

ACIAR Mango Agribusiness Research Program

Workshop Outcomes March 2019

2016/006	<i>Mango Information</i>
2016/007	<i>Mango Markets</i>
2016/008	<i>Mango Biosecurity</i>
2016/009	<i>Mango Quality</i>



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ACIAR Mango Agribusiness
Research Program
2017 – 2019

Workshop Outcomes

Haikou, China
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About this publication

The ACIAR Mango Agribusiness Research Program Workshop Outcomes is a Griffith Asia Institute publication, offering new perspectives on the key issues affecting mango trade in the Asia-Pacific region. Our objective in publishing this collection is to share research and insights around mango information, market, quality and biosecurity, and to encourage informed debate on Australia's engagement with ACIAR partner countries.

Photography

All photographs taken at the Mango Agribusiness Workshop, Haikou, China.

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ACIAR Mango Agribusiness Research Program 2017 – 2019

Mango is the third most widely grown fruit in the tropics and sub-tropics, after watermelon and banana. Global production has increased by some 50 per cent during the last decade, by an average of 4.5 per cent per annum. Mango production, market demand and trade patterns are very dynamic both globally and in the Asia-Pacific region. Domestic demand and export markets are steadily growing and becoming more diversified and sophisticated. Increasing demand for quality, safety, variety, seasonal availability and produce consistency is creating opportunities for smallholder farmers.

Most mangoes in the Asia-Pacific region are grown by smallholder farmers. Engaging in research and development to increase production and returns for mangoes will directly improve the incomes and livelihoods of many thousands of smallholder farming communities. To understand the current market and trade environment, a series of projects under the Mango Agribusiness Research Program, funded by the Australian Centre for International Agriculture Research (ACIAR) and implemented by Griffith University were undertaken. This booklet presents the outcomes of those mango research and development studies from across the program and shares the research findings from final workshop discussions.

Funding Agency

ACIAR was established under the auspicious of the *Australian Centre for International Agricultural Research Act 1982*, described at the time as 'an Act to encourage research for the purpose of identifying, or finding solutions, to agricultural problems of developing countries'. This was updated by the *ACIAR Amendment Act 2007* as part of the Australian government's response to the *Review of Corporate Governance of Statutory Authorities and Officeholders* (the Uhrig Report). This research program has been funded by support from ACIAR.

Implementing Agency

Griffith University is a highly ranked university with an international outlook, deeply connected to the Asia region. Our research excellence, innovative teaching and learning practices, along with our strong ties to industry, make us one of the leading providers of higher education in the Asia-Pacific region.

Since its establishment over 40 years ago, Griffith University has been strongly engaged in regional relationships, socially conscious and environmentally aware, an integral part of regional communities and heavily industry-focused for a sustainable future. Griffith University has evolved into a comprehensive, research-intensive university, ranking in the top 2 per cent of universities worldwide. Griffith University is responsible for implementing the ACIAR Mango Agribusiness Research Program.

About Griffith Asia Institute

Griffith Asia Institute (GAI) is an internationally recognised research centre in the Griffith Business School. GAI strives to be the informed voice leading Australia's strategic engagement in Asia and the Pacific by cultivating knowledge, capabilities and connections that will inform and enrich Australia's future in this region. We are currently ranked 18th worldwide / 1st in Australia in the 'university affiliated regional studies centres' category in the *2018 Global Go To Think Tank Index*. Our research in the field of political science is ranked 'above world standard' in the most recent *Excellence in Research Australia* exercise.

Our focus is on conducting and supporting excellence in relevant research on agribusiness, politics, security, economies and development in the Asia-Pacific region; facilitating effective partnerships and policy outcomes for positive impacts in the region; leading and informing public debate on Australia's place in this region; and shaping the next generation of Asia-Pacific leaders.

Authors

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Robin is an Associate Professor in Agribusiness with GAI and the Griffith Business School. She holds a PhD in international business and trade from Griffith University. Robin has particular expertise in applied research relating to the management of global and national consumer brands and products, with key interests in mapping export opportunities, value chain research, labelling and packaging, and new product development in the Asia-Pacific region. Robin has proven success in delivering increased business performance through market research, and her understanding and dedicated interest in the South-East Asian region makes her a particularly valuable researcher in the field of international business. Robin took up her current position with Griffith University following over 25 years' industry experience in international trade, commercial research and marketing management with national and international FMCG organisations. Through her industry experience, Robin leads and collaborates in research teams that have successfully launched new products and increased exports for a number of public and private sector organisations.

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Wendy is an organisational development consultant, with extensive experience in the development of people, systems and structures within organisations of all sizes. Working with a diverse range of clients has allowed Wendy to recommend effective strategies for transforming an organisation's current culture to a desired culture, and providing ongoing support to create sustainable outcomes. Wendy works with teams at all levels: coaching senior leaders; designing, developing and delivering leadership initiatives; reviewing systems and processes; restructuring organisations to release employees' potential. Wendy has been in national and international industries such as construction, meat, fisheries, horticulture, infrastructure and finance, for over 15 years to develop sustainability and resilience in the leadership and systems that run through the organisations.

Contents

ACIAR Mango Agribusiness Research Program 2017 – 2019	iii
About Griffith Asia Institute	iv
Authors	iv
1. Program Overview	1
Issue and Opportunity.....	1
Projects.....	2
2. Mango Information.....	3
Project Overview.....	3
Workshop Presentations	4
Workshop Reflections and Discussions	4
Going Forward	5
3. Mango Markets	7
Project Overview.....	7
Workshop Presentations	8
Workshop Reflections and Discussions	8
Going Forward	10
4. Mango Biosecurity	11
Project Overview.....	11
Workshop Presentations	12
Workshop Reflections and Discussions	12
Going Forward	13
5. Mango Quality.....	14
Project Overview.....	14
Workshop Presentations	15
Workshop Reflections and Discussions	15
Going Forward	16
6. Attendees.....	18

Funding Agency



Australian Government
Australian Centre for
International Agricultural Research

Implementing Agency



Collaborating Institutions



SIAEP



1. Program Overview

Issue and Opportunity

There is a strong case for focused investment in mango agribusiness research and development within ACIAR. There are a number of supporting reasons, including: economic benefits, potential market growth, smallholder livelihood improvements, and market development priorities in Australia and ACIAR partner countries.

Economically important crop

Mangoes, mangosteen and guava are globally the most abundantly produced group of tropical fruits, principally due to the sizable volumes of mango production. On this basis, mango is one of the most economically and socially important tropical fruits in terms of production, export value and trade growth throughout the Asia-Pacific region. In 2017, the Asia-Pacific region contributed 76% of total world mango production, with 10 countries accounting for over 70% of total global production. India with 18.7m tonnes (approximately 40%) continues to be the major producing country, followed by China with 4.7m tonnes (FAO, 2017). Mangoes have become a significant fruit across communities in the region and in the rural development pathway of many developing countries

Strong potential for market growth

The market fundamentals for mango in the Asia-Pacific region are promising. Global mango production and trade in the last decade has experienced significant growth, with the main producing countries located in Asia. Mango market supply-demand, trading trends and patterns are very dynamic both globally and in the region. Australia's export markets are steadily growing at rates of 8% per annum. Markets are becoming more diversified and sophisticated. Growing consumer demand for quality, safety, variety, seasonal availability and produce consistency is creating both opportunities and barriers for smallholder farmers. A common issue is the struggle to keep up with production and supply of fresh and processed products to domestic and export markets. This situation presents opportunities for Asian smallholder producers and Australian growers. However, little systematic information has been published regarding the complex and rapidly developing trade requirements in key markets such as mainland China.

To understand areas of comparative advantage and implications for farmers in ACIAR partner countries and Australia, information is needed about: seasonal supply gaps, customer and consumer preferences for specific mango varieties, physical and eating quality attributes and preferences, losses in supply chains, cost-efficient strategies to improve quality and shelf life, and market entry opportunities and cross-border trade.

An overarching objective for the ACIAR Mango Agribusiness Research Program is to obtain greater strategic benefits and impacts from investment in mango research through partnerships, and a more coordinated approach to priority research areas with the Australian Mango Industry Association (AMIA) and with overseas institutions (public and private) engaged in mango research and development.

Projects

Under the banner of the Mango Agribusiness Research Program, ACIAR invested and supported, over two years, four closely integrated small research activities with specific research aims.

➤ **AGB/2016/006 – Supporting access to mango research information, communication, collaboration and capacity development**

Mango Information – To support and enhance information access, communication, collaboration and capacity for mango agribusiness at regional and country levels in the Asia-Pacific region.

➤ **AGB/2016/007 – Challenges and opportunities for meeting requirements of China mango markets**

Mango Markets – To develop a detailed understanding of challenges and opportunities to meet requirements in China mango markets.

➤ **AGB/2016/008 – Opportunities and strategies to improve biosecurity, market access and trade for selected mango markets**

Mango Biosecurity – To identify opportunities and strategies to improve biosecurity, market access and trade for selected mango markets through a better understanding of knowledge and stakeholder gaps.

➤ **AGB/2016/009 – Enhancing mango fruit quality in Asian mango chains**

Mango Quality – To develop a common approach to assessing, describing and improving fruit quality in Asian mango supply chains.

The mango agribusiness projects further contributed to strengthening the partnership network with researchers and institutions in China and throughout Asia. This opportunity and priority for Australian and ACIAR partner countries provided collaborative research training, capacity development and mainstreaming of technical research methods to provide important strategic mutual benefits to over 50 researchers across the program.

2. Mango Information

Project Overview

Mangoes provide a powerful vehicle for increasing the incomes of smallholder farmers across many parts of the Asia-Pacific region. Mangoes are also one of the most economically important tropical fruits for over 800 growers in Australia. In the last 35 years, ACIAR has supported a number of mango-related projects, creating significant impacts for mango industries across a number of countries. However, impacts could be further amplified with a more strategic focus on communication and collaboration between the ACIAR project teams and stakeholder communities in partner countries and Australia.

The initiation of a strategic, coordinated approach to mango research within the Mango Agribusiness Research Program, in conjunction with partner country research institutions, the AMIA and Australian institutions (universities and state/territory governments), has the potential to create strong aligned networks and increase engagement to share mango research outcomes. This project provided the linkages, communication, collaboration and capacity building necessary to bring alignment and engagement to the broader suite of projects in the Mango Agribusiness Research Program.

Project aim and objectives

The overall aim was to support and enhance information access, communication, collaboration and capacity for mango agribusiness at regional and country levels in the Asia-Pacific region. Specifically, this project engaged with Mango Markets, Mango Biosecurity and Mango Quality studies to deliver coordinated research outcomes and optimise investment efficiency.

The study objectives were to:

1. Promote engagement, collaboration and partnerships among key stakeholders.
2. Improve information access and communication to facilitate the exchange of learnings between project partners.
3. Support participation and capacity development for young agribusiness researchers and industry personnel.

Research method

Effective research partnerships required a shared understanding of the issues and respect for the knowledge and capability of each research team. The partnerships brought to the table diverse skills and experiences in facets of mango agribusiness trade to address challenges and issues, and to consider solutions across regional mango supply chains. This project facilitated a series of activities including: inception and end-of-program workshops; digital platforms to create a mango research network; early career researcher (ECR) pilot program; and QR code technology in the China market.

Using a consultative approach, the project undertook the development and evaluation of online and social media tools to share the learnings and outputs

from across the projects, supporting both the research program and the wider mango agribusiness research community. Communication approaches were monitored, analysed and reported. The communications strategy engaged with partner country researchers, their institutions and the Australian mango industry community. This participatory approach was extended by the reporting of the business case for ongoing communication and sharing of mango research and development outputs across the region.

Additionally, this project supported research collaboration with a focus on ECRs (current and recent graduates) and cross-country projects to enable and build longer-term capacity in collaborative mango research. This was achieved through a small studies program enabling ECRs to enhance their research skills through an investigation of issues relevant across the Mango Agribusiness Research Program. Projects were mentored by experienced researchers who supported the ECRs to develop throughout their experiential learning exercises.

Partnerships

This project was co-led by Griffith University and the Department of Agriculture and Fisheries, Queensland, with contributions from AMIA and partner countries: Cambodia, Indonesia, Pakistan, the Philippines and Vietnam.

Workshop Presentations

ECR case studies

Sharing research in Vietnam	Tran Thi Ut Linh
QR code study in China	Colin Leung
Capacity building study	Geoff Dickinson
Collaboration study	Ebony Faicheny
Socialising research - online & social media	Robin Roberts

Workshop Reflections and Discussions

Following the presentations, the presenters engaged in a Q&A session and subsequent table-talk conversations. Several broad themes emerged: communication structures, competence, and social process. Common issues related to being kept informed and research funding.

Communication structures – appropriate platforms and modes of communication are crucial across the various demographics. The need for structured approaches and coordinated activities was expressed by participants. A clear communication protocol across all projects including regular information streams was seen as an important element linked to success. The ECR initiative was highlighted with interest by the participants. Whilst not without challenges, this scheme was seen as a ‘great activity within the program which increased confidence, networks, experience and exposure’.

Competence – building capacity in diverse teams was strongly highlighted. To share information and exchange learning effectively required a sound understanding of the technical language and discipline nuances. Participants expressed the need for researchers and teams to engage with digital applications and internet technology to effectively access and advance research outcomes.

Social process – generally occurs through the natural interaction of teams, thereby building rapport, collaboration and capacity. In the case of this broad research program, the participants noted that the social process was overridden by the technical or commercial aspects of the research activities. Participants commented that '(social) communication was not the first priority for the project teams due to priority of work activities'. Comments were also made about the need to plan early activities to build cultural awareness and understanding of contextual communication for the diverse personnel in the teams.

Discussion issues linked to the commentary from the previous themes. Participants noted the need to 'better structure and incorporate communication activities into project milestones'. Information sharing from project leaders to researchers and *vice versa*, highlighted the challenge for information dissemination, particularly timeliness and amount of material. A number of participants also commented on the role and choice of media channels, including online and app style formats, needed to share information in a one-on-one basis or in a group format, for example the use of WeChat when collaborating with Chinese research partners and more commonly the use of WhatsApp in countries such as Vietnam and the Philippines.

Participants commented on the value of the ECR projects throughout the program. What was commented on was the need for continued funding support for ECR researchers to enable valuable capacity development and field research activities. The group identified the important of the ECR studies to facilitate engagement between mentees and mentors. A larger investment in the monetary value and the parameters of the ECR studies was noted as being more beneficial to future programs.

Going Forward

Future opportunities for the Mango Information project were highlighted by the participants and summarised in three areas of importance: networking, development and structure information sharing.

Networking was signalled by the participants as their desire to stay connected, continue to share information, and gain knowledge after the research program was completed.

The key supporting reasons for staying connected included:

- to continue to expand their network
- to increase exposure and learning
- to increase linkages with mango and other ACIAR research projects
- to develop multi-country, cross-disciplinary focused project engaging ECRs to working on a single mango research topic.

Participants expressed an interest to continue their mango research and development program. Specifically, an interest was expressed to engage in activities that further develop their technical research capacity, improve their field research skills and develop individual competencies to write up research reporting and journal papers studies.

Interestingly, participants requested a systematic method to receiving project information, communicating feedback and engaging across the teams. Of benefit would be regular and interactive team meetings within their projects, additional time to plan collaborative research strategies, information sharing and ongoing feedback.



3. Mango Markets

Project Overview

The market fundamentals for mango in Asia are promising. World mango production in the last decade has experienced tremendous growth, with the main producing regions located in Asia. Mango market supply-demand, trading trends and patterns are very dynamic both globally and in the Asia-Pacific region. Australian demand and export markets are steadily growing at rates of 4% and 8% per annum, respectively. Markets are also becoming more diversified and sophisticated. Increasing consumer demand for seasonal availability and produce consistency is creating both opportunities and barriers for smallholder farmers, growers and traders. Common to all is the struggle for production to keep up with and deliver supply to domestic and export markets in fresh and processed segments.

The People's Republic of China was identified as a priority market given the rapid expansion in the middle-class demographic, close proximity to most of the major mango producing nations in the region and the recent expansion of its own domestic production capacity. While this presented an opportunity for both Asian and Australian producers and traders, little information was available about the complex and rapidly developing market requirements in the China mango market. To understand areas of comparative advantage, and the implications for stakeholders, information was needed regarding seasonal supply gaps, customer and consumer preferences for different mango varieties, physical and eating quality attributes and preferences, cost efficient strategies to improve quality and shelf life, and opportunities across a range of market segments and supply chains.

Project aim and objectives

The overall aim was to develop a detailed understanding of challenges and opportunities to meet requirements in China mango markets.

The study objectives were to:

1. Characterise the current situation and trends in mango markets and segments in mainland China.
2. Develop an in-depth understanding of supply and demand across market segments in mainland China, including issues, constraints and opportunities.
3. Evaluate the current and potential competitive advantage of targeted ACIAR partner countries and Australia in China and identify strategic research, policy and development interventions.

Research method

The project was conducted in two phases. The first involved the identification of suitable stakeholder informants and university research partners in China and partner countries, training and consultation, then undertaking market research activities in China.

The second phase comprised an in-country workshop with key researchers and government and industry representatives in mainland China, to evaluate areas of competitive advantage and plan the individual mango research activities to be undertaken in the China market.

Partnerships

The project was led by Griffith University and the University of Adelaide. The research team collaborated with Chinese partners including the University of Guangxi and the Southern China Agricultural University. Mango exporters from Australia and partner countries participated in key consultations and market research activities in China, providing deeper engagement and insights for the project.

Workshop Presentations

ECR case study

China Market – Segmentation study	Sarah Wheeler
Willingness to pay study	Alec Zuo
E-commerce study	Robin Roberts
Cross-border study	Meiying He & Tiago Wandschneider
Linking supply with demand activity	Alec Zuo
China market assessment study	Xinjian Chen & Xiaoqiu Chen

Workshop Reflections and Discussions

After the presentations, the participants engaged in Q&A sessions followed by table-talk conversations. It was strongly agreed that the fresh mango market is a challenging environment impacted by structural and societal variables such as growing seasons, consumer preferences and buying channels. Mango varieties traded and supply chain arrangements differ across and between partner countries into China. The following themes emerged from these discussions: market dynamics, education, and market access.

Market dynamics – the Chinese market is vast and very dynamic, and this was reflected in multiple workshop discussions. Participants noted that tier-one cities in China are rapidly evolving. Consumption levels, desire for quality and increasing demand show the complexity for exporters and traders to provide what the consumer demands. Participants commented that mangoes may be given as gifts in addition to being purchased for general consumption. This placed a high demand on fruit quality and was supported by the ‘willingness to pay’ presentation. Specific market sectors were highlighted in discussions and participants agreed that further studies to identify specific demographics and purchasing channels such as e-commerce were required.

Education – there was strong appreciation for the need to better understand the China market, particularly for opportunities in the tier-two and tier-three cities. In some cases, the China market may require educating consumers about the different mango varieties as reflected by the qualities of size, taste and product usage occasion.

Market access – the need to strategically review market access requirements for partner countries. Discussions regarding cross-border trade with Vietnam highlighted the informal trade of mangoes and the current lack of regulation enforcement. Further, the volume of mangoes currently being traded was most probably under-reported by each government. Participants discussed specific issues such as product quality and biosecurity relating to the cross-border trade.

Participants noted each country had differing challenges relating to biosecurity, such as traceability and registration of HWT facilities for Pakistan, export protocols for Australia, pesticide costs, and farmers knowledge about exporting requirements in the Philippines.

Discussions regarding mangoes that are imported via sea and air, focused on two main issues: the quality of the product through the supply chain (for example ripening process and shelf life) and the consumer demand for quality fruit. While the quality of the product was directly linked with the supply arrangements and the post-harvest handling of the fruit, it was commented that it was a common issue for all exporting countries in the region. In the Philippines and Pakistan, the inability to supply fruit of a consistent quality was the key concern, while in Australia and Vietnam the level of supply and the unreliable production due to a short supply window were challenging.

As noted previously, the dynamic nature of fresh produce channels in China increases trading vulnerabilities for partner countries. Participants acknowledged that China is not a homogenous market when considering mango trade. Different mango varieties are sought after in different provinces and regions. For example, Vietnam currently trades the Cat Hoa Loc and Elephant mangoes varieties, while the Philippines trades the Carabao mango variety. Seasonally there is also the competition from Chinese produced mangoes from areas such as Hainan Island and Guangxi.

After comments from individual country researchers, there was discussion and reflection on individual market challenges. For example, the Philippines was challenged by the 'all in' pricing scheme; Vietnam was challenged by packaging and labelling; Australia was challenged by distance to port and access to VHT facilities and Pakistan's main concern was connections and marketing opportunities to access retailers. Participant discussions raised concerns regarding mango country of origin mislabelling and consumer confusion.

Going Forward

A range of themes were discussed as potential areas for future research opportunities relating to:

- Market expansion – evaluating second and third tier cities
- Expanding consumers' knowledge of mango nutrition value
- Collecting evidence-based data through QR and/or tracking methods for marketing that captures consumer preferences for mango varieties
- Understanding Chinese cultural nuances and food customs
- Further assessing the different and emerging business channels in southern and northern Chinese markets
- Evaluating value-add and processed mango products.



4. Mango Biosecurity

Project Overview

China represents a significant export market for Australia and ACIAR partner countries producing mangoes. The emerging middle class and low mango consumption base, on a per capita basis, means that China has substantial growth potential for export trade in the region. Being a phytosanitary regulated market, China has historically been difficult, inconsistent and expensive to access directly. Some countries are unable to meet the rigid requirements for import of mangoes. Exporters and importers have often opted for the informal channels to access this growing market. This, however, is not a sustainable business approach for the long-term development of the China mango market.

The Philippines, Thailand, Pakistan and Australia have approved market access for mangoes into China, and Vietnam currently has a land access agreement. Indonesia does not currently have direct access to the Chinese mainland mango market.

Project aim and objectives

The overall aim was to identify opportunities and strategies to improve biosecurity, market access and trade for selected mango markets into mainland China through a better understanding of knowledge and stakeholder gaps.

The study objectives were to:

1. Examine and document the current import protocols and informal trade channels for the markets of mainland China (Shanghai).
2. Understand technical issues and barriers for each partner country.
3. Document issues and opportunities.
4. Develop a detailed 5-year plan including short-, medium- and long-term timelines for technical priorities and strategic development.

Research method

Initial desktop investigations were undertaken to review available data on existing protocols between partner countries and target markets. Meetings were carried out with partner country stakeholders to gain an understanding of the commercial reality of opportunities, issues and impediments related to the current export trade and market entry into the Chinese market.

Using market observations and semi-structured interviews, the researchers developed an understanding of the real-life impact of the market access protocol on the chains in the export markets of Australia, the Philippines and Vietnam. This element of the study was conducted with insights from the other Mango Agribusiness Research projects. The insights generated from the desktop research, observations and in-market interviews were compiled, reviewed and shared at the final workshop, thus allowing an evaluation of the current issues facing partner countries and Australia.

Partnerships

The project was led by Griffith University with significant contribution and country-level coordination from each of the five ACIAR partner countries, Cambodia, Indonesia, Pakistan, the Philippines and Vietnam. As leading mango technical institutes in Australia, the Northern Territory Department of Primary Industries and the Department of Agriculture and Fisheries, Queensland, along with the AMIA, were consulted during the project.

Workshop Presentations

ECR case studies

Market entry & biosecurity – Australia	Samantha Frolov
Market entry & biosecurity – the Philippines	Ivory Galang
Market entry & biosecurity – Vietnam	Le Minh Hung

Asia-Pacific region study	Peter Johnson
China market presentation	Olivia Li

Workshop Reflections and Discussions

Following the presentations, the workshop participants engaged in a Q&A session followed by table-talk conversations. The participants noted that the themes addressed in the Mango Biosecurity project interlinked with the Mango Markets and Mango Quality projects. Meeting market entry and protocol requirements emerged as the key theme.

The complexity of market entry protocols and the differing requirements across countries were discussed. The time needed for a protocol to be established, changes in protocols and the quality consistency needed to meet the market entry requirements were discussed. This included issues related to pesticide residues and microbial testing.

Participants highlighted the need to communicate more effectively with growers, traders and key stakeholders in the export chain, regarding market access and biosecurity. There was significant discussion concerning the approved treatments and methods to prepare fruit for export and the critical success factors facing producers.

The confusion over rejections and the need for transparency of market requirements led to the need for increased home country government support for export to China. This would assist with the timeliness for product supply in export markets. The 'overstrict regulations' were perceived to be causing delays and quality issues in specific markets including mainland China. It was noted that the establishing of a protocol process can take up to 10 years, directly affecting market access. The affordability of mango treatments (HWT, VHT, IRR) as well as the ensuing effect on mango quality of meeting the protocol requirements was raised in group discussions. Participants agreed the costs arising from and access to treatment facilities posed a significant barrier to exporting.

Going Forward

Looking to future areas of investigation, participant discussions focused on issues relating to infrastructure and communications, such as:

- increased support from governments to improve communications with and between mango exporters and traders
- increased collectives that build critical mass of export contracts in regional communities
- regional/national mango working groups
- testing and validation of current and new treatment methods to replace VHT
- improve traceability to increase export to phytosanitary markets
- validation of HW dipping methods and publication of results
- evaluation of export costs – to seek more efficient alternatives to VHT.



5. Mango Quality

Project Overview

Mango quality into export markets is highly variable, market requirements for quality characteristics are unclear, and importers, retailers and consumers are frequently disappointed. Along supply chains from ACIAR partner countries into the opportunistic market of mainland China, better understanding is required of strategic industry, and market development for improving mango quality, including developing and sharing a common understanding of quality parameters. At present, partner mango-producing countries and their supply chains either do not or cannot consistently deliver high-quality mango into major markets, including mainland China.

There is a compelling case for focused investment in mango agribusiness research and development within ACIAR. Mangoes are among the most economically and socially important of all tropical fruit crops. During an informal workshop at the International Mango Symposium in Darwin, 2015, mango quality parameters, from demand and supply perspectives, were identified for attention. For sustainable success, it is both fundamental and imperative to understand mango fruit quality as sought by consumers in major marketplaces in the Asia-Pacific region.

Projects aim and objectives

The overall aim was to develop a common approach to assessing, describing, and improving mango quality in Asian mango supply chains.

The study objectives were to:

1. Develop a common objective language for describing physical and eating quality in fresh mango supply chains across project partner countries
2. Enhance common understanding and develop capacity in the assessment and improvement of physical and eating quality in mango supply chains
3. Evaluate opportunities to improve quality in select mango supply chains and key market segments in mainland China.

Research method

The project focused on fresh whole mango supply chains to mainland China, with participation by ACIAR partner countries and Australia.

The project initially established a regional network of post-harvest professionals, directly linked with partner countries, mainland China and Australia, who were active research, development and extension providers in mango supply chain principles and practices. Once the core members were confirmed and available, quality criteria were collated at Workshop 1, Guangzhou, China. The next steps saw the consolidation of the agreed quality parameters, ensured a consistent approach to organoleptic assessments, and in-market training was undertaken using a case study approach to map supply chain activities.

The project team undertook case research and evaluation studies on international in-transit monitoring of supply conditions and supply chain simulations focused on comparative quality evaluation for different mango varieties. The supply chain case studies utilised established commercial chains from the Philippines and Australia into the mainland China market. Simulation mango studies compared the performance in terms of outturn, shelf life and end-of-chain quality of commercial and new mango cultivars.

The case supply chain studies for Australia and the Philippines exports to China were undertaken by the core project team members using hands-on research into fruit quality in their domestic markets. Finally, the project research results were shared by the core team at the final workshop in Haikou, China. Participants shared a range of learnings, including cost-benefit assessment of supply chain interventions and the collective study of a regional market's fruit quality characteristics.

Partnerships

The project was co-led by Griffith University and the Department of Agriculture and Fisheries, Queensland Supply Chain Innovation team. The project was further supported by the Innovative Food Technology team in Brisbane, AMIA, and partner country researchers in Cambodia, Indonesia, Pakistan, the Philippines, and Vietnam.

Workshop Presentations

ECR case studies

Monitoring temperature and quality – Philippines	Leizel Secretaria
Monitoring temperature and quality – Australia	Yiru Chen

Testing the Mango Quality Manual case studies

China mango market	Noel Ainsworth
Cambodia	Som Bunna
Indonesia	Zainuri
Pakistan	Aman Ullah Malik
Philippines	Emma Ruth Bayogan
Vietnam	San Tram Anh
Road testing the manual – consumer view	Philippa Tyler
Applying a cost/benefit approach activity	Ammar Azziz

Workshop Reflections and Discussions

Following the presentations, the participants took part in a Q&A session and table-talk conversations. The themes that emerged from the discussions included: producing and supplying the desired quality to Chinese market; creating sustainability of supply chains; and the need to use a common technical quality language across countries to allow for greater consistency of fresh mango supply. It became clear from the discussions that the projects were linked by a focus on product quality to the end market.

The quality and supply themes that emerged revealed the value of a 'quality' manual for growers, farmers and supply chain stakeholders. The idea of a mango quality manual was received well by each country. Further, the need to expand on its content to make it country specific without losing its quality

standards was considered necessary. The creation of standardised terminology across countries with quality grades and scores, as well as technical language, was advocated by all participants as necessary to aid improvements for market entry.

There was general commentary around issues relating to the manual, such as ownership and use of the manual in a multi-language format and how the standards would be adopted across partner countries. There were questions raised about the ongoing monitoring and review of the manual. There was strong support for customising the manual to allow for language, social and cultural nuances whilst maintaining the standard.

There were discussions around the necessity for more testing to validate findings. Specific country issues were discussed. In Cambodia, reputation and poor harvest quality were noted. The Indonesian participant discussed the lack of consistency in market and the limitations with having only one main variety. Vietnam participants expressed concern relating to product handling and fruit quality at end-market arrival. Australian researchers shared their concerns regarding mango weight loss and shelf life in the lengthy transportation process.

Going Forward

The main messages, captured from the discussions, were consistent with other project discussions. A need for further research into consumer preferences for mango from northern and southern regions of mainland China was emphasised strongly to understand the desired quality and variety spectrum.

Future areas of research discussed included:

- Detailed consumer understanding – buying patterns and sensory awareness at point of sale and varietal preferences.
- Market supply – extending export of different mango varieties and understanding the end-user expectations.
- Reviewing opportunities for strategic whole-of-industry initiatives
- Examining policies and generating dialogue related to strategic developments
- Sharing of cross-country learnings e.g. packaging and handling
- Introduction of a regional QMS in export supply chains
- Understanding post-harvest impact on quality
- Introduction of temperature data loggers and post arrival handling information

Further development of the mango quality manual:

- Investigate an app-based platform
- Customise manual images and language for on-farm and chain use
- Evaluate quality manual feedback and monitoring for future improvements



6. Attendees

Given names	Surname	Institute	Country
Noel	Ainsworth	Department of Agriculture and Fisheries, Queensland	Australia
Ammar	Aziz	The University of Queensland	Australia
Emma Ruth	Bayogan	University of the Philippines, Mindanao	Philippines
Som	Bunna	Cambodian Agricultural Research and Development Institute	Cambodia
Christina	Chen	MZ Marketing Communications	China
Xiaoqiu	Chen	South China Agricultural University	China
Xinjian	Chen	Guangxi University	China
Yiru	Chen	Department of Agriculture and Fisheries, Queensland	Australia
Geoffrey	Dickinson	Department of Agriculture and Fisheries, Queensland	Australia
Rodd	Dyer	Australian Centre for International Agricultural Research	Australia
Ebony	Faichney	Department of Agriculture and Fisheries, Queensland	Australia
Samantha	Frolov	Australian Mango Industry Association	Australia
Aiping	Gao	Chinese Academy of Tropical Agricultural Sciences	China
Howard	Hall	Australian Centre for International Agricultural Research	Australia
Wendy	Hall	Pentagram Potential	Australia
Meiyang	He	South China Agricultural University	China
Yuanyuan	Huang	Chinese Academy of Tropical Agricultural Sciences	China
Yan	Jin	Chinese Academy of Tropical Agricultural Sciences	China
Peter	Johnson	Griffith University	Australia
Irene	Kernot	Australian Centre for International Agricultural Research	Australia
Hung	Le Minh	Sub-Institute of Agricultural Engineering & Postharvest Technology	Vietnam

Given names	Surname	Institute	Country
Colin	Leung	Department of Agriculture and Fisheries, Queensland	Australia
Chunxia	Li	Chinese Academy of Tropical Agricultural Sciences	China
Enping	Liu	Chinese Academy of Tropical Agricultural Sciences	China
Haiqing	Liu	Chinese Academy of Tropical Agricultural Sciences	China
Aman Ullah	Malik	University of Agriculture Faisalabad	Pakistan
Antonia	Medhurst	Griffith University	Australia
Ivory	Myka Galang	Philippine Institute for Development Studies	Philippines
Sarah	Neil	Griffith University	Australia
Andrew	O'Neil	Griffith University	Australia
Robin	Roberts	Griffith University	Australia
Anh	San Tram	Sub-Institute of Agricultural Engineering & Postharvest Technology	Vietnam
Leizel	Secretaria	University of the Philippines, Mindanao	Philippines
Linh	Tran Thi Ut	Southern Center of Agriculture Rural Policy and Strategy	Vietnam
Philippa	Tyler	Department of Agriculture and Fisheries, Queensland	Australia
Tiago	Wandschneider	Consultant	Portugal
Guanglin	Wang	Australian Centre for International Agricultural Research	China
Peng	Wang	Chinese Academy of Tropical Agricultural Sciences	China
Yan	Wei	Chinese Academy of Tropical Agricultural Sciences	China
Sarah	Wheeler	University of Adelaide	Australia
Tracey	White	Griffith University	Australia
	Zainuri	University Mataram	Indonesia
Alec	Zuo	University of Adelaide	Australia



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