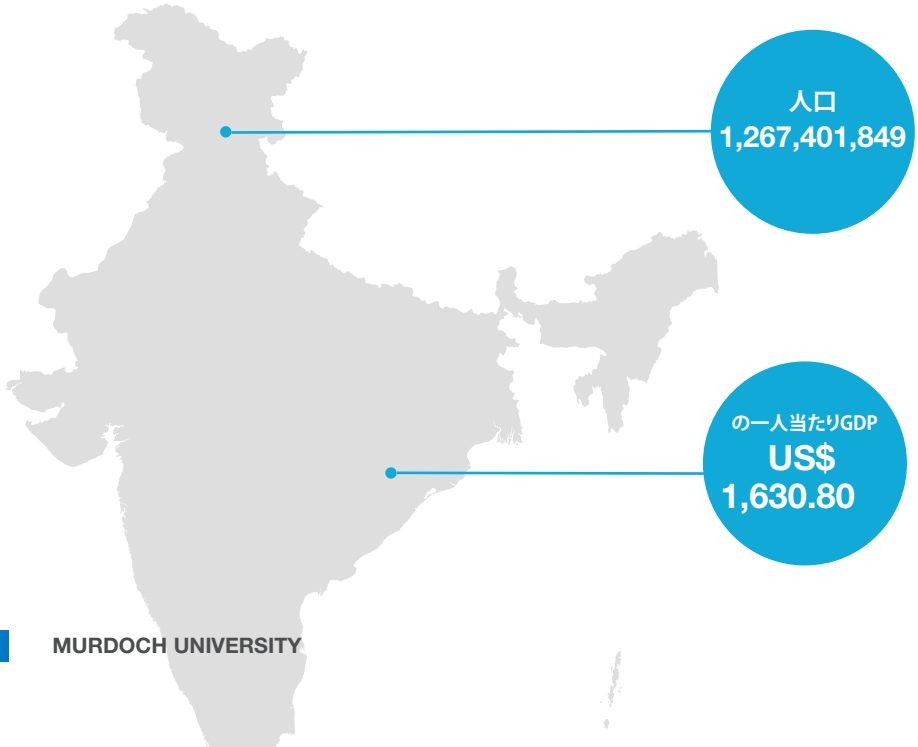
農業研究開発公共投資（百万購買力平価ドル（2005年））	2121

栄養不足蔓延率（人口に対する%）	15%
栄養過多蔓延率（人口に対する%）	1.9%

世界飢餓指数順位（2014年順位、2009年～2013年のデータに基づく）	55

農業従事者数	137,757,000
平均耕地面積（ヘクタール）（2010年までの10年間）	1.3

生物生産力 過不足（1人あたりグローバルヘクタール）	0.5（不足）



国別概要

2014年のインドの人口は1,267,401,849人で、GDP（国内総生産）は$2,066,902,397,333.3、国民1人あたりGDPは$1,630.80（USドル、2014年公式年間為替レート）。GDPに対し、農業は17%を占める。インドの農産物は多様であり、主要農産物は米、麦、油糧種子、綿、ジュート、茶、さとうきび、レンズ豆、たまねぎ、じゃがいも、乳製品、羊肉、山羊肉、鶏肉、魚である。1951年から2014年にかけての70年間で、インドは麦の生産を約15倍（650万トンから9,600万トン）、米を5倍（2,060万トンから1億650万トン）、とうもろこしを14倍以上、牛乳を8倍、魚を12倍、じゃがいもを26倍に増やした。現在、牛乳の生産国としては世界第1位、野菜・果物、米、麦、砂糖の生産国としては世界第2位である。より重要なのは、インドは現在食料の純輸出国であり、米の輸出は世界第1位、牛肉（水牛肉）の輸出では世界第2位であるということである。この農産業のめざましい発展は、政府の拡張サービスの支援に裏打ちされた生化学技術の一括導入などの各政策と、助成金の投入、最低支持価格の導入、穀類その他食品の公共調達、相当量の緩衝在庫運用などの農業（価格）支援政策を組み合わせた結果である。

検討結果－食料安全保障の課題

- 今日、インドの食料安全保障は、国としては達成されているが、世帯レベルではまだ深刻な問題である。5歳未満の人口の40%は栄養失調で、大人には貧血、タンパク質不足などの微量栄養素不足が蔓延している。インド人口の約25%は、最低限の食料（十分なエネルギー量）を入手できる貧困ラインを下回る生活をしている。国の自給率と食品供給は改善されたが、これは全国民の栄養保障とはなっていない。実際、経済的に十分な食品にアクセスできるようにすることが、深刻な課題となっている。
- インドは第二の緑の革命を発表し、東部で統合政策を行っている。農業政策と食料安全保障政策を多角的に見直し、再構築することが求められている。食品の生産と消費に対する助成金により、灌漑、農地拡大サービス、マーケティング、食品加工インフラなどへの公共投資が後回しになっている。
- 農業は国家経済の中で最も改革が遅れているセクターであり、農業の自由市場における大幅な効率化が得られず、国の食料安全保障に貢献することができない状態である。中でも、農業の労働生産性の改善が必須である。余剰労働力を農業以外の活動に回し、個人レベルの経済改善を行って十分な食品へのアクセスができるようにすべきである。

- 投入助成金をやみくもに使うことは、土壌劣化、水不足、土壌汚染といった環境問題を悪化させる要因となり、長期的な食料安全保障では、産出量の鈍化や目的とは逆の作用をもたらすことになる。
- ある概算によると、損失の余裕がない国であっても、約30%の収穫後損失がある。消費者用の食料助成金には大きな漏れがあり、誤った対象者の選択や流用が見られる。これが、この国の公共流通システムや緩衝在庫運用から貴重な公共資源を大きく流出させている。

検討結果－食料安全保障関連の機会

- 現在、公共流通システムは数少ない作物だけしかカバーしていない。幅広い種類の作物を公共調達すれば、大多数の世帯にとっての主なタンパク源、脂肪源である豆類（レンズ豆）や油糧種子といった作物の供給反応が改善し、乾燥地農業や栄養保障といった分野での農業の多様化を促進するであろう。
- 公共流通システムは公共調達や緩衝在庫をもとにしており、インドの食料安全保障に貢献しているが、中期的には国民の栄養保障問題に取り組む必要がある。このシステムの効率化には大きな改善の余地がある。対象の選定、流通、備蓄の運用管理に生体認証システム（AADHAR）のプラットフォームを早急に導入し、システムの漏れ、汚職、食料廃棄を削減するべきである。
- 余剰食料を生み出すために展開された1960年代中頃から1970年代の農産物価格政策は見直しの必要がある。現在のインド食料経済の問題を取り組むように再構築されるべきであろう。例えば、栄養価の高い作物の生産と消費をサポートし、穀物以外の食品への多様化を促進することが考えられる。
- 食料輸出に有利になるように認識と政策を変えれば、農業効率や食料安全保障の改善につながる可能性がある。システムを市場主導型にするべきである。
- 収穫後処理技術をより活用すれば、輸送、保管等のインフラ不足による収穫後損失を減少させる機会が得られる。

- インドは物品配送と研究拡張の機会を追求するべきである。農業の研究開発で製品開発段階に到達しても、それを大規模に農業従事者に配布するシステムがない。
- 環境問題を誘発するような政策は見直す必要があり、農業生産には土壌や水資源を持続可能なかたちで使用することが奨励される。

検討結果 - オーストラリア／西オーストラリア州との関係発展の可能性

- インドの酪農産業は世界最大であるが、その生産性は低い。酪農セクターで協力の機会が存在する。オーストラリアの酪農の知識、専門技術を移転し、インドの酪農産業の能力を高めることが可能である。
- インドの乾燥地農作物の生産性向上のための研究は、オーストラリアの農業研究能力と農業慣行から恩恵を得ることができる。
- インド国民の食生活に重要な役割を果たしているレンズ豆／豆類（通常大量の水を必要としない）は、国内生産と需要のギャップを埋めるために輸入に依存しているが、オーストラリアはこの主要供給源となることができる。
- 農業従事者の交流計画も考えられる。インドの農業従事者が海外の農場を訪問する研修旅行やトレーニングを行い、これにオーストラリアの農場訪問も含めることができる。

COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN CHINA

主要データ — 中国

人口 — 現在	1,364,270,000
人口 — 2035年予測	1,407,087,000

ジニ係数	37
人間開発指数	0.719

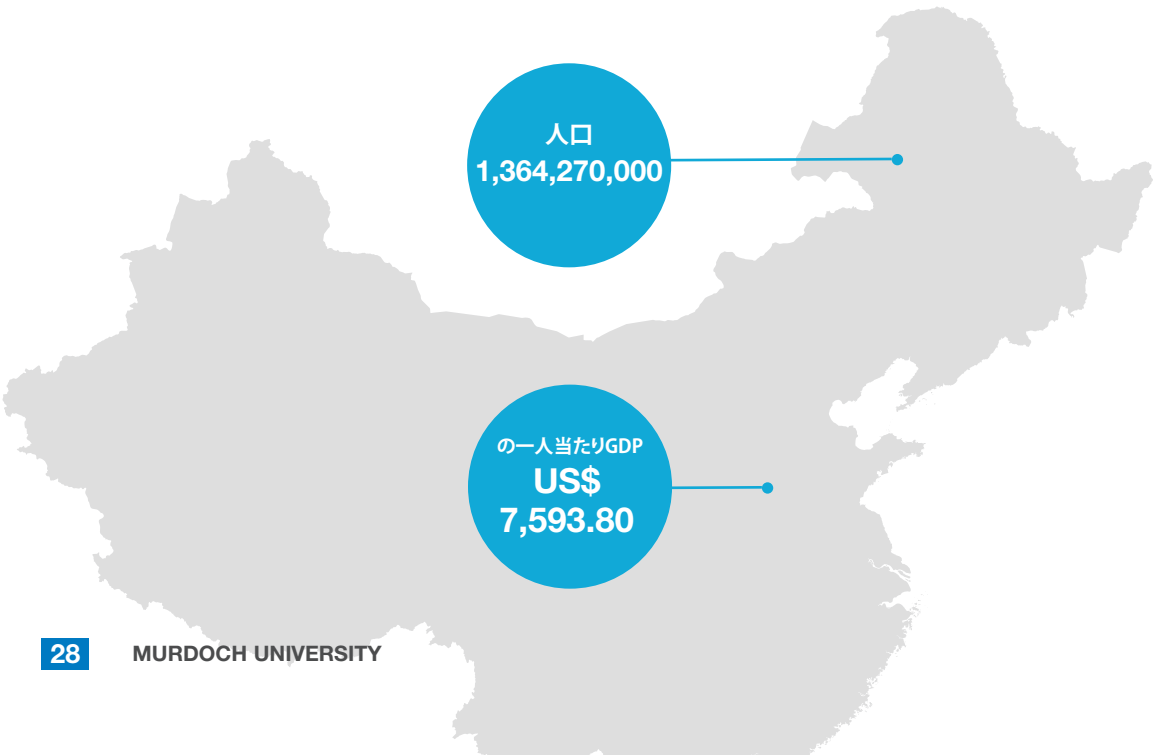
農業研究開発公共投資（百万購買力平価ドル（2005年））	4048

栄養不足蔓延率（人口に対する%）	11%
栄養過多蔓延率（人口に対する%）	5.7%

世界飢餓指数順位（2014年順位、2009年～2013年のデータに基づく）	5

農業従事者数	200,555,000
平均耕地面積（ヘクタール）（2010年までの10年間）	0.7

生物生産力 過不足（1人あたりグローバルヘクタール）	1.6（不足）



国別概要

ミレニアム開発目標達成への努力の一環として、中国は約5億人を極貧状態から改善させることに成功し、短期的には国家レベルで食料が保障されていると見られている。2014年の中国の人口は1,364,270,000人で、GDP（国内総生産）はUS$10,360,105,247,908.30、国民1人あたりGDPはUS$7,593.80。GDPに対し、農業は9.2%を占める。中国の主要農産物は米、麦、じゃがいも、とうもろこし、落花生、茶、キビ、大麦、りんご、綿、油糧種子、鶏肉、豚肉、魚である。2012年には労働力の三分の一（33.6%）が農業に従事しており、耕作地は国土面積の11.3%を占めていた。2014年に農業部（Ministry of Agriculture、MOA）は生産方式を転換し農業構造を調整する新政策を導入した。これは1978年以来、食料生産と食料安全保障に対する中国で最も大きなアプローチで、環境と資源の劣化、農地改革、機械化、持続可能な農業慣行、農業の職業化に取り組むものである。中国では栄養の保障への注目が高まっている。また、肥満率の増加と非伝染性疾患の懸念が大きくなりつつある。

食料安全保障の課題

- 非常に大きな進歩を遂げてはいるものの、いまだに1億5千万人の中国国民は貧困ラインを下回る生活をしており、特にへき地や地方の居住者、少数民族の中には、十分な量の栄養ある食料を手に入れることができない者もいる。食料不安は季節的なものである場合もあるが、地方と都市の所得格差が大きくなっており、地方に住む人々が食料および栄養の保障目標を達成できるよう、ミクロレベルで的を絞った介入がますます必要となってくるだろう。地方人口は女性、子ども、高齢者（もしくは虚弱者）が占める割合が増えている。彼らは、家族のメンバーが都市部に移住して取り残された者たちである。教育や資金および土地へのアクセスを通して女性の農業参加を促すことは、辺境の地方コミュニティーを貧困や食料不足から救う重要な要素となるであろう。この点に積極的政策をとっている地方政府もある。四川省政府のサンシャインプロジェクトは、男性の都市部への移住への対応として女性をサポートする構想である。農業や農産ビジネスを起こした女性に、政府から、ビジネスを発展させ続けるための助成金とトレーニングが提供される。
- 中国の食料安全保障における中長期的課題としては、人件費の上昇、農業労働力の高齢化、耕地地代の高騰、環境および資源の深刻な悪化（特に土壌と水）、大幅な気候変動、食習慣の変更による肉類や乳製品の消費増加が考えられる。中国は、適切な経済発展を促すために、いまだにある程度の都市化を必要としているが、政府の課題は都市化と農業生産用の土地の

保全のバランスをとり、いまだに貧困生活を送っている国民のニーズに対処することである。

- 中国政府による価格維持は、所得分配の公平化に役立っており、社会的結束を強める重要な手段である。しかし、この方針は、中長期的には維持できない価格の歪みを生み出しており、市場主導で価格が決定される方向に早急に転換する必要がある。

食料安全保障関連の機会

- MOA（中国農業部）の新「持続可能な農業戦略」は、食料生産と保障に対する中国のアプローチを大幅に改革するものである。中でも、この戦略では、保有地面積を広げ、機械化と農地改革を進めることにより、中国の農業技術不足問題を解決し、農業を職業化することを目指している。
- 農業問題や、食料安全保障に影響する水質や土壌の劣化などの環境問題についての中国政府との話し合いは、より開かれた透明性のあるものになった。海外で開発されたソリューションの導入検討について、より前向きな姿勢がみられる。GMO（遺伝子組換生物）に関する討論においても変化が見られた。GMOは食料安全保障に便益をもたらす新しい技術であり、さらなる研究をするべきであるというより柔軟な認識がされるようになった。
- カドミウム汚染米などの一連の出来事で、中国では食品の安全と質が重視されるようになった。民間の意識では、この一連の不祥事で、国民のための安全な食品を生産する国の能力に対する信頼が失墜した。現在、国民の多くは、中国に輸入される前にできるだけ多くのバリューチェーンの過程を海外で経てきた商品のほうに信頼を寄せている。中国政府は、両問題に取り組むための多くの活動を始めている。この活動はMOA傘下の専門機関、委員会、作業部会の設立（ただし、各省庁からの代表者でメンバーが構成されている）から、食品安全規則、消費者保護法の改正まで、多岐にわたる。地方政府でもこれらの懸念に取り組むためのシステムを整備している。

オーストラリア／西オーストラリア州との関係発展の可能性

- 安全でクリーンな食品の生産とバリューチェーンに沿った農産食品サービスの提供の両分野において、オーストラリアには専門知識や実績がある。これをもとにした研究や協業の機会は多い。中国は、家畜の栄養補助食品から、市場の発展を促すより洗練されたEコマースオプションまで、全範囲にわたる研究や新技術導入への介入を求めている。共同の研究および新技術導入により、オーストラリアの持つ専門知識とプロセスを中国の状況に適合させることができるであろう。二国間の産業間パートナーシップも重要である。この分野では、Australian Dairy Corporation（オーストラリア酪農庁）やタスマニアのCherry Growers（チェリー生産者団体）がそれぞれの中国における相当機関と協力して成功を収めている。
- オーストラリアの研究者たちは中国の研究者と共に、家畜の質を向上させ、羊毛と酪農業の生産性を上げるための大量の研究に取り組んでいる。生きた牛の貿易は注目を集めている分野であり、貿易関係を促進する可能性が大きい。鍵となるのは、適切な貿易協定を定め、必要なサプライチェーンを正しく配置することである。
- フードロスの分野では、オーストラリア（および西オーストラリア州）と中国との協力や約定の機会は多い。中国で収穫中、収穫後、輸送段階で無駄にされる穀物の量は、オーストラリア全体の小麦の収穫量を上回る。この展開には、生産、防疫対策、サプライチェーン開発の知識やノウハウを共有することが含まれる。中国の科学技術能力を高めることも、フードロス削減を続け、食品の安全と質を高めて栄養の保障を改善し、中国の生産品に新しい市場を開くために重要な必要条件である。

COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN VIETNAM

主要データ — ベトナム

人口 — 現在	90,730,000
人口 — 2035年予測	100,572,000

ジニ係数	35.6
人間開発指数	0.638

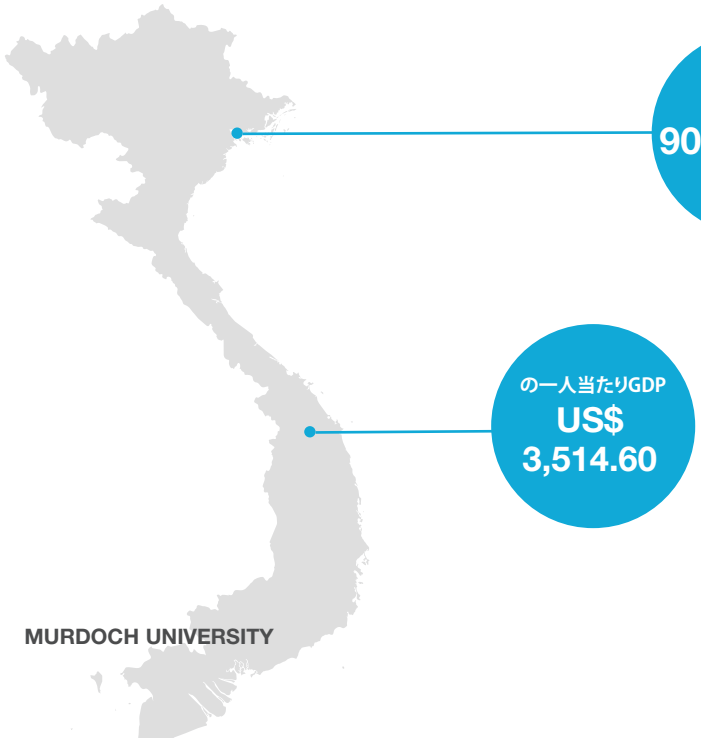
農業研究開発公共投資（百万購買力平価ドル（2005年））	86

栄養不足蔓延率（人口に対する%）	13%
栄養過多蔓延率（人口に対する%）	1.7%

世界飢餓指数順位（2014年順位、2009年～2013年のデータに基づく）	15

農業従事者数	10,689,753
平均耕地面積（ヘクタール）（2010年までの10年間）	0.7

生物生産力 過不足（1人あたりグローバルヘクタール）	0.4（不足）



概要

ベトナムは、食料安全保障に成功した国だと広く認識されている。この成功は、1980年代に始められた一連の改革によるところが大きい。これは、一連の介入方針の変更とともにベトナム経済をより市場主導型にし、強い経済成長を促進した。この結果貧困や栄養不足が減少し、現在ベトナムの食料安全保障順位はアジア第3位、世界第55位である。2014年のベトナムの人口は90,730,000人で、GDP（国内総生産）は$186,204,652,922.30、国民1人あたりGDPはUS$3,514.60。GDPに対し、農業の占める割合は18.1%。ベトナムの主要農産物は米、コーヒー、ゴム、茶、こしょう、カシューナッツ、鶏肉、果物、ナマズ（バサ）、魚介類、木製家具である。2012年には人口のほぼ半分（48%）が農業に従事しており、耕作地は国土面積の20.6%を占めていた。ベトナムとタイは、特に米に関して、ASEANのトップ輸出国である。ベトナムは高付加価値農産の先進国でもある。ナマズ（パンガシウス）の1994年の生産量はわずかだったが2009年には中国、インドネシア、アメリカを抜いて世界でもトップクラスの生産量（120万トン）に押し上げた。ベトナムの農業政策は貿易自由化を焦点にしており、直接の助成金政策はほとんどない。

食料安全保障の課題

- ベトナム国民の食料は概ね保障されているが、へき地や山岳地方の居住者、少数民族では、地方ごとの（または季節ごとの）食料不安がある。栄養保障はいまだに大きな問題であり、食の質と栄養バランスの両方に課題がある。アジアの近隣諸国と比較すると、ベトナムでの肉や卵の価格は安い。しかし、個人の栄養知識は十分でなく、肉や卵を含んだバランスの取れた食事を摂取すること、特に子どもに適切な食事を摂取させることについての知識がない。子どもの32%が栄養不良、低体重で、微量栄養素、特にビタミンAとカルシウムが不足している。地方や山岳地帯では牛乳は効果な栄養補給食品とみなされており、日々の食事には取り入れられていない。また、自給生活から市場での購買生活に急激に変化したために、人々には、食品の栄養価や、どうやってバランスの取れた食事を作るかという知識がない。
- いくつかの方針がベトナムの食料安全保障の課題に貢献している。例えば、380万ヘクタールをの土地を保護し、米の栽培にあてるという土地政策である。この保護政策は国内消費、輸出、備蓄をまかなうために、4,200～2,500万トンの米の生産を確保するために策定された。近年、政府が効率的生産や農業従事者の収入の向上に重点を置くようになったため、実際には、この政策は緩和された。米栽培のための耕作地は、植え付け時期に沿って減少する可能性がある。農業従事者は米栽培からより付加価値がある作物の栽培に変更することができる。
- 食品の安全は大きな課題であり、農産システムは全体を通して透明性に欠ける。小規模の野生生物農場にはほとんど規制がなく、農薬や肥料の使用

に関するずさんな管理が横行している。これはベトナムの水産業に対する措置とは対照的である。水産業に対しては、莫大な量の食品安全事業が施され、産業の発展をサポートして世界の水産市場への参加を可能にしている。

- ベトナムは気候変動で大きな影響を受けやすい。変動する気候のもとで、どうやって米の生産率を増やすか、どうやって農産物を多様化するか、ということを今すぐに検討し始める必要があると思われる。沿岸地域の食料生産中心地では、すでに季節の変動が現れており、メコンデルタでは塩分レベルが上昇している。ベトナムはエルニーニョやラニーニャなどがもたらす特異気象の影響も受けやすい。この影響は、気候変動によってさらに激化するであろう。シナリオ研究では、ベトナムは十分な米生産レベルを維持し、国内の食料安全保障を確保しつづけるが、黒字の減少が予測され、経済の成長と発展に影響が出るという見解となった。

食料安全保障関連の機会

- ベトナムの国家栄養戦略（National Nutrition Strategy）は栄養保障に取り組み、国民の食生活を（質と栄養バランスの面で）改善し、子どもの栄養不足と発育不良問題に対処するために案出された。この新しい焦点は、より広範囲に栄養保障問題に対処するために、食料安全保障の概念が米から多様な農産物に切り替えられたことを示している。
- ベトナム政府は市場販売作物のための農場サイズを拡大する政策を発表した。この政策が導入されれば、大規模農業組合を作って効率化を図る機会ができる。
- ホーチミンには40kmにわたるハイテク農業ゾーンがある。民間企業が主に出資しており、このようなゾーンを5年以内に7箇所作ることを目標としている。 この計画には300ヘクタールのバイオテクノロジー・ゾーンも含まれている。こうしたプロジェクトを発端とした高度の研究開発は、食料安全保障に貢献することが可能である。このようなイニシアチブには出資や研究パートナーシップで協力する機会がある.
- ベトナムはASEAN諸国が以下の発展において結集するのに貢献することが可能である。
  - 緊急食料システム
  - 備蓄、価格、技術の情報システム

- 品種と育種
- 国外備蓄／倉庫システム
- 以下を通した国際交流：技術交流、米生産の方法と政策、比較優位性や相補性に基づいた地域の計画論的研究、研究開発

オーストラリアおよび西オーストラリア州との関係発展の可能性

- 西オーストラリア州とは、二国間の比較優位性に基づいた食品バリューチェーンに沿った出資や、中小企業（SME）の能力を強化してバリューチェーンに参加できるようにする、といった分野で協力の可能性がある。
- 西オーストラリア州は、ベトナムの防疫対策の改善、天然資源の管理、気候変動への適応努力などの取り組みをサポートすることが可能である。
- ベトナムは、食品安全、食品供給監視システム、経済のモデル化を通して、地域パートナーシップや協調体制に貢献することを強く望んでいる。
- ベトナムの農学専門家は実地調査スキルや専門知識を豊富に持つ。これをオーストラリアの技術（採種および検査）、知的財産、インフラ開発の専門知識と提携させれば、ベトナムの農業の可能性を拡大することが可能である。
- 農学関連の科学、技術、方針について二国間で教育訓練を実施することで、南―南協調体制という展望に向かった前進が期待できる。

COUNTRY BRIEFS: EXPLORING FOOD SECURITY IN INDONESIA

主要データ — インドネシア

人口 — 現在	252,812,245
人口 — 2035年予測	303,382,000

ジニ係数	38.1
人間開発指数	0.684

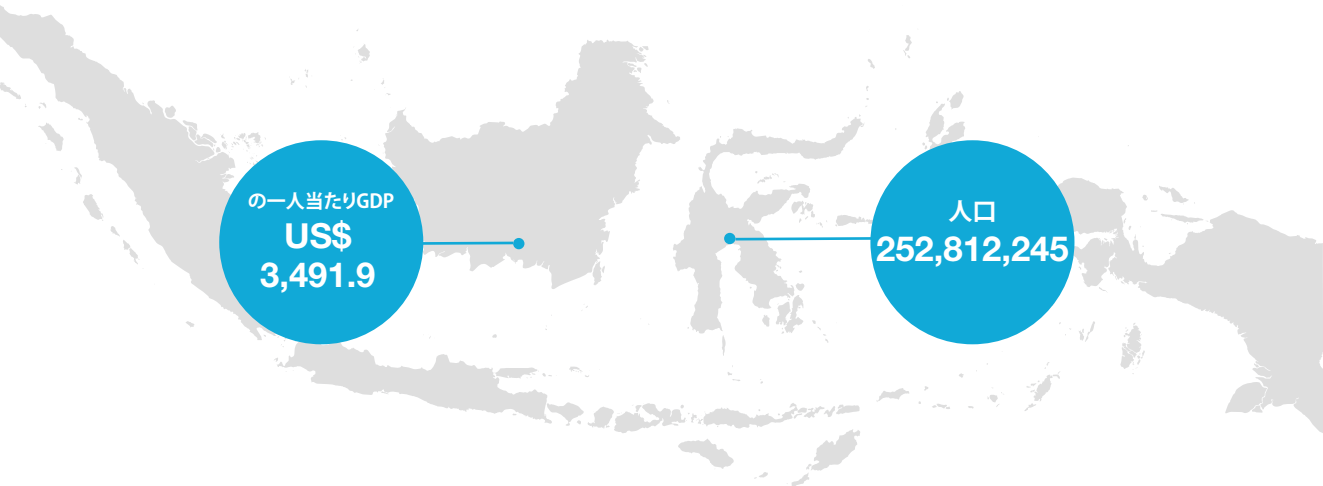
農業研究開発公共投資（百万購買力平価ドル（2005年））	379

栄養不足蔓延率（人口に対する%）	9%
栄養過多蔓延率（人口に対する%）	4.8%

世界飢餓指数順位（2014年順位、2009年～2013年のデータに基づく）	22

農業従事者数	24,868,675
平均耕地面積（ヘクタール）（2010年までの10年間）	0.8

生物生産力 過不足（1人あたりグローバルヘクタール）	0.1（不足）



国別概要

インドネシアは世界で人口が4番目に多く、農業生産はトルコ、フランスに続く世界10位で、ドイツやアルゼンチンを上回っている（OECD、2012年）。ヤシ油の生産は世界第1位で、天然ゴムは世界第2位、米の生産および消費は中国、インドにつづいて世界第３位である。インドネシアは農業用地が乏しく、国民1人あたりの面積では世界平均の三分の一にすぎないが、比較的豊富な水資源を持つ。インドネシアのGDPで農業の占める割合は、1990年には19%だったものが2014年には10%に落ち込み、総就業人口に対する割合も、同期間で56%から30%に下落した。ヤシ油とゴムは全農産食品輸出の60%を占め、農産食品貿易に大きな黒字をもたらしている。

インドネシアの農業の特徴は小自作農による農業であり、特に食用作物の生産でこれが顕著である。全体では、2,580万の家族経営農場が存在し、その平均農地面積は0.8ヘクタールである。1,420万（55.2%）の家族経営農場は、所有地0.5ヘクタール未満の小自作農（petani gurem）である（CBS、2014年）。年間を通して収穫できる作物については小自作農が重要な生産者であるが、全栽培面積の15%を占める大規模の民間もしくは国有の農場が、平均面積2,600ヘクタールの農地でヤシ油とゴムの栽培をしている.

食料安全保障に関しては、政府が戦略的産物、すなわち、米、とうもろこし、大豆、砂糖、牛肉の生産促進に重点を置いている。上記産物に続き、エシャロット、唐辛子、じゃがいもの生産にも力を入れている。政策、研究、開発予算で重要視しているのは米である。生産成長率は年間2.5%（2000年～2001年）から1.63%（2014年）と下降したものの、インドネシアは十分な量の米の生産を達成している。それでも、安定化を図る目的で国内備蓄を強化するために、米を輸入する年もある。

マクロ経済の変化によりもたらされた食の多様化によって主食の需要が減少し、豆類、野菜、果物、家畜生産品などの栄養価の高い食品への需要が高まった。2010年の野菜の消費レベルは1999年の120%、果物の消費は125%に達した。消費量の増加が最も著しかったのは肉、卵、牛乳で、2010年には200%を超えた。

食料安全保障の課題

- インドネシアは最近になって国による詳細な食料統治を強化し、食料安全保障（特に米の自給）と国家安全保障に強く結びつけた広範囲の保障のなかでこれを表現し始めた。農業拡張分野に軍の市民活動任務の担当者を起用したことは批判を浴び、全体からの支持は得られていない。
- 借地権問題は食料安全保障に課題を提起している。投資、インフラ開発、農業生産能力への制限が設けられており、これに、気候変動に対する農家の適応能力の問題も加わる。改革なくしては、インドネシアの多くの小自作農はスケールメリットを活用することにも限界がある。この状況は家計を改善する機会を妨げ、発展を阻害し続け、所有土地平均面積0.4ヘクタールの

1,900万戸でミクロレベルの気候適応への投資を余儀なくさせることになる。

- 農業と地方の発展への投資は、政府が確定した自給思想や官僚主義、そして市場への不信感によって制限されているようである。インドネシアは、相対的な強みがある分野で付加価値を最大限にする戦略的なアプローチを取るよりも、すべてをうまくやろうとする傾向がある。
- 研究者と営利事象者とのつながりがないために、改革、研究、開発が阻まれている。営利事業者は素晴らしいアイデアを持っているが、それを発展させるための研究能力がなく、逆に、技術能力を持つ研究者は、その商品開発や商品化をサポートする商業活動に接触することができない。
- 食品の取扱と安全の問題は持続的で重大な懸念であり、空気や水で感染する病気の頻繁な発生が、食料生産にも影響を与えている。この問題に対する民間の認識を高め、フードロスと食品廃棄についても広く理解してもらうことが必要である。

食料安全保障の課題

- 政治的には米が重要視されているが、米作用地の使用は効率的でないことが多い。だが、この事実はあまり認識されていない。食料生産を多様化し、価値の高い園芸作物や多年生作物を生産することで、インドネシアは生産効率を向上し、米への依存度を軽減する機会を得ることができる。インドネシア国民の富裕度が高まることで、パンやパスタなどの小麦製品への需要が増えるという機会もある。
- インドネシアの構造改革が農業に与える影響を精査する必要がありそうである。また、新しい食料安全保障の定義とその測定基準を確立することも必要であろう。食料生産に関する現在の焦点は、食料安全保障の定義をより総括的にして、保障、栄養、健康を包含したものにすることである。これらの変化により、インドネシアは食料安全保障の測定が可能となり、食品バリューチェーン全体にわたって機会を活用できるようになる。
- KADIN（インドネシア商工会議所、Indonesian Chamber of Commerce）は民間セクターから政府に提言をすることで方針の伝達に一役買っている。この緊密な協調体制は、民間セクターが見識や実際の業務から学んだこと

などを、より多くの政策担当者と共有できるようになったという点で、今後の期待ができる進歩である。

- 生産性向上の鍵である教育は、インドネシアの食料安全保障の有望分野として立ち上ってきた。PISAgro（インドネシア持続可能な農業のためのパートナーシップ）はKADIN、農業省（Ministry of Agriculture）、商業省（Ministry of Trade）が共同で3年前に発足した。このビジョンは、収穫量と農業従事者の収入を20%増やし、排気量を20%減らすというものである。9作物の分野で試験的試みが成功し、小自作農レベルで収穫量が15～80%増量した。小自作農の以前の米生産率は1ヘクタールあたり5トンだったが、PISAgroによって8トンまで増やすことができた。
- 麦などの食料備蓄システムに対するインドネシア政府の政治的コミットメントは歓迎すべき発展である。同様に、インドネシアはASEAN食料安全保障情報システム、ASEAN+3マクロ経済リサーチオフィスに積極的に貢献するべきである。

オーストラリアおよび西オーストラリア州とのさらなる協力の可能性

- インドネシアの空気感染、水感染の疫病発生を防ぐ能力を高めるために、オーストラリアは防疫対策、公共衛生の教育や訓練の提供に協力できる機会が多いにある。
- インドネシアの目標は、アジア地域向けの、特にイスラム教徒市場で、牛肉輸出国となることである。この目標には、オーストラリアのビジネスおよび産業とパートナーシップを結び、セクターの長期的成長、発展への援助を得

ることで前進できる。また、オーストラリアの育種技術とインドネシアの畜殺および包装の技術を結びつけることで、オーストラリアとインドネシアは第三者機会も提唱できる可能性がある。

- 西オーストラリア州とインドネシアは、麦や穀物の生産、加工における協力体制で利益を得ることができる。インドネシアの世界レベルの製粉産業と西オーストラリア州の麦生産が連携して、麺などの製粉製品の大きな成長を見込むことができる。
- インドネシアの食生活の変化は、野菜や嗜好品などの代替品の需要を加速しており、西オーストラリア州の輸出機会を創出している。西オーストラリア州からはすでにインドネシアへにんじん、じゃがいもの種子を供給しているが、空輸や貿易許可など、解決すべき物流上の問題を抱えている。2015年9月に発表された新経済政策パッケージは、これらの問題のいくつかに対応している。また、150%というワインの関税率により、いくつかの市場（例えばマーガレット・リバーの赤ワイン）は取引が成り立たなくなっている。インドネシアのトロピカルフルーツ栽培者はオーストラリア市場に進出し始めている。双方向貿易促進の機会を探り、オーストラリア、そして西オーストラリア州の生産者がインドネシア市場によりよいアクセスを得られるようにするべきである。
- オーストラリア企業にとっては、インドネシア企業と食品加工においてパートナーシップを結ぶ機会がある。例えば、Idofoodは国内で125,000トンのじゃがいもの加工を目指している。インドネシアの国内じゃがいも生産は現在30,000トンであるので、短中期的に需要に対応するには、未加工のじゃがいもを他国から輸入する必要がある。

3: FOOD SYSTEM PRODUCTIVITY AND PUBLIC INVESTMENT

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

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

Loss of cropland to urbanisation

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

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

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

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

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

Technology and productivity

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

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

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

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

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

RECOMMENDATION 3.1
Promote the adoption of new and improved environment-friendly technologies and practices to increase the productivity of the food production system. Programmatic interventions are required across Asia in order to inform and change farming practices e.g., via integrated pest management.

Productivity-related reforms within the production system

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

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

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

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

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

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

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

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

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

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

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

RECOMMENDATION 3.2

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

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 it is of comparatively low quality. Farmers in Myanmar may be able to increase production with better access to finance that can fund productivity-boosting farming activities and competitive behaviour could be removed through a regional mechanism that recognises comparative advantages and allows more collaboration in terms of food reserve pricing.

RECOMMENDATION 3.5

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

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

RECOMMENDATION 3.6

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

4: TRADE POLICIES AND REGIONAL FRAMEWORKS IN THE FOOD ECONOMY

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

Trade and pricing

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

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

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

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

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

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

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

RECOMMENDATION 4.1
Expedite free trade agreements and food market liberalisation regionally and globally.

RECOMMENDATION 4.2
Communicate the benefits of food trade liberalisation between countries in Asia by providing appropriate information to all stakeholder groups and raising awareness of benefits.

RECOMMENDATION 4.3
Commit to minimising price distortions and facilitate increased infrastructure investment by promoting private sector and foreign direct investment in food production systems.

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

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

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

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

Box 4.1: Cooperative Bulk Handling and supply chain management

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

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

RECOMMENDATION 4.4
Develop policies to support lowering of trade-related transaction costs, creation of improved information systems, better marketing strategies and infrastructure such as storage, distribution and transportation systems for public and private institutions engaged in the food value chain.

Mapping regional frameworks

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

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

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

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

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

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

ASEAN Plus Three Emergency Rice Reserve

APTERR was conceived after the 2008 food price crisis[6] 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

[5]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)
[6]ASEAN Plus Three Emergency Rice Reserve Agreement (2011). Jakarta, Indonesia, 7 October. Available at (http://www.scribd.com/doc/97411992/APTERR-Agreement)

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

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

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

RECOMMENDATION 4.5

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

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

Regional capacity building and information sharing

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

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

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

ASEAN's Integrated Food Security Information Systems (AFSIS) aims to forecast and monitor supplies and the uses of basic food commodities. Efforts to make AFSIS a credible regional information platform are hampered, however, by the lack of timely, reliable data from member states[7]. 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).

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

Forging partnerships and strengthening intra and inter-regional collaboration

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

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

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

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

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

RECOMMENDATION 4.6

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

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

5: INNOVATION FOR FOOD SECURITY

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

Research and capacity development systems

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

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

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

Agricultural careers in Asia

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

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

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

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

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

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

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

RECOMMENDATION 5.1
Maintain a balance between education programs that produce graduates with specialist skills, and programs that train generalists capable of systems level thinking and implementing solutions.

Extension and technology transfer systems

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

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

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

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

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

Box 5.1: Lotus Rice in Vietnam

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

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

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

RECOMMENDATION 5.2
Maintain traditional public sector extension systems to ensure small farmers continue to have access to new knowledge and technologies whilst encouraging the private sector to emphasise technology transfer systems aimed at expediting the adoption of new private sector technologies.

Technologies and regional research and development cooperation

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

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

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

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

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

RECOMMENDATION 5.3
Communicate the merits of GM products across the region, paving the way for increased private R&D investment. New biotechnologies are indispensable to provide the food production and productivity gains needed for Asia to feed itself and for food exporting countries to continue their exports.

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

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

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

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

Box 5.2 ACIAR – A Model For Project Partnerships

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

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

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

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

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

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

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

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

RECOMMENDATION 5.4
Leverage the regional centres of expertise sharing capacities and R&D advancements through collaborative arrangements such as research/ training consortia and other regional forums. Middle-income countries should also continue to support the Consultative Group for International Agricultural Research (CGIAR) and other international research agencies, subsequently allowing the enhancement of national agricultural research systems (NARS).

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

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

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

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

RECOMMENDATION 5.5
Strengthen institutional capacities to produce inter-disciplinary researchers, extension and technology transfer workers across the areas of the food value chain.

Management capability

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

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

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

Box 5.4 Little Donkey Farm in Beijing, China

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

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

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

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

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

Source: JieYing (2015)

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

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

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

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

RECOMMENDATION 5.6
Foster, through sustained R&D efforts and public-private partnerships, the development of new business models and information and communication technologies. These innovations should be directed towards alleviating supply chain constraints, building skills and management capability and preparing for impacts of climate change.

CONCLUDING REMARKS

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

COMMISSIONER PROFILES

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

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

Professor John Edwards, Director, One Health Solutions

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

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

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

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

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

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

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

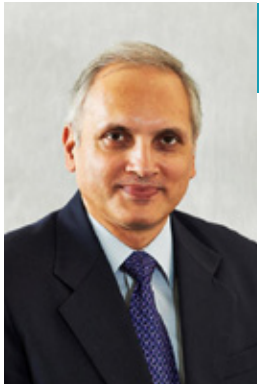
Dr Dang Kim Son holds a PhD in Farming System Research from Vietnam Agricultural Science Institute, an MA in Development Economics from the Food Research Institute, Stanford University, and a BSc in Agronomy from Hanoi Agricultural University. He served with the Ministry of Agriculture and Rural Development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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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.