International network on preserving safety and nutrition of indigenous fruits and their derivatives

Knowledge Mapping Workshop

19-21 September 2011

Venue: BRAC Inn, Dhaka, Bangladesh

Workshop minutes

Introduction

The Knowledge Mapping Workshop was the first in a series of five workshops to be organised by the Leverhulme Trust funded 'International network on preserving safety and nutrition of indigenous fruits and their derivatives'. It was attended by the project partners from Bangladesh, India, Vietnam, Sri Lanka, France and the UK. The partner from Cambodia was unable to attend. Further workshop participants included post-harvest scientists from the Bangladesh Agricultural Research Institute (BARI), the Bangladesh Council of Scientific and Industrial Research (BCSIR), local NGOs Environment & Population Research Centre (EPRC) and the Centre for Mass Education in Science (CMES), and the Horticultural Export Development Foundation (HORTEX). In addition, three participants from food manufacturing industries attended the workshop. Mr Faruque, Additional Secretary of the Ministry of Agriculture, Dr Kabir, Executive Chairman of the Bangladesh Agricultural Council, Dr Bhuyan, Director of the Horticulture Research Centre and Dr Mondal, Director General of BARI attended the opening session. A full list of participants is provided in Appendix 1. The workshop programme (see Appendix 2) consisted of two days of presentations, discussion sessions and a visit to a food processing company for all participants followed by a third day restricted only to the project partners.

Opening Session

The opening session was presided over by **Dr Md. Rafiqul Islam Mondal, Director General of Bangladesh Agricultural Research Institute.**

Dr Md. Abdul Jalil Bhuyan, Director, Horticulture Research Centre (HRC), BARI, welcomed the participants. He highlighted the achievement of improved cereal crop yields which have almost reached self-sufficiency. However production of fruits (at 4.2million tons) is still lagging behind national requirements of 4.65million tons (based on a requirement of 85g per person per day). He explained the potential role played by the food processing industry to overcome the problem of fruit gluts. He also pointed out the need for the processing industry to use a wider range of species and to embrace more modern techniques to access export markets.

Dr Kate Schreckenberg, Coordinator, Centre for Underutilised Crops, University of Southampton highlighted the potential nutritional roles of indigenous fruits and the fact that they are often easily integrated into traditional land use systems with low external inputs and may be particularly important for women and other marginalised groups and during agricultural off-seasons. Growing international interest in 'exotic' fruit (not just as fresh fruit but particularly for their flavours, aromas and functional compounds) means that there are opportunities for the development of indigenous fruit not just for domestic markets but also for international markets. However, there are many constraints preventing the contribution of indigenous fruit to achieving more sustainable livelihoods, rural development and poverty reduction. These include unreliable quantities and qualities of production, poor market and transport infrastructure, poor processing techniques and quality assurance, lack of communication between researchers and end users and lack of coherent policy and legislation (within and between countries). The network funded by the Leverhulme Trust has been set up to help overcome some of these constraints and has the following aims:

1. Within member countries, to build teams of technical and socio-economic researchers, private sector and policymakers to overcome post-harvest constraints in fruit value chains, and achieve improved synergy between national research and development and trade policies in relation to the preservation of nutritional qualities and food safety of indigenous fruits and their derivatives;
2. Between member countries, to promote knowledge transfer on fruit derivative issues and research techniques and to foster cooperation and development of human resources through five research training workshops;
3. To establish national and regional research programmes related to providing safe, high quality and nutritious fruit derivatives.

Dr Schreckenberg highlighted that the project does not focus on fruit production aspects but rather on processing and food safety and nutritional issues in relation to indigenous fruits. Furthermore, the ultimate aim of the network is to move beyond transfer of known technologies to develop cutting-edge research projects. She outlined the specific objectives for the workshop as:

1. To analyse the key post-harvest technical and policy constraints to improving the volume, value and nutritional quality of local, regional and international trade in indigenous fruit and fruit derivatives
2. To determine the key training needs for national and regional stakeholders
3. To identify key research needs and put in place a plan for obtaining research funds
4. To determine the precise topics, locations and dates of subsequent workshops

Special guest, Dr Wais Kabir, Executive Chairman of Bangladesh Agricultural Research Council explained the importance of the workshop at a time when the people of Bangladesh are facing uncertainty in terms of food security, food nutrition and health hazards. Scientists, development partners and policy makers must work together to find a way to overcome these adverse conditions. While the focus to-date on high-yielding cereal varieties has been successful, there is a need for similar success in relation to fruits and vegetables. Dr Wais Kabir highlighted the importance of the project in developing fruit production for local, regional and international markets and explained that a national research priority to 2030 is to focus on underutilised crops. Indigenous species are of particular interest as they are often more adapted to local conditions than exotics and may have nutritional and medicinal values. Dr Wais Kabir went on to emphasise the need to overcome post-harvest losses (often as high as 30%) and to maintain the safety and quality of fruits and their products. He highlighted a hot water treatment developed by BARI to extend the shelf life of mangos and called for similar innovations

for other species. The network includes countries from the same agroecological zone so should be able to contribute to improving best practice and building capacity. It is important to include the many actors involved in processing from producers to private sector and processing. A priority for Bangladesh, which is dominated by smallholder agriculture, is primary or secondary processing at farm level.

Chief Guest, Mr Anwar Faruque, Additional Secretary & Director General (Seed), Ministry of Agriculture, Government of Bangladesh, reminded the participants that Bangladesh's economy is an agrarian economy with 60% of the workforce employed in this sector. While improvements in cereal crops mean that food security (defined as an individual having two meals with a full stomach) is improving, less attention has been paid to meeting nutritional needs from fruit and vegetables. These can also provide an important source of income for farmers. Although Bangladesh used to produce many indigenous fruits, the markets are now dominated by imported fruit and Mr Faruque welcomed the project's focus on indigenous fruit. He highlighted the Hill tracts as a particularly suitable area for fruit production and described the efforts of the Ministry of Agriculture to improve the quality of the seedlings provided by the more than 12000 private nurseries. Getting research results to farmers is a particular problem. If one could overcome the high post-harvest losses, prices could be reduced for consumers but currently there are only a few companies with good transport, processing and storage systems at farm level. Recommendations are needed for how to involve the private sector in this area, e.g. through special investment packages. Mr Faruque underscored that due attention should be given to food safety, hygiene and quality issues and he urged cooperation among national and international organisation to improve producers' access to markets in other regions. During his presentation, Mr Faruque expressed his concern about the indiscriminate use of fruit ripening chemicals – lack of information about the correct chemicals and the proper dose is leading to a loss of confidence among consumers.

Dr Rafiqul Islam Mondal closed the opening session. He spoke about food safety and nutrition of fruits as it affects markets, human health and food quality. He cited 47 kinds of indigenous fruits that are grown in Bangladesh. He informed the participants that food-borne diseases are spreading due to an alarming increase in use of pesticides by farmers. He was optimistic about the workshop's outcome which he hoped would facilitate sharing, learning and exchange of knowledge and ideas among the participants.

The opening programme was concluded by a vote of thanks given by **Dr Madan Gopal Saha**, Principal Scientific Officer, Bangladesh Agricultural Research Institute and project partner, Bangladesh.

Session 1: International and national priorities, cutting edge work and key constraints on preserving safety and nutrition of indigenous fruit

Dr Nazmul Haq, Centre for Underutilised Crops, University of Southampton: *Overview of CUC's work on underutilised crops in Asia.*

Dr Haq spoke about his long collaboration with BARI, beginning with work on legumes. A meeting in Bangladesh in 1992 focused on producer-to-consumer issues, raising much the same issues as

now. It prioritised crops and research constraints. These were addressed first through a DFID-funded project "Diversity and improvement of underutilised fruits in Asia" and two PhD students (registered at Southampton University) worked on this project. Three students from Asia also attended short courses at Southampton. At the same time the "Underutilised Tropical Fruits of Asia Network (UTFANET)" was funded by the Commonwealth, the UK Lottery and FAO. This was coordinated by the Philippines under the overall management of the then Southampton International Centre for Underutilised Crops (now CUC). This network, which included 10 Asian countries, provided training programmes, and worked with NGOs to distribute improved planting materials. It also carried out research including work with BCSIR on jackfruit processing. This work developed nutritious jackfruit-based biscuits which were trialled in schools to test their acceptability and taste. They made a linkage with India through that project. The UTFANET project was followed by a DFID-funded project to disseminate technical knowhow on fruits in many formats and languages to target a range of different stakeholders. Several market studies were carried out in collaboration with DFID to identify market opportunities for fruit products in several Asian countries. There remains a lot of interest in new products. To fulfil this need, better coordination of information and communication between producers, processors and traders is necessary and a networking project "Fruitasia" was developed by CIRAD and Southampton CUC, on which the present network project is based.

Dr Max Reynes, UMR Qualisud TA, France: ***Preserving safety and nutrition of indigenous fruits and their derivatives: Some alternative new technologies and added value products***

Dr Reynes stressed the importance of preserving the nutritional components of fruit, e.g. their nutrients, vitamins, polyphenols and antioxidant properties. This requires a research strategy and a common language as, for example, there are around 25 methods for analysing antioxidant levels. He discussed the experience of the EU-funded PAVUC (Production of Added Value from Underutilised Crops) project (http://www.pavuc.soton.ac.uk/Default.aspx), on which the Southampton CUC was a partner, which found that it takes at least five years to progress from identifying nutritional compounds in fruit to clinical studies. However, this can be a worthwhile process – in the case of cashew apple, for example, two molecules extracted from the apple appear to be able to reduce obesity, which would make them more valuable than the cashew nut itself. He highlighted the need to reduce temperature and oxygen during processing as these destroy all antioxidant activity. Unfortunately current processing technology (e.g. for drying) tends to destroy all nutritional content. He described a number of more appropriate technologies which aim to:

- Preserve the health and organoleptic (taste, smell) characteristics of the fruit;
- Limit browning reactions and new-formed compounds;
- Meet the quality needs of the market as well as consumer taste;
- Be transferable to small-scale processors, requiring limited investment.

These include flash explosion (to remove oxygen) and membrane technology (cold pasteurisation and cold concentration). He compared the nutritional results of these new methods with classical concentration techniques. He was optimistic about improving dehydration and frying processes through the use of osmotic dehydration before frying. Using the correct packaging and nitrogen gas is important to maintain product qualities.

The dehydration techniques described attracted the attention of the private entrepreneurs present at the workshop who asked whether these methods had been used for jackfruit chips. Dr Reynes stated that jackfruit chips have not yet been made but that combination osmotic dehydration should produce good quality jackfruit chips in a similar way to mango chips. Dr Haq highlighted the fact that

as most indigenous fruits are heterozygous, this leads to the production of non-uniform products which is problematic for the processing industry. He indicated that appropriate production from vegetatively propagated plants could produce more consistent products.

Dr Pham Huu Yen Yen Phuong, University of Nong Lam, Vietnam: ***Emerging Technologies in Quality Control of Asian fruits for International trade*** .

Dr Phuong discussed the quality control requirements for international trade in terms of food safety management such as Hazard Analysis Critical Control Point (HACCP), Global GAP (Good Agricultural Practice) and international food standards. Quality control measures require microbiological examination and physico-chemical analysis of fruits and these techniques need to be fast and non-destructive. Using the example of mangos, Dr Phuong discussed how traditional fungicide and bactericide treatments can leave residues on the fruit in contrast with an alternative lactoperoxydase system (LPS). She highlighted three types of physico-chemical analysis of fruits: as a quality and maturity indicator; to detect disease and contaminants; and to identify varieties and authenticate their (country of) origin. She then described some emerging non-destructive technologies (Gas exchange & applied energy), their principles, advantages and drawbacks. She explained how Near Infrared Spectrophotometry (NIR) can be used to assess the maturity and freshness of Dragon fruit.

Dr Abdul Jalil Bhuyan, Director, Horticulture Research Centre, BARI: ***Indigenous fruits of Bangladesh: Challenges and opportunities.***

Dr Jalil highlighted the importance of fruits in terms of nutrition, employment creation and food and financial security. He discussed the availability and status of fruits in Bangladesh, suggesting that current consumption at 76g per person day is still below the recommended 85g. Although over 70 fruit species are grown in Bangladesh, only 10 species make up 94% of the production area and 92% of fruit volume. The seasonality of these 10 species is a problem as more than 50% of them are available in May-Aug. Some of the 'minor' fruit have a much better spread in the Sep-April period. Currently fruits only occupy 0.98% of cultivated land so there is scope to develop production in the hilly areas and on fallows. Dr Jalil underlined the problems of post-harvest losses, low levels of post-harvest processing, lack of market and transport infrastructure and problems with exploitative middlemen. He showed that there has been an increase in the value and volume of exports from 2005 to 2011 although overall exports are still very low. He provided examples of the many new fruit varieties and treatments developed by HRC in the last years.

Dr D. K. N. G. Pushpakumara,University of Peradenia, Sri Lanka: ***Indigenous fruits: communication with different audiences*** .

Dr Pushpakumara began by highlighting the fact that the project needs to be clear whether it is looking at underutilised fruit (which could include exotics) or only indigenous fruit and, if the latter, how strictly we are defining indigenous species (strictly defined there are none that are indigenous to all Asian partners). Indigenous species may be more appealing to audiences concerned with biodiversity conservation and resilience issues whereas underutilised species is a broader category, possibly of more interest to audiences focused on food security and trade issues. This issue immediately highlighted the many different audiences the project may need to communicate its results to. Dr Pushpakumara proceeded to discuss the need for communication with local, regional and international policy-makers about the importance of fruit for food security, nutritional security

(while Asian countries have high vegetable consumption they are lagging behind in fruit consumption although a small mango could fulfil a child's daily Vit A requirements) and health benefits (why not replace 'an apple a day keeps the doctor away' with 'an amla a day keeps the doctor away'?); with researchers to highlight the research needs in relation to indigenous species; with processors on quality issues; with various stakeholders on environmental issues (e.g. fruit trees are among the most water-efficient crops) and biodiversity aspects (e.g. high genetic diversity of indigenous species). He also highlighted the need to communicate with different stakeholders through formal education systems as well as by using a range of different format materials (as in the books, posters, newsletters, manuals, policy briefs, training materials, etc., produced by the International Centre for Underutilised Crops). He ended by describing the evolution of agriculture leading to the current agro-industrial period, in which successful agribusiness requires collaboration of raw material suppliers, producers and processors. He highlighted the different steps in the producer-to-consumer cycle, emphasising the linkages and coordination among the different stakeholders and the need to identify key gaps to work on.

Session 2: National priorities, cutting edge work and key constraints on preserving safety and nutrition of indigenous fruit

Dr Susanta K Roy, Amity International Centre for Post-harvest Technology & Cold Chain Management, India: ***Overcome post- harvest storage and transport constraints by developing processed products.***

Dr Roy highlighted that the high perishability of most indigenous fruits combined with poor transport infrastructure means that most require some kind of processing for marketing beyond the locality. One approach for tackling the constraints of storage is the Zero Energy Cool Chamber (ZECC) which provides low temperature and high humidity. Originally designed with 100kg capacity, a new Walk-along Cool Chamber can now hold up to 1 metric ton. Dr Roy also explained how to solve some transportation problems, e.g. through using cardboard liners for plastic crates to overcome vibration damage. He pointed out that some of the problems associated with fresh consumption of indigenous fruit (e.g. high astringency) can be overcome by processing to enable the consumer to enjoy the fruit. Some of those fruits are highly nutritive, rich in vitamins, minerals and good source of antioxidants. He explained about the need to encourage minimal processing among urban consumers with an opportunity to produce ready-to-cook, ready-to-eat products and more rural employment. He emphasised the need for integrated post-harvest management to ensure that only the required parts of the fruit are transported to the processor/end user (to reduce waste in urban areas). He underscored the necessity to undertake research and development jointly with farmers, processors and the market.

Dr Sunil Saran, Amity International Centre for Post-harvest Technology & Cold Chain Management, India: ***Logistics of Cold Chain Management.***

Dr Saran began by emphasising the potential of indigenous fruit in Asia, highlighting 16 promising species in India with their food value. Because of the heterozygosity of indigenous fruit species, he also pointed out that it is important to select the right varieties for different products (e.g. for pulp, juice or kernel) and propagate the correct germplasm. One of the biggest constraints facing farmers is the lack of cold chain management. In India less than a tenth of the cold storage volume needed

is available and there are only 5000 refrigerated trucks operating in all non-dairy sectors combined. However, Dr Saran also pointed out some of the major policy initiatives taken by the Indian government to increase the proportion of products transported through a cold chain in the next few years. These are designed to overcome key bottlenecks such as the lack of knowledge and trained manpower, the lack of backward and forward linkages in the cold chain (e.g. that refrigerated trucks are not fully laden in both directions) and concern by investors about the low viability of cold chain technology due to perceptions that it requires high capital investment as well as high operational costs. He then described the Cool room and CoolBot project for small farmers – a collaborative programme with USAID & University of California Davis – which use standard room air conditioners, highly insulated walls and temperature sensors to keep rooms at a constant 4-7°C. This can be successfully combined with the Walk-in Zero Cooler for pre-cooling products.

Ms Duong Thi Ngoc Diep, University of Nong Lam, Vietnam: ***Value addition for indigenous fruits – the example of Dragon fruit.***

Ms Diep explained that Vietnam is an agricultural country with vast agricultural land and diverse products. Around 780,000 ha are dedicated to fruit production, yielding 7 million tons per year. Only 10% of this production is targeted for export as export is hampered by low post-harvest technology. One of the underutilised (though not strictly speaking indigenous) fruit with great potential value is the dragon fruit, of which there are three types. This fruit has an export market in USA and Japan. In addition to a pleasant taste and long shelf-life, dragon fruit are rich in fibre and anthocyanins, low in calories and the seeds are high in protein. The fruit are supposed to have benefits for the digestive system as well as for skin and vision). She pointed out some of the problems associated with the processing of Dragon Fruits; she also suggested that a long term solution would require investing in post-harvest technologies and promotion of Dragon Fruit processing industry with an aim of product diversification. Policy issues are important – currently over 60% of trade is cross-border trade with China which is completely unregulated and Chinese buyers try to force down the price during good production years leading to a massive glut in Vietnam. If farmers can be helped to apply the VietGAP standards (which are accepted by EurepGAP), then there is a high potential that Vietnam can capture the EU and US markets for dragon fruit.

Dr Saleh Ahmed, Hortex Foundation, Bangladesh: ***Post harvest management of indigenous fruits for better quality, safety and nutrition.***

Dr Saleh pointed out that of the 70 fruit grown in Bangladesh about 47 are indigenous species. He highlighted the 25-45% post-harvest losses and explained the main factors causing post-harvest loss and the loss of fruit quality during harvest. He spoke about the value addition of fruits. He pointed out the alarming increase of pesticide use (328% by volume used and 600% per ha) in Bangladesh from 1997 to 2008. He also highlighted adulteration as another concern in Bangladesh, often missed because of the poor state of the quality assurance system. He emphasised the need for research and development in this sector with a focus on developing maturity indices and protocols of washing, sorting and grading of fruits, creating awareness on the importance of better post-harvest practices, improving packaging technology, developing and/or adapting appropriate technologies for value addition and encouraging government subsidy and private sector investment to establish packing houses, grading and pre-cooling facilities.

Miss Sufia Khanam, EPRC, Bangladesh: ***Opportunities and challenges in promoting community and NGO Participated fruit processing: A case study from Bangladesh.***

Miss Khanam described two studies carried out in 2003 and 2006 which indicated that training and knowledge improvement is not enough to improve fruit processing. When undertaken by an .NGO, more support was provided to NGO members and it engendered a high level of dependency on the NGO. Her recommendation was that more emphasis is needed on promoting an independent enabling environment. She explained a case study from Bangladesh where community and NGO's participated in fruit process plant.

Session 3: Key research constraints

A brain storming session was held to identify key constraints and knowledge gaps in the production of high quality indigenous fruit products for local, regional and international trade. The participants worked in three groups and fed back their results to plenary:

Group A looked at constraints for processing indigenous fruit as experienced by various actors in the value chain:

Rural processors

- Non-availability of preservatives and packaging in rural areas (NB. PRAN provides crates to contract mango growers – as cheaper than the post-harvest losses)
- Lack of understanding of and ability to measure maturity status
- Inappropriate use of pesticides and ripening substances
- Lack of understanding of qualities required by market for fruit and fruit products
- Poor market infrastructure (lack of washing and appropriate storage facilities)
- Lack of market information – which products are required when, prices, etc.
- [NB post-harvest handling – lots of problems but solutions are well-known and need to be transferred to producers]

Value chain intermediaries

- Training needed of intermediaries and empowerment of producer groups (e.g. self-help group in India) to engage with intermediaries
- Consolidation of value chains (e.g. vertical integration with one actor controlling more of the producer-to-consumer process)

Industrial processing (e.g. PRAN)

- Lack of suitable varieties for processing – e.g. high starch content for jackfruit and banana chips (good opportunity for marketing in Bangladesh; varieties already exist in Thailand and Vietnam)
- Higher proportion of edible portion
- Guava juice exported to Asia, but not yet ready to fully implement EurepGAP standards
- Lack of (good) varieties with high productivity so farmers will accept them
- Inconsistent supply of raw material (quantity and quality)

Industry and Govt

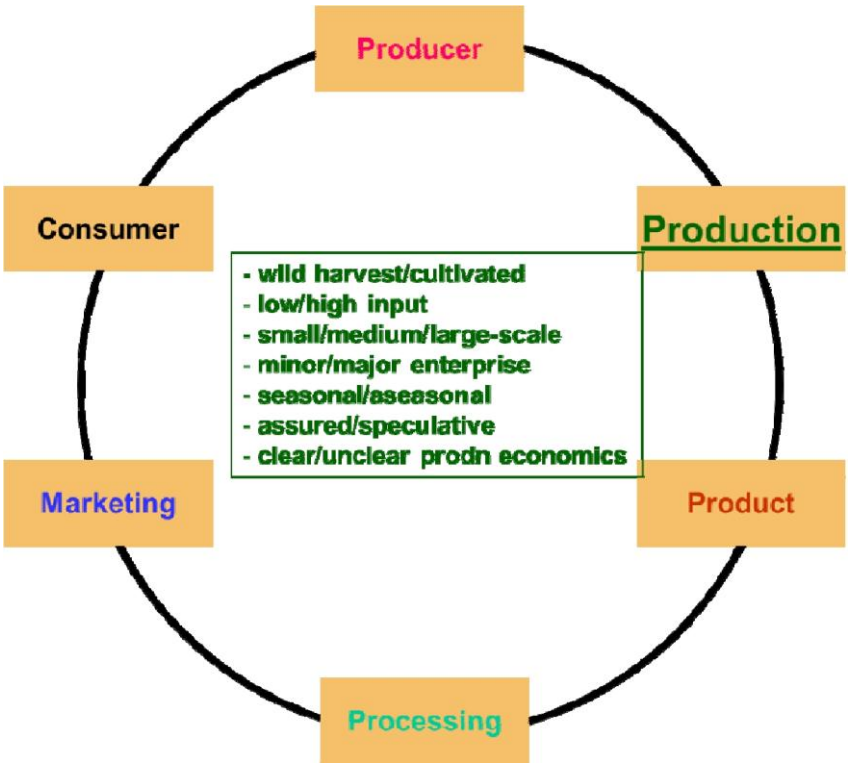
- Inadequate lab facilities for assessing microbial activity and nutritional content (of final product)
- Testing facility for packaging material (Bangladesh)

- No accredited facilities in Bangladesh for EurepGAP
- Lack of human expertise to use processing and analysis equipment
- Lack of single information point (one-stop shop)
- Need to know regulatory standards (e.g. food additives) for all import countries
- Need to simplify regulatory approval for SMEs

Group B first discussed some key species JAMUN (*Syzygium cuminii),* AONLA (*Phyllanthus emblica*) and BAEL FRUIT (*Aegle marmelos*) and then thought about novel products. They focused on the idea of producing a new fruit juice with high nutritional value based on a mixture of 3 indigenous species. In this scenario, constraints were highlighted as follows:

Process	**Constraints**
Producer	(not the focus of this project)
Harvesting	Inadequate tools and technology
Handling	Improper handling and packaging
Transportation	Packaging, loading and unloading, cooling.
Short-term storage	Minimum infrastructure (temperature, humidity, ventilation)
Processing	Juice extraction, thermal degradation
Final product retail – mixed juice	• Legal issues: trade to Europe would require products to be on the 'novel foods' list • Research needed to back up the nutritional claims made in marketing strategies

Group C took a producer to consumer approach (see diagram).



Several key species were identified: Jackfruit (*Artocarpus heterophyllus)*t, Jamun (*Syzygium cuminii)*, Amla (*Phyllanthus emblica*). Jamun and amla are important in India and Sri Lanka but less so in Bangladesh as production levels are not high enough. The different products discussed included: jam, jelly, candy, pickle, chips, dehydrated products, etc.

The key policy and technical constraints considered by the group included:

- Legal problems – ministerial level, lack of knowledge on GAP, GIP (Good Industrial Processes), etc. This requires training of national partners in GAP and GIP, etc.
- Technical problems – (i) insufficient and inconsistent amount of primary material production (requires better organisation of production), and (ii) hygiene of production process, lack of concern for nutritional quality
- A key research constraint is to understand the quality parameters of processed products – what qualities are desired and how can they be assessed?

In summary, while there was recognition that production-level issues (e.g. disorganised production and lack of information on suitable varieties for specific products) are still important for many of the participants, there are a number of common constraints arising further along the value chain which could be of particular interest to this network:

- Storage and transportation, particularly issues around keeping the fruit and its products cool.
- Lack of information on nutritional contents of key species. More research needed to back up nutritional claims.
- Processing – what qualities are desired by the market and how to achieve/retain them during processing?
- Legal issues – lack of information at all levels about food quality standards, both national (e.g. what are the standards relating to ripening substances?) and international (e.g. GAP and GIP) and lack of capacity to test and certify quality.
- The need for an integrated approach involving all actors in the value chain.

Tuesday, 20th September

Session 4: Discussion of dates, objectives and outputs of the next 4 workshops

This session discussed the format, content, target groups and funding for the four workshops to be organised during the remaining 20 months of the project. General conclusions of the discussion were:

- ***Training or research?*** Although the network proposal describes these workshops as 'research training' workshops, many of the participants were keen that they should be solely training workshops which enable SMEs and researchers to get trained in different aspects of processing, preserving, maintaining quality and food safety issues. It was agreed that, in order to increase impact, the hosts need to produce training materials which participants can take home to use in seminars and training of colleagues. To meet our network aims of

developing research proposals, a session at each of the workshops will need to focus on outstanding research issues related to the workshop topics.

- ***Who should attend?*** As a networking project, there needs to be some continuity of participation from the partner institutions. However, this does not mean that the same people participate in every workshop. The aim is to send the most relevant people – either as resource persons to assist in the workshop training and/or to take part in the learning process. Partner institutions need to ensure that workshop participants share their experience with colleagues on their return from workshops.
- ***Who pays?*** The project budget only provides for participation of one person per partner country plus about 11 local participants. Depending on location and costs of the workshop, this budget may be stretched slightly to cover costs of more participants from partner countries. However, the discussion made clear that partners can look for other ways of funding additional participants, either from their own funds or from local/regional donors. Some participants from the private sector and NGOs may also have access to funds to cover their participation. It was agreed that a small leaflet/brochure would be produced describing the four workshops (content, target group, dates and costs) so that potential participants could apply to take part and organise their funding as necessary.

Workshop 2, India, March 2012: Microbiology and bio-technology and the cold chain
This workshop will be organised at Amity University outside Delhi. Provisionally, the participants will review (i) the influence of post-harvest operation, processing, packaging and storage on the quality of fruits including chemical stability and bioavailability of functional compounds; (ii) the classification of fruit products according to pH and ease of spoilage, problems of contamination, microbial growth on foods, and effects of low temperature on microbial growth; (iii) how the adoption of cold chains and emerging fruit processing technologies could support changes in traditional processing.
Dr Saran and Dr Roy highlighted that there is a good group of resource persons around Delhi. Amity can also draw on its expertise as part of the Global Cold Chain Alliance and may also be able to source additional funding by combining this training workshop with training funded under another project. The principal target group for the workshop would be small-scale manufacturers – for this type of SME tried and tested technologies are most appropriate but some sessions on emerging technologies could be included (possibly more targeted at government and larger-scale industry).

Workshop 3, Vietnam, end of July 2012: Biochemical characterisation of fruit
This workshop will probably take place at Nong Lam University, Vietnam. The workshop will promote research into the sensory, nutritional and functional components of fruits by providing training in analytical methods, in vitro assays for the evaluation of biological activity and bioavailability, extraction and detection methods of flavour and aroma compounds, and assaying and preserving antioxidant content of different fruit products. Ms Diep and Dr Phuong highlighted that for this workshop to be really effective, participants should inform the hosts about which compounds or parameters (e.g. vitamin C, polyphenols, and maturity) they would like to learn how to assess. The training can then be tailored to their specific needs and, where possible, using the fruit that they work on.

Workshop 4, Cambodia, late 2012/early 2013: Food safety issues for fruit processing.
The details for this workshop will be discussed further with the Cambodian partner, who was unable to participate in the Bangladesh workshop. According to the proposal, the intention is that participants will learn about International food safety legislation, including the need for clear and standardised labelling and related quality management tools to facilitate trade negotiation and

increase consumer confidence. Training will focus on helping small and medium enterprises (SMEs) implement and maintain food hygiene procedure according to the principles of hazard analysis critical control point (HACCP), including methods to identify and control mycotoxins.

Workshop 5, Kandy, Sri Lanka, April 2013: [Provisional title] Initiatives and tools to facilitate uptake by SMEs of new post-harvest technologies for fruits and their derivatives.
The precise content of this workshop still needs to be discussed. It is likely to be more of a forward-looking planning workshop than a training workshop. Participants must include all country coordinators as the meeting will provide an opportunity to provide updates on any new initiatives in their countries and to monitor the impacts of the network in order to adjust the programme for future years. The workshop will also provide an opportunity for partners to develop (or finalise) focused research and development proposals in areas of common interest relating to fruit quality and safety.

Session 5: Knowledge management and dissemination

There was a discussion about knowledge management and dissemination and for this the importance of website was highlighted in the discussion. Dr Schreckenberg agreed to establish a web site to include project information, appropriate technology information, materials sourced from partners (‘cafeteria like’) and also policy briefings. In relation to the training workshops, the website should include information about the workshops (a ‘brochure’) plus the resulting training materials and feedback from participants.

As a first step, the need for a policy briefing was identified to highlight the need for a holistic and systematic approach from producer to consumer to promote safe and nutritious indigenous fruit products. This could emphasise some areas in which there are easy wins to be made such as providing post-harvest training for producers.

Session 6: Field visit to PRAN

The participants visited one of the largest processed food industries in Bangladesh. After arrival in the factory complex the participants were welcomed by the General Manager of PRAN. He showed a video presentation of the overall activities of the factory. After the presentation the participants visited different section of the industries including production and packaging. Although the company focuses heavily on dairy products, fruit-based juices are a major part of their product range. Their production is vertically integrated with fruit produced through a company outgrower scheme in which PRAN provides seedlings and training to growers. PRAN is also the biggest plastics producer in the country and produces much of the packaging for its products on site (from plastic crates for fruit transport to plastic bottles for fruit juices). PRAN exports to many countries worldwide particularly in Asia, the Arab states and Africa with the EU and USA currently making up a small proportion of their business.

List of appendices

The following appendices are provided in a separate pdf file:

Appendix 1

List of Participants at Knowledge Mapping Workshop

19 - 21 September 2011

Sl. No.	Name	Address	Contact/e - mail/cell
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Appendix 2: Workshop Programme

International network on preserving safety and nutrition of indigenous fruits and their derivatives
Knowledge Mapping Workshop
19-21 September 2011
Venue: BRAC Inn, Dhaka, Bangladesh
Draft Programme (15th September 2011)

Project Background and Objectives

The aim of this project is to develop an interdisciplinary research network to promote technical innovation and cooperation in the production to consumption system of indigenous fruits in the Asian region as a new approach to linking sustainable agriculture with preventative nutrition. In contrast to earlier projects which have focused on the agronomic and harvesting aspects of indigenous fruits, this project focuses on upgrading the processing and trade of existing and new fruit products and their derivatives, with a special interest in improving the nutritional quality of products.
Specific project objectives are:

1. Within member countries, to build teams of technical and socio-economic researchers, private sector and policymakers to overcome post-harvest constraints in fruit value chains, and achieve improved synergy between national R&D and trade policies in relation to the preservation of nutritional qualities and food safety of indigenous fruits and their derivatives;
2. Between member countries, to promote knowledge transfer on fruit derivative issues and research techniques and to foster cooperation and development of human resources through five research training workshops;
3. To establish national and regional research programmes related to providing safe, high quality and nutritious fruit derivatives.

To achieve the network's aims, we will hold five workshops over the next two years, beginning with a knowledge-mapping workshop in Bangladesh.

Bangladesh Workshop objectives

1. To analyse the key post-harvest technical and policy constraints to improving the volume, value and nutritional quality of local, regional and international trade in indigenous fruit and fruit derivatives
2. To determine the key training needs for national and regional stakeholders
3. To identify key research needs and put in place a plan for obtaining research funds
4. To determine the precise topics, locations and dates of subsequent workshops

19th Sept. Day 1
08.30 Registration

09.00-10.05 Opening session [Chair: Dr Madan Saha]
- 09.05 Tilawat-e-Quran (opening prayer)
- 09.10 Welcome address – Dr Md. Abdul Jalil Bhuyan, Director, HRC, BARI
- 09.20 Introduction to the Workshop – Dr Kate Schreckenberg, Centre for Underutilised Crops, University of Southampton
- 09.30 Special Guest Address – Dr Wais Kabir, Executive Chairman, BARC, Gazipur
- 09.40 Chief Guest Speech – Mr Quazi Akhtar Hossain, Additional Secretary, MOA, GOB
- 09.50 Chairman Address – Dr Md. Rafiqul Islam Mondal, Director General, BARI
- 10.00 Vote of Thanks – Dr Madan Gopal Saha, Project Partner, Bangladesh

10.05-10.30 COFFEE BREAK

10.30-12.30 International and national priorities, cutting edge work and key constraints on preserving safety and nutrition of indigenous fruit [Chair: Dr Kate Schreckenberg]
- 10.30 Dr Nazmul Haq: Overview of CUC's work on underutilised crops in Asia
- 10.50 Dr Max Reynes: preserving safety and nutrition of Indigenous fruits and their derivatives: Some alternatives new technologies and added value products
- 11.20 Dr Pham Huu Yen Phuong: Emerging technologies in Quality control of Asian fruits for international trade
- 11.40 Dr Madan Saha/ Dr Md. Abdul Jalil Bhuyan: Indigenous fruits of Bangladesh: challenges and opportunities
- 12.00 Dr. Pushpakumara: Indigenous fruits: communicating with different audience

12.30-13.30 LUNCH BREAK

13.30-15.20 National priorities, cutting edge work and key constraints on preserving safety and nutrition of indigenous fruit [Chair: Mr Malik Hamid]
- 13.30 Dr Susanta Roy: Overcoming post-harvest storage and transport constraints by developing processed products.
- 13.50 Dr Sunil Saran: Logistics of cold chain management
- 14.10 Ms Diep Duong: Value addition for indigenous fruits – the example of dragon fruit
- 14.30 Dr Saleh Ahmed: Postharvest management of indigenous fruits for better quality, safety and nutrition
- 14.50 Miss Sufia Khanam: Opportunities and challenges in promoting community and NGO Participated Fruit Processing: A case study from Bangladesh.

15.10-15.30 TEA BREAK

15.30-17.00 Identification of key constraints and knowledge gaps in the production of high quality indigenous fruit products for local, regional and international trade. [Chair: Dr Kate Schreckenberg]
- 15.30 Brainstorm/discussion in two (or three?) working groups.
- 16.30 Report back to plenary and discussion
- 17.00 Close

20th Sept. Day 2 [Session chairs to be assigned]

09.00 Review of previous day
09.15 Prioritisation of key constraints and focus areas for the network (matching up the constraints with the expertise of the network members)
10.00 Discussion of dates, objectives and outputs of the next 4 workshops

11.00 COFFEE BREAK

11.30 Knowledge management and dissemination (website, policy briefings, training materials, media, etc.)

12.30 LUNCH BREAK
13.30 Visit to Factory (PRAN)

21st Sept. Day 3 – for network partners only
06.00 Travel to HRC, Joydebpur.

08.30 COFFEE BREAK

09.00 Tour of HRC facilities
09.30 Research discussion
- Large proposals (existing and forthcoming funding opportunities, possibly designate lead people to draft proposals)
- Mini (catalytic) research to be funded through network (discuss criteria, selection process, etc.) [£8000 available in total]

11.30 Financial issues – workshop budgets, expenses, use of any project savings
12.00 Any other business.
12.25 Workshop closure [Dr Nazmul Haq].

12.30-13.30 LUNCH BREAK
13.30 Return to Dhaka.