

# DAIRY ASIA: TOWARDS SUSTAINABILITY

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Proceedings of an international  
consultation held in Bangkok, Thailand  
21–23 May 2014







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Food and Agriculture Organization of the United Nations  
Regional Office for Asia and the Pacific  
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## Prepared by

### **Vinod Ahuja**

Livestock Policy Officer  
FAO Regional Office for Asia and the Pacific (FAO RAP), Bangkok

### **Joachim Otte**

Senior Animal Production and Health Officer  
FAORAP, Bangkok

### **Harinder Makkar**

Livestock Production Officer  
Animal Production and Health Division  
FAO, Rome

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## Our Partners



## ABBREVIATIONS

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ADN	Asia Dairy Network
AGA	Animal Production and Health Division of FAO
APAF-N	Asia Pacific Animal Feed Network
APHCA	Animal Production and Health Commission of Asia and the Pacific
APMEA	Asia-Pacific, Middle East and Africa
APRACA	Asia Pacific Rural and Agriculture Credit Association
ASEAN	Association of Southeast Asian Nations
BAAC	Bank for Agriculture and Agricultural Cooperatives
BLRI	Bangladesh Livestock Research Institute
DLS	Dept. of Livestock services
BMPCUL	Bangladesh milk Producers' Co-operative Union Ltd.
CFC	Common Fund for Commodities
CGIAR	Consultative Group on International Agricultural Research
CWU	Consumptive Water Use
DALY	Disability Adjusted Life Year
DANIDA	Danish International Development Agency
DPO	Dairy Farming Promotion Organization of Thailand
EADD	East Africa Dairy Development
EC	European Community
FAO	Food and Agriculture Organization of the United Nations
FAO-RAP	FAO Regional Office for Asia and the Pacific
GASL	Global Agenda for Sustainable Livestock
GDA	Global Dairy Agenda for Action
GHG	Greenhouse gases
HCM	Ho Chi Minh City
HF	Holstein Friesian
ICAR	International Centre for Agriculture Research
ICARD	Indonesian Centre for Animal Research and Development
ICARDA	International Centre for Agricultural Research in Dry Areas
ICRISAT	International Crop Research Institute for Semi-Arid Tropics
IDF	International Dairy Federation
IDP	International Dairy Products
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
IPSARD	Institute of Policy & Strategy for Agriculture & Rural Development
IWMI	International Water Management Institute
LEAP	Livestock environmental assessment and performance
LMDP	Livestock and Market Development Project
MDA	Myanmar Dairy Association
MERIS	Medium Resolution Imaging Spectrometer
MLF	Myanmar Livestock Federation
MODIS	Moderate Resolution Imaging Spectroradiometer

MRL	Maximum Residue Levels
NASA	National Aeronautics and Space Administration
NDDB	National Dairy Development Board, India
NDP-I	National Dairy Plan of India
NIANP	National Institute of Animal Nutrition and Physiology
OECD	Organisation for Economic Co-operation and Development
PUU	Pasture User's Unions
RDCD	Rural Development and Cooperatives Division Resources
SPOT	Satellite Pour l'Observation de la Terre, lit (French) Satellite for observation of Earth (English)
StAnD	Sustainable Animal Diets
TDIA	Thai Dairy Industry Association
UHT	Ultra-High Temperature
VIIRS	Visible Infrared Imaging Radiometer Suite
WSPA	World Society for the Protection of Animals

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## BACKGROUND AND SUMMARY

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The Asia region has emerged as a major player in global dairy production and consumption. Aggregate consumption gains in dairy products in Asia over the past decade have exceeded twice the annual global average. Recent OECD-FAO Agricultural Outlook estimates that the demand for milk and milk products in the region will touch almost 320 million tonnes by the year 2021 (OECD-FAO, 2012). This means the region will need to increase milk availability by another 40 million tonnes within this decade. While dairy prices in 2008 had declined in line with other agricultural commodities, many of the factors prompting higher prices will likely underpin market fundamentals in the dairy sector over the medium term. These market conditions provide an attractive opportunity for developing Asian nations to further consolidate the gains by investing in measures to enhance productivity, quality and market access.

This growth in demand is happening at a time when concerns about resource scarcity, growing pressure on feed resources, climate change and the need for more equitable development are becoming more and more important. Farmers worldwide face the challenge of producing more food with fewer resources while also addressing climate change and impacts on ecosystems. The agriculture sector in general is under pressure to increase the efficiency of natural resource use to meet society's growing food and environmental needs. For the dairy sub-sector, this means that the economic agents along the entire dairy value chain must adopt technologies and management practices that facilitate integration of environmental health, economic profitability and social and economic equity goals.

Further, it is imperative that the transition to a more sustainable path considers sustainability in its full complexity encompassing all its pillars—economic, ecological, and social. Partial solutions will not produce the desired results. For example, any efforts towards conservation that ignore the need for economic development, food security and livelihoods are unlikely to succeed. Conversely, socio-economic development will not be sustainable if it does not maintain the ability of the ecosystem and society to adapt to short and

long-term changes. This complexity necessitates consideration of sustainability as a societal issue and requires integrated efforts by a wide range of stakeholders to capitalize on the strength of dairy production systems in Asia and to minimize the potential negative impact of rapid growth in demand and supply of dairy products in the region. It is also imperative that such efforts be realistic, equitable, and conscious of region's ecological, socio-economic and cultural dimensions.

To discuss and debate these issues, promote collaboration and knowledge exchange among relevant national and international agencies and to discover the ways of addressing future challenges, FAO, Regional Office for Asia and the Pacific (FAORAP) together with Animal Production and Health Division (AGA) of FAO, the Global Agenda for Sustainable Livestock (GASL), Dairy Farming Promotion Organization of Thailand (DPO), Department of Livestock Development, Royal Thai Government, (DLD) and other partners, organized the Regional meeting 'Dairy Asia—Towards Sustainability' in Bangkok on 21-23 May 2014. The meeting was attended by about 90 participants from over 20 countries comprising stakeholders from governments, national and international research agencies, civil society organizations, multilateral institutions, think tanks, private sector and regional and global networks. The meeting provided a platform to share experiences, debate issues of key concern, and provide guidance for the nature of required response in different countries and growth scenarios. The meeting was structured around three thematic areas—(i) Natural Resources and the Environment, (ii) Growing feed and fodder scarcity and the required response, and (iii) food security, rural livelihoods, public health and human nutrition. The chosen themes reflected the need for a multifaceted response to support sustainable growth of the Asian dairy sector.





## Opening and keynote addresses

The opening and keynote addresses highlighted the challenges and opportunities of rapidly growing Asian dairy sector and the nature of required response towards guiding the sector growth along a more balanced and sustainable path. Mr. Hiroyuki Konuma, FAO's Assistant Director General and Regional Representative for Asia and the Pacific highlighted the broad challenges of addressing food security, equitable economic growth and undernourishment; and the need to fine tune technology and institutional choices to meet these challenges. He also exhorted the stakeholders to come together in pursuit of determined collective action.

Jack Holden, Sustainability and Social Responsibility Manager, Fonterra Cooperative Group, delivered the first keynote address and highlighted the importance of farm profitability as the key driver of the dairy system. Based on Fonterra's experience he advised that the future growth strategies for the dairy sector should be underpinned by three pillars: dairy excellence, nutrition for all, and responsible dairying. According to him, dairy excellence materializes when milk production per inputs (water, energy, feed and nutrients) increases. This can be achieved through improved genetics, better husbandry practices and better feeding management. Further, in terms of interventions and farm management, it is critical to make sure that all inputs are used as efficiently as possible. With efficient management, a 20-30 per cent improvement in efficiency can be achieved, leading to an increase in profitability.

Mr. Holden further noted that reducing greenhouse gases (GHGs) is an important issue that must be dealt with in order to attain dairy sustainability. On this point, he asserted that farmers should take steps

to understand the GHG footprints of their farms, especially given that 85 per cent of dairy sector GHG emissions come from on-the-farm activities. Increasing the amount of milk produced per animal using fewer inputs would reduce GHG emissions. He further noted that, in practice, farmers tend to adopt GHG prevention practices when it is in their financial interest to do so.

The second keynote address by Mr. T Nanda Kumar, Chairman, National Dairy Development Board of India (NDDB) recalled the new strategic objectives of FAO and expressed that any discussion on livestock and dairying must occur within this framework. He emphasized the need to improve the interdependence between livelihood issues of smallholder farmers and the challenges of arresting natural resource degradation and climate change. According to Mr. Nanda Kumar, any solution which ignores the livelihood issues would be inequitable. In terms of dealing with resource scarcity, he emphasized the need for sustained efforts to augment the availability of feed and fodder and to significantly increase the efficiency of their utilization. In this context, he shared the recent experience of NDDB in promoting balanced rations which has contributed towards significant increase in daily net income of farmers, reduction of the occurrence of metabolic disorders, and reduction in methane emissions. Finally, he noted that if we are to collectively address the challenges of increasing productivity to meet rapidly growing demand for nutrition, it is not enough to have ideas, technology, projects and budget allocations. The ideas need to be converted to actionable plans and implemented by qualified professionals and, in that context, supported the idea of promoting 'Dairy Asia' platform for collaborative action, knowledge sharing and innovation.

## Technical presentations

A number of presentations covered ongoing changes in the dairy sector, new challenges, good practices, and initiatives from local, national and international perspectives. The presentations highlighted the importance of dairy sector for food security and nutrition both at national and at household levels and the implications for resource management and ecological sustainability.

Pressure on water resources, mitigation of GHG emissions and growing scarcity of feed and fodder were identified as among the most serious challenges for the region for meeting the growing demands for dairy products and for alleviating the adverse environmental impacts. In that context, a number of presentations reviewed the experiences in managing natural resources, feed and fodder management including grassland restoration, the lessons learnt, the knowledge gaps and the way forward.

With respect to food security, public health, human nutrition and livelihood support, a number of presentations reviewed scientific evidence and shared field experiences in meeting multiple objectives. The presentations highlighted elements of good practices that, though sometime specific to special contexts, had important lessons for policy makers across the region. The presentations reiterated the importance of smallholder producers and the role of dairy in poverty reduction, employment generation, building social capital and nurturing a more inclusive and sustainable development agenda in the region. The presentations argued for a central place for local communities and smaller players in national and international policies. A summary of all the presentations is made available in Section 2 of this report. Full video presentations are also available through World Wide Web as per the links provided in Annex 1.

## Panel discussions

Four panel discussions were organized to further elaborate on selected issues. A brief summary of the discussions in these panels and the broad messages that emerged from the deliberations are given below.

### Panel 1: Natural resources and the environment

The deliberations related to growing pressure on natural resources, the need to enhance efficiency of resource use and to minimize the impact on biophysical environment, reflected knowledge gaps, uncertainties, and the diversity of stakeholder vision about the future of Asian dairy sector. These also reflected a sense of sincerity in dealing with climate change, water scarcity, biodiversity losses and resource use efficiency issues. In this context, it was pointed out that milk production is a biological process with its own biophysical limits on nutrient recovery and management. While it is important to discuss ways and means to improve resource use efficiency and nutrient management, such discussion must occur within the confines of these biological limits.

Substantial discussion also took place on the question of triple wins—the required and realized practice change to facilitate simultaneous desired environmental, social and economic outcomes. Panellists argued that it is not possible to address environmental issues without addressing the social and environment issues and it often takes public investment and long term policy commitment for improving environmental outcomes.

Discussions also reflected the need for a more specific and nuanced assessment of environmental outcomes with respect to dairy production in different production systems and geographical areas. It was pointed out that the discussion on implications for natural resources and the environment is often embedded within the larger livestock-environment debate and is overshadowed by the natural resource and environmental implications of meat production. Considering the substantial differences in the environmental impact of these two products, it is essential to differentiate the debate to enable more informed policy choices.

Finally, there is a need to (i) situate the nutritional outcomes of consuming milk and dairy products in the context of global changes in diets and lifestyles, and (ii) highlight positive effects that connect dairy agriculture, nutrition and health at the local, national and global levels, and to identify gaps in current knowledge in these areas.

## Panel 2: Sustainable animal diets: concepts to implementation

Animal feed and feeding has an impact on all aspects of animal production—productivity, health and welfare, product quality and safety, rural incomes, land use, water pollution, green-house gas emission and overall profitability of livestock operation. The deliberations centred on the concept of 'Sustainable Animal Diets (StAnD)' developed through various consultative processes. The concept is based on the Three-P dimensions of sustainability (*Planet, People and Profit*), complemented by a further vital aspect of animal nutrition, namely the ethics of using a particular feed. The discussions reflected that growing competition between food and feed and high input requirements—energy, land, water and labour—for feed production strongly justify the implementation of the StAnD concept.

Towards this end, the panellist highlighted the steps that academia, feed industry and cooperatives and farmers organizations are taking that are consistent with the StAnD concept. Some examples in that context included the use of balanced diet at farmers' doorstep, use of agro-industrial by-products to decrease food-feed competition, reduction in feed wastage, conversion of 'wastes' to resources (for example conversion of horticulture wastes to animal feed), giving emphasis on the use of locally available feed resources, avoidance of excessive feeding which is prevalent more in intensive production systems, and making the feed production chain more energy efficient. Future options that are consistent with the principles of the StAnD concept were also deliberated. The benefits of using these interventions in terms of the three dimension of the sustainability were identified and highlighted. The emphasis of the discussion was also on the socio-economic dimension of the StAnD implementation in addition to making the livestock production more profitable and environment friendly. Most of the examples discussed supported socio-economic dimension by increasing income of the smallholder farmers and particularly of women, contributing to social equity and inclusive growth. An important message that emerged was that sustainability of animal diet is vital for sustainable animal production including dairying.

The consensus was that there is a need to change the manner in which the feed is being produced, procured and fed; and the framework developed for the StAnD concept could be a starting point for introducing this change. To achieve this, guidance

provided by a stakeholders-survey conducted by FAO should be useful. This survey has prioritised various elements of the four pillars of the StAnD concept, for which indicators should be identified. Operationalizing these pillars would however require concerted efforts towards building awareness about the benefits of StAnD, developing guidelines and good practices for implementation of the StAnD, and achieving broad stakeholder engagement on the StAnD endeavour.

## Panel 3: Dairying as an instrument of inclusive economic development

In many countries within and outside the Asia Pacific region, dairying has been recognized as an instrument of inclusive economic growth and social and economic empowerment for poor, specially women. This has been made possible by recognizing the central role of smallholder dairy farmers and facilitating policy and institutional choices in support of smallholders. In the recent past however there is an ongoing debate in the region about the ability of smallholder dairy producers to respond to a growing market that demands higher quality, consistent and diverse products. Some observers argue that scope of technology infusion on small farms is limited and hence the region must strive towards building and promoting larger dairy farms. Others however argue that small farmers can meet the demands of markets but need public policy and organizational support that build capacity and facilitate access to services, finance and technology. There is also growing evidence that whilst the ownership of milch/dairy animals may provide a steady source of income, it is often, on its own, not enough to lift families out of poverty. Notwithstanding this debate, investment in the further development of both smallholder and industrial scale dairy in the region continues at pace. There was strong consensus among the panellists that despite the pressures of market, smallholder producers continue to be an important and critical part of dairy production systems and market chains in the region, and investing in these systems to raise their productivity and bargaining power must remain an essential component of the policies and strategies for dealing with poverty and malnutrition. The consensus provides an opportunity for creating a stronger voice and a collective platform that can argue, more strongly, the need for targeted investment for supporting and enabling smallholders.

There is also a need to better recognize the new kinds of organizational structures and forms for linking smallholders to markets. The classic models of

collective action such as cooperatives and producer groups remain important and there is a continuing need for public support for these models but, at the same time, there are new sets of private sector initiatives and organizational models that are not fully integrated into the discussions on smallholder market participation. A closer understanding of these initiatives and models can help discover new opportunities for involving smallholders through innovative public-private partnerships and for refocusing pure public support measures to areas which may not yet be sufficiently attractive for private investors.

Finally, it must be recognized that with the regional economic outlook remaining robust, there will be natural exit of smallholders from the sector in the medium and the long term. The challenge in this context will lie in mediating the transition in a manner that ensures a balance between exit rate and the absorptive capacity of the rest of economy, thus avoiding large scale disruptions in livelihoods.

#### **Panel 4: Multi-stakeholder action in pursuit of sustainable dairy**

Growing pressure on natural resources, accelerating climate variability and change, and the continuing imperatives of addressing equity, poverty alleviation, and livelihood support are posing new challenges for meeting the food demands of a rising, more urban and more prosperous population. Participants recognized that given the size and complexity of these challenges, joining forces is a necessity. The question is not whether stakeholders need to come together but what is the most suitable mechanism for collaboration and cooperation.

Based on the experience of partnership being developed around the world, it was pointed out that dialogue is at the heart of forming partnerships. Most sustainable partnerships invest substantial time and effort in the beginning to understand partner perspectives and to come to a common understanding of the shared objectives. Even after the formation of partnerships, it is important to operate on the basis of consensus, transparency and continued investment in promoting values that respect diversity of interests and views.

Another important consideration for sustaining multi-stakeholder partnerships is to give due attention to the value addition for each partner. This can be

difficult considering the range of interests that might be represented in the coalition but is essential for success. Finally, while the organizational structure of the coalition will inevitably involve representation of key stakeholders, the secretariat function of the coordinating the coalition must be entrusted to an organizational body that is respected by all stakeholders and is perceived to be a neutral and honest broker.

## **Concluding session**

The concluding session comprised discussions based on the presentations of break out groups and the presentation on proposed elements of a regional dairy strategy. Participants recognized the challenges and opportunities of growing demand for milk and milk products in Asia. They also recognized that despite the ongoing structural changes and the pressure to scale up operations, the small producers remain central to the past, present and future of Asia's dairy landscape and improving their organization to give them better bargaining power in the market place must remain a core element of the dairy development strategy. At the same time, the participants acknowledged the pressures of increasing resource scarcity and the sustainability imperative that entails. This necessitates articulation of a new vision that can foster multi-stakeholder collaboration to achieve sustainable dairy sector growth. Participants identified several elements that must be considered when drafting a new dairy development policy for the region. These are listed in Section 4 (Concluding Session) of this report.

Considering that the feed provision is the greatest single cost in livestock production, and feed efficiency is central to sustainable livestock production, APHCA and AGA have provided technical support and taken initiatives during the past one year to encourage countries to put in place mechanisms to assess national feed resources and to establish an Asia-Pacific Animal Feed Network (APAF-N). The network was introduced in the concluding session of the meeting outlining its vision, mission and goals. The Network aims to provide up-to-date information on feed resources, feed demand and supply, feed price, feeding systems and to develop guidelines on efficient feed resources management at national, regional, and international levels.

Substantial discussion also took place on the need for establishing a multi-stakeholder platform to facilitate regional cooperation, knowledge exchange, policy

dialogue and catalytic action in pursuit of shared goals. There was a consensus that such a coalition/platform is essential and the process of creating such a community would involve identification of willing partners, agreeing on a common minimum agenda, putting in place an organizational structure, commitment of resources and a monitoring and accountability mechanism. This should be an open, voluntary and iterative process and such a coalition should be given time to evolve and establish credibility among stakeholders. It was pointed out that the organizations present in the meeting—FAO, NDDDB, APHCA, IDF, WSPA, in particular, bring unique and complementary strengths and are best positioned to creating such a coalition. The stakeholders agreed to continue the dialogue on formation of Dairy Asia platform as a parallel process to the development of regional dairy development strategy.



# OPENING AND KEYNOTE ADDRESSES



# Welcome address

## **Tritsadee Chaosuancharoen**

Director General  
Department of Livestock Development  
Royal Thai Government

Distinguished guests,

On behalf of Royal Thai Government and my own behalf, I would like to extend a very warm welcome to all of you to Bangkok, Thailand, the Land of Thousand Smiles.

It is our privilege that FAO and other international organizations have chosen to organize the Regional Meeting on “Dairy Asia: Towards Sustainability” in Bangkok. The sector is full of challenges and opportunities and it is our collective responsibility to mobilize and direct public and private interest in the dairy sector towards common goods and sustainable production.

As you know, Asia is the world’s fastest growing economic region. The economic growth in Asia has also generated growing trends of livestock production and increased the demand for livestock products in Asia. For the dairy sector, the demand for milk and milk products in Asia has more than doubled since 1980. Milk production in the region in 2010 crossed the 260 million tonnes mark. However, as we know, the agriculture sector in general is under pressure to increase the efficiency of natural resource use to meet society’s growing food and environmental needs. For the dairy production this means deployment of appropriate production technologies and control along the dairy value chain in a manner that facilitates integration of environmental health, economic profitability and social and economic equity goals. Investing in sustainable dairy is no longer a question of choice.

I would like to take this opportunity to express our sincere thanks on behalf of the Department of Livestock Development, Thai and ASEAN livestock industry representatives to FAO and other international

organizations to carry forward the momentum and discussion on sustainability in dairy production.

I once again thank you for your presence today and your active participation to discuss and advocate the key regional policy issues on Dairy Development in Asia – Towards Sustainability. In addition, I would like to acknowledge the leadership of FAO in making this meeting happen.

I wish you fruitful discussions and an enjoyable stay in Thailand.

Thank you very much.



# Opening address

## Hiroyuki Konuma

Assistant Director-General and  
FAO Regional Representative for Asia and the Pacific

Distinguished delegates, ladies and gentlemen,

I am pleased to be here this morning and to have the opportunity to share with you some of my thoughts which I hope will be helpful in your deliberations in this meeting and beyond in your work and consultations.

Ladies and gentlemen,

Together we face the challenge of feeding more people than at any point in history.

The world's population is expected to rise from 7.2 billion in 2013 to 9.6 billion by 2050.

At present, the world produces sufficient food to meet the demand of everyone, and maintains adequate food stocks. Despite this, the world is home of 842 million undernourished people.

Notwithstanding its rapid economic growth, the Asia-Pacific Region remains home to nearly two thirds of the world's chronic hunger population. .

The benefits of economic growth have not been shared equally among populations in different economic groups. In many cases, it benefitted the rich who could invest further, while the poor who did not have either means or opportunities to invest were left behind. This resulted in widening of economic disparity.

We have gathered here to find ways of working together to make dairy development in the region more sustainable. The demand for milk and milk products has continued to grow in the region. OECD-FAO outlook estimates that Asian milk demand will touch almost 320 million tonnes by 2020 and that means the region will need to increase milk availability by another 40-50 million tonnes by the end of this decade. This provides

a perfect opportunity for public and private investment in milk production and processing while at the same time contributing to household level food security and nutrition.

But, as we think about these opportunities and plan future investments, we must consider the ongoing changes that will affect the production, marketing and consumption of dairy products. The technology and institutional choices we make would need to be conscious and cognizant of these changes.

First, we need to recognize that this growth in demand is happening at a time when concerns about resource scarcity, growing pressure on feed resources, climate change and the need for more equitable development are becoming more and more important. Farmers worldwide face the challenge of producing more food with less resource while also addressing climate change and impacts on ecosystems. Meeting future challenges requires: substantial investment in improved resource use efficiencies.

Second, considering that nearly 80 percent of the milk in the region is produced by smallholders, improving their organization to give them better bargaining power in the market place must remain a core element of our work in future. While we recognize that bulk of investment will come from the private sector, we should work towards creating synergies and guiding investment in a manner that it does not marginalize smallholder producers.

Third, we must work towards raising consumer awareness about nutritional virtues of milk and we must do so by bringing science based evidence about nutritional effects of milk and linking it with policy and regulation.

Fourth, as you are well aware, women have been and continue to be key actors in dairy sector, especially in poor agrarian societies. Dairying provides women with a regular daily income, vital to household food security and family well-being. Women are not only centrally involved in milk production, but also in collection, processing and marketing of dairy products, roles which were often overlooked by development programmes. As we devise new projects and programs, we must ensure that the participation of women in dairy sector is not diminished and this participation must be such that the women not only contribute their labour but also become an active participant in strategic decision making.

Thus, our agenda goes far beyond simply producing enough food to meet the growing demand. Our challenge is to build sustainable food systems and provide sustainable nourishment to people. For the dairy industry, this means providing consumers with the nutritious dairy products in a way that is economically viable, environmentally sound and socially responsible – now and for future generations

It is not enough that we recognize and talk about these challenges. We need to take concrete action. These are complex challenges and cannot be addressed by individual players. We must work closely together in dealing these challenges—the governments, the industry, the farmer organizations, national and international organizations must come together to ensure economic, social and environmental sustainability of food systems. For this to happen we need a platform for coordination of self-determined collective action. A platform whose members would be committed to the ideals of collaboration and mutual assistance and I hope this meeting will mark the beginning of shaping such a platform.

FAO remains committed to working with all stakeholders and I hope together we can make visible contributions towards improving livelihoods and nutrition. Welcome once again and I wish everyone productive and exciting deliberations.

Thank you very much.

# Dairy farm profitability through environmental sustainability

## Jack Holden

Sustainability and Social Responsibility Manager  
APMEA Region  
Fonterra Co-operative Group

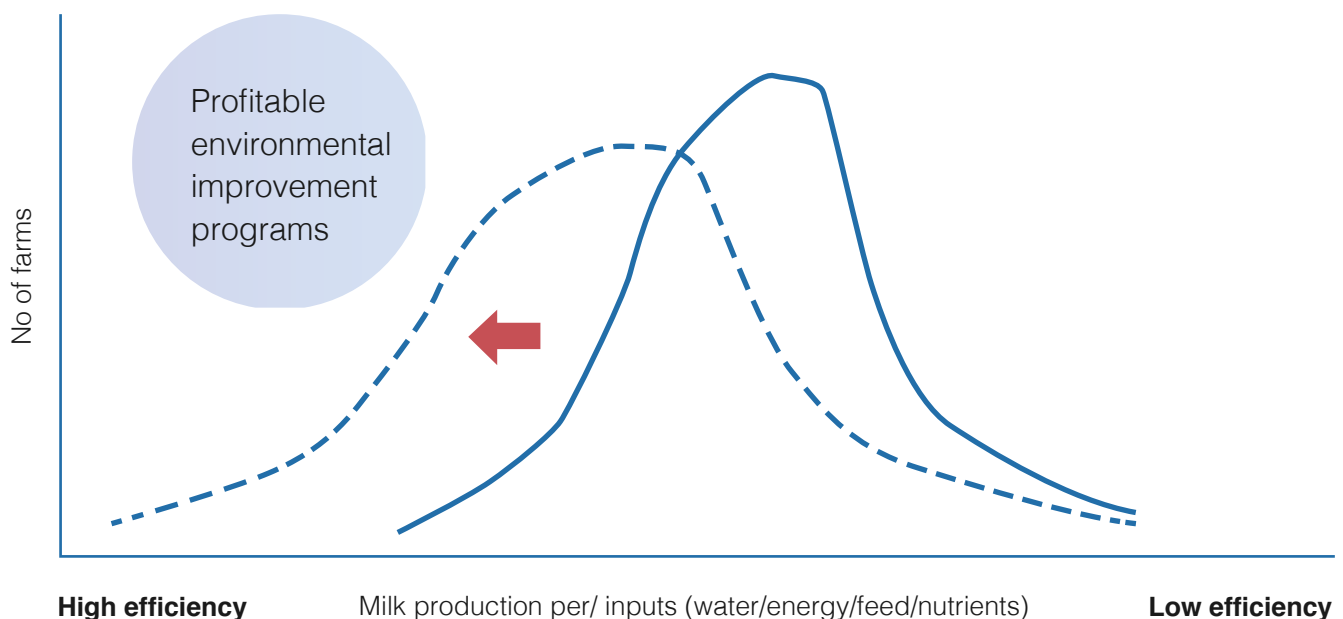
Distinguished delegates, ladies and gentlemen,

It is a great privilege to be invited today to this meeting that is addressing one of the key challenges we face. We particularly appreciate the opportunity to join such a distinguished group of professionals. From our point of view, we are here to give a business view of what we can contribute to addressing the enormous challenges outlined by previous speakers. We have significant on ground experience on how we can address the issue of producing more food with less impact and we are pleased to share some of those insights and experiences in this meeting.

One of the key questions in the context of this meeting is how can we produce more nutrition in a way that can be sustained indefinitely and to ensure that the future generations of farmers and consumers are left with a better future. In our experience, the key factor

that drives the change to grow more food with less environmental impact revolves around profitability for farmers. Farm level profitability is the key driver of the dairy system and as we drive profitability for farmers around the world we can unlock the potential for addressing the sustainability challenge we are addressing today.

In our experience, the dairy development approach needs to be underpinned by three pillars: dairy excellence, nutrition for all, and responsible dairying. Dairy excellence materializes when milk production per inputs (water, energy, feed and nutrients) increases at a lower cost. Dairy excellence can be enhanced through improved genetics, improving feeding and water supplies and ensuring farmers have the incentives to adopt better husbandry practices. In term of interventions and farm management, it is critical to make sure that all inputs (cows, energy, water and feed)



are used as efficiently as possible (getting more milk for every single input). Experience suggests that under most farming and production systems, it is possible to identify a 20-30 per cent opportunity for improvement in efficiency across a sample of farmers leading to an increase in farm profitability and improved productivity with lower environmental impacts. Unlocking this efficiency is the key part of growth and this requires moving bulk of the farmers to best production practices and technology frontiers within given geographical areas. Our experience suggests that there is usually a distribution around farm level efficiency in any given area (see figure for a stylized distribution pattern) with some farms being highly efficient, some being very poor in efficiency and a large proportion in the middle. The challenge is carefully study the practices of efficient dairy farmers and designing and implementing programs with the objective of moving the majority of farmers to good practices and technology frontiers. This requires good data on farm productivity, profitability and production practices and continuous recording and monitoring as we make progress.

Sustainability also requires managing nutrients so as to minimize nutrient loss and reducing damage to natural resources (air, land and water) and the biophysical environment. Once again the key is to have good farm level data so as find ways of recovering the nutrients from waste and to turn the waste into income. This requires substantial investment in data collection, analysis and feedback systems. But the bigger challenge often is to engage the farmers in these processes. The key to engaging farmers once again is to demonstrate how changing practices can lead to higher revenues or lower costs or both. The farmers we work with now keep the data on the use of fertilizers and manure. We then use this data to understand the fertilizer efficiency at farm level, map that against their milk production then advise on practices that can convert the gains from improved efficiency into farm profits. The third issue in the sustainability debate is how to reduce greenhouse gases (GHGs) and assisting the farmers better understand the GHG footprints at their farms. This is important considering that around 85 per cent of dairy GHG emissions come from on-the-farm activities. This again goes back to the notion of improving efficiency at farm level as increasing the amount of milk produced per animal using fewer inputs. One important way of reducing emission intensity of dairy products is to help farmers reduce the calving intervals. That would allow produce more milk over a cow's lifetime and would have a direct impact on

emission intensity. This will also allow farmers to earn more profits from their enterprise.

While changing practices at farm level is critical for moving towards more sustainable dairy sector, it is also important that, as stakeholders, we invest in reaching out to other stakeholders, especially bringing consumers and farmers together to enhance the understanding of consumers about milk production processes and to enhance the pride of dairy farmers. It is also important to work with other partners, specially the governments, the service providers, community groups, and other non-government national and international agencies. All the partners and stakeholders bring insights to the challenges we face although no single agency or individual has all the answers. By working together we can magnify the impact of what we do in our respective work areas. In that spirit, we are pleased to participate in this meeting and express our commitment towards multi-stakeholder partnerships.

Thank you.

# Society, equity and livestock in Asia: Aspirations, reality and dilemmas with specific reference to dairy

## T. Nanda Kumar

Chairman  
National Dairy Development Board  
India

Distinguished guests, ladies and gentlemen

Let me begin by thanking the previous speakers for laying out the broad issues and the outline of this conference. The previous speakers have identified all the key issues that we need to deliberate on. But, coming from a different perspective, the solutions we seek are slightly different than that of large farm holding model.

In order to put my talk in proper perspective, I wish to go back to the five strategic objectives of FAO. These are (i) help eliminate hunger, food insecurity and malnutrition; (ii) make agriculture, forestry and fisheries more productive and sustainable; (iii) reduce rural poverty; (iv) enable inclusive and efficient agricultural/food systems; and (v) increase the resilience of livelihoods to disasters.

Any discussion on livestock and dairying must occur within the above framework, and that there needs to be a better understanding and appreciation of the interdependence between livelihood issues of smallholder farmers and the challenges of arresting natural resource degradation and climate change. Any solution which ignores livelihood issues would be inequitable and therefore may not find acceptance in the poorer regions of the world.

The quality of human life and nutrition, particularly in rural areas today, is inextricably linked to the quality of livestock products, which, in turn, is significantly influenced by the genetic potential and nature of the raw materials fed to livestock. There are many concerns and challenges that the dairy industry in Asia must cope with, especially with regard to increasing and sustaining productivity and ensuring food and nutrition security.

In most developing countries, the aspirations of the

people and policies of most governments are focused on the eradication of hunger, malnutrition and poverty, and that such eradication must ensure inclusive economic and social progress and promote sustainable management and utilization of natural resources, particularly land, water and genetic resources. This would only be possible by making agriculture, forestry and fisheries more productive; reducing wastage of natural resources; and enabling inclusive and efficient agricultural and food systems. Disasters, such as droughts, affect the poor disproportionately, and that livestock often remain their only hope in such situations. Smallholder farms are therefore the best insurance against starvation and acute malnutrition in adverse climatic conditions. In many parts of the world, malnutrition can be addressed only through smallholder dairying.

Management of society, equity and livestock requires a clear understanding of the sensitivities of the poor, the limitations of their resources, the legal framework on the use of common lands for grazing cattle, the immense possibilities of technology adaptation and the changing nature of climate and markets. This requires a holistic approach, which takes into consideration factors that impact land, water and climate. Feeding systems could eventually become irrelevant if the factors that adversely affect agricultural production and availability of water are not addressed as they have a direct impact on the productivity of livestock on a sustainable basis. The livestock feeding systems in India are based mainly on by-products of cereal crops. Grains are not normally used for ruminant feeding. This type of feeding system is efficient and sustainable because it is not in direct competition with human beings, especially for grains. The balance between food, feed and fibre in agriculture is ensured for long term sustainability.

While we target growth in milk production, we need to be aware of the limitations of our resources. The availability of feed and fodder could become major constraints on the dairy system. Well thought out and sustained efforts are required to implement strategies and programs to augment the availability of feed and fodder and to significantly increase the efficiency of their utilization. Such an approach, anchored in scientific knowledge and adapted to local systems, is necessary both from an economic and an ecological point of view.

In the face of climate change, water is most likely to become the major limiting factor in the future. Scientific management and prudent use of this resource is the new challenge, not only for livestock, but for agriculture as a whole. Climate variability is already visible in most parts of the world.

India was able to increase its milk production from 22 million tons in 1970 to 66.2 million tons in 1996 through “Operation Flood,” which introduced modernisation in liquid milk processing, transport, packaging and marketing and product innovations in milk products. Most important, Operation Flood made dairying a remunerative occupation for millions of India’s rural poor. Between 1996 and 2014, milk production in India increased from 66.2 million tons to about 140 million tons. Presently, In India, there are 15 state cooperative dairy federations, 189 district milk unions covering several thousand village dairy cooperative societies and around 15.2 million milk producer members (of which about 29 per cent are women) and whose combined cash income from sale of milk to cooperatives is estimated at US\$ 5 billion (not including other private producers and the unorganised sector).

India’s milk production has been increasing at about 5 million tons per annum. This is a remarkable achievement given the fact that India is a tropical country and collection, storage and processing of milk remains a challenge. Unlike major developed countries, milk production is a subsidiary activity to crop production and/or wage employment. India’s milk producers are predominantly smallholders or landless people. Dairying, for them, is livelihood. Dairy animals in India are largely fed on agricultural by-products and crop residues and are cared for mainly by women. From a gender perspective, this model provides economic and social empowerment to a large number of poor women in India. Smallholder dairying has also created value for resources that otherwise would have limited economic value. Even with these constraints, milk production in India has been increasing steadily, and the demand for milk has been

increasing at a rapid pace.

It has become increasingly apparent that feed resources in India (and Asia as a whole) are not going to increase dramatically in the years to come. It is, therefore, essential that we use these resources as judiciously and efficiently as possible. This involves leveraging frontier technologies and developing and implementing models that are climatically and geographically appropriate for the many regions in India and in Asia.

Feed accounts for almost 70 per cent of the total cost of milk production. Therefore we must focus on ways to lower the cost of feed, while improving the overall nutritional value of milk and milk products. We have no option but to improve the efficiency of utilization of existing feed resources by adopting available field-tested technologies that can improve their nutritive value and by feeding animals a climate/region appropriate balanced ration. This, can have a significant and immediate impact on increasing milk production and the productive life of the animal, and could also add to the economic benefits of the farmer.

The National Dairy Development Board (NDDB) in India has been engaged in the development and use of strategic feed supplements for improving milk production and reproduction efficiency, so that milk production and the productive life of dairy animals can be increased with the available feed resources. These include urea molasses mineral block lick, bypass protein supplement, bypass fat supplement and region specific mineral mixtures, among others. Balancing the ration with available feed resources and an area-specific-mineral mixture could significantly increase the net daily income of milk producers and reduce the occurrence of several metabolic disorders.

Preliminary data generated by the NDDB on more than 90,000 animals show that feeding a balanced ration leads to an increase in daily net income of more than Rs. 25 (about half a US dollar) per animal through reduction in the cost of feed and increase in milk/fat. With specific reference to India and other Asian countries, feeding a balanced ration is also the only way in which feed resources can be used judiciously. The importance of feeding calves a ration that leads to optimum gain in body weight — enabling them to attain about 75-80 per cent of mature body weight at puberty — is not well understood by many small farmers. It is well known that poor feeding of young calves leads to higher age at first calving and overall loss of productive life. Some cattle-feed plants owned by cooperatives have started

production of calf starters in India. Serious and aggressive efforts are being made to produce and popularize the use of feed for young calves and to make it available to milk producers at an affordable price. With regard to feed, Mr. Kumar asserted that adoption of appropriate, region-specific feeding practices aimed to make optimal use of available feed resources for a balanced diet have been recognized as a cost-effective solution for healthier productive animals.

Breeding programs are important and should lead to producing animals with a higher feed conversion efficiency. The National Dairy Plan of India (NDP-I), with an outlay of US\$ 255 million, focuses on increasing the productivity of animals through improved breeding and provides ration-balancing advisory services. Given the fact that the constraints of stress due to climate variability and the availability of feed will intensify in the future, more emphasis should be placed on promoting indigenous breeds. A few specially selected organizations across the country are carrying out progeny testing and pedigree selection programs to produce bulls of indigenous breeds, cattle and buffalo breeds. These breeds can compete well, if not better, than crossbreds under harsh and arid conditions.

On the subject of greenhouse gases (GHGs), the strategic players are conscious of the need to reduce the GHG footprint of dairy animals in India, either directly from enteric fermentation or indirectly from deforestation or other activities related to feed production. Animals fed an unbalanced ration not only produce less milk at a higher cost but also produce more methane per litre of milk. Studies undertaken by the NDDB under field conditions have demonstrated that it is possible to reduce methane emissions by 12-15 per cent by feeding animals a balanced ration. The combination of a breeding program leading to producing animals with a higher feed conversion efficiency and feeding them a balanced ration appears to be the practical route to reduce methane emissions.



If we are to collectively address the challenges of increasing productivity to meet rapidly growing demand for nutrition, it is not enough to have ideas, technology, projects and budget allocations. What we also need is a carefully thought out, science based, sustainable and locally relevant approach to breeding, feeding and animal health care. The ideas need to be converted to actionable plans and implemented by qualified professionals and should also include women who are engaged in livestock management.

Dairy Asia is perhaps the right platform for collaborative action, knowledge sharing and innovation, but the problems that confront Asia are, in some ways, different from the problems faced by other parts of the world. Therefore, a “one size fits all” solution may not work in the Asian region. We need a common, but differentiated approach for this region.

Thank you.





# TECHNICAL PAPERS / PRESENTATIONS



# Environmental performance of the dairy sector

**Carolyn Opio**

Natural Resources Officer  
FAO  
Rome, Italy

Over the past four decades milk production has increased rapidly worldwide, especially in the developing world, resulting in a convergence in total milk production between developing and developed countries. Asia has played a key role in this convergence driven by rapid increases in income, growth in population and increasing share of population living in urban areas.

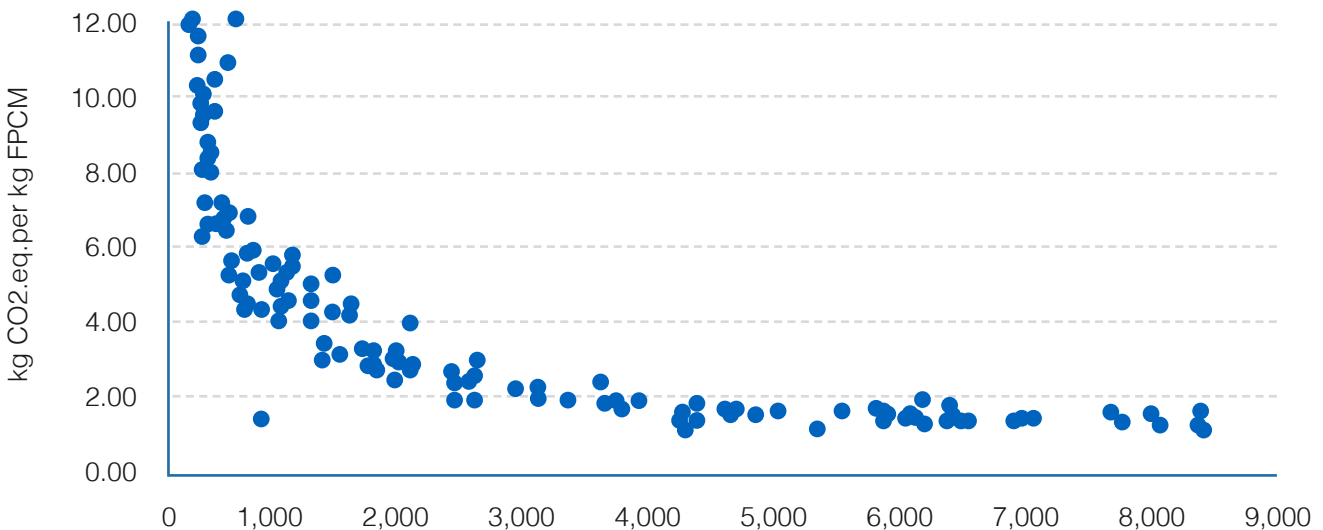
Considering that the dairy products are a major source of animal protein, energy, vitamins and micronutrients, it is not surprising, that the aforementioned dairy sector growth have led to benefits in terms of improved nutrition and health. The sector growth also has tremendous potential for reducing poverty and malnutrition in the region (especially considering that over 80 per cent of the dairy animals in the region are raised by smallholders). Improvements in productivity can result in the improvement of the environmental sustainability of the sector.

Growing demand and the necessity to produce more pose significant implications for the natural resource base and environment. The scarcity of resources (water, energy and land) will shape future food production, and resource supply constraints and climate change will result in larger and more frequent shocks to dairy food chains. As the demand for a sustainable dairy sector takes root, the sector will have to reduce its environmental footprint. Productivity must increase to meet growing food demand in a way that reduces the sectors environmental impact.

One of the challenges in this context is to convert these challenges into opportunities. For example, some of the recent work in this context in FAO and other agencies has shown that investment in in productivity enhancing measures can also simultaneously result in reduced emission intensity per unit of product (Figure 1). Similar win-win opportunities may be identifiable

**FIGURE 1**

Emission intensity and milk production



with respect to increasing feeding efficiencies, health control and improved genetics of animals. Identifying such opportunities and capitalizing on them for future sustainable development of the sector however requires collaborative multi-stakeholder action.

The livestock environmental assessment and performance (LEAP) initiative is a multi-stakeholder partnership on the environmental benchmarking of livestock supply chains. LEAP originated out of the need to address the lack of balanced, detailed and comprehensive data on environmental performance, along with the need to build a broadly accepted framework to guide and monitor progress on sustainability. LEAP is under the broad umbrella of the GASL. The LEAP Partnership focuses on livestock supply chains; develops harmonized metrics and methods to guide environmental performance improvement, benchmarking and monitoring; examines a wide range of environmental criteria; and is a multi-stakeholder initiative.

LEAP is based on two key principles: the dialogue on sustainability must be evidence based, and common metrics should be based on science and agreed to by stakeholders. These principles are shared with the GASL, the umbrella under which LEAP is nested. LEAP uses science-based life cycle approaches and utilizes leading expertise from around the world to develop sector-specific guidance; it focuses on tangible outputs

(databases, guidelines, etc.) and identifies opportunities to work with other international entities. The LEAP Partnership, which began in 2012, comprises several participants from governments, civil society organizations and the private sector, and is hosted by FAO.

LEAP activities have been shaped by sector specific guidelines. Three have been developed to date, namely poultry, small ruminants and animal feed, and under preparation are guidelines on large ruminants (dairy and beef, buffalo) and biodiversity. The guidelines were developed by various experts around the world with the purpose of providing guidance on measuring environmental performance. LEAP activities also involve the development of a database on GHG emissions from feed production (maize, soybean, wheat, barley, cassava) and the construction of effective communication strategies on sustainability and environmental performance.

LEAP is attempting to ensure international input from diverse farming and supply systems, improve the science on biodiversity and water, improve communication on environmental sustainability and enlarge its membership, among others. LEAP presents an opportunity to increase the level of engagement and raise commitment of stakeholders in the dairy sector to meet the challenge of sustainability, to increase the level of technical expertise, and to connect with other related initiatives.



# Water footprint of the dairy sector

## Upali Amarsinghe

Senior Researcher, IWMI  
Hyderabad Regional Office

Water footprint is the amount of water used to produce a specified amount of food and measures the volume of freshwater to produce the product. For example, it takes approximately 1,000 litres of water to produce one litre of milk, 15,400 litres of water to produce 1 kg of beef, and 1,600 litres of water to produce cereals<sup>1</sup>. A water footprint is generally broken down in 3 components: blue, green, and gray<sup>2</sup>. At the global level, the water footprint (on a per kg product basis) of milk compares favourably with other food sources (even lower than the cereals). On per unit of nutritional value as well the water footprint

compares reasonably well and is among the lowest when compared other livestock products.

Despite a relatively reasonable water footprint at the global level, there are many milk producing areas across Asia that are under severe water stress. There is a pattern of unsustainable groundwater use across many dairy producing areas in Asia. And climate change is having an impact on the distribution and amount of water across Asia.

**TABLE 1**

The global average water footprint of crop and livestock products

Food Item	Water footprint per unit of weight (L/Kg)				Water footprint per unit of nutritional value		
	Green	Blue	Gray	Total	Calories L/Cal	Protein L/g of protein	Fat L/g of fat
Vegetables	194	43	85	322	1.3	26.0	154.0
Fruits	726	147	89	962	2.1	180.0	348.0
Cereals	1,232	228	184	1,644	0.5	21.0	112.0
Oil crops	2,032	220	121	2,364	0.8	16.0	11.0
Pulses	3,180	141	734	4,055	1.2	19.0	180.0
Milk	863	86	72	1,020	1.8	31.0	33.0
Eggs	2,592	244	429	3,265	2.3	29.0	33.0
Chicken meat	3,545	313	467	4,325	3.0	34.0	43.0
Pig Meat	4,907	459	622	5,988	2.2	57.0	23.0
Sheep or goat meat	8,253	457	53	8,763	4.3	63.0	54.0
Bovine meat	14,414	550	451	15,415	10.2	112.0	153.0

Source: Mekonnen, M. M., and A. Y. Hoekstra. 2010. "The green, blue and grey water footprint of farm animals and animal products", Value of Water Res. Rep. Ser. No. 48. UNESCO-IHE, Delft, the Netherlands.

<sup>1</sup>This of course varies from cereal to cereal. For example, the global water footprint of wheat is estimated around 1800 litres per Kg compared to 2500 litres for rice.

<sup>2</sup>The blue water footprint is the volume of freshwater evaporated from the surface and groundwater. The green water footprint is the volume of water evaporated from the rainwater stored in the soil and the the gray water footprint is the volume of polluted water.

A water footprint has two main components. The first is the amount of rainfall consumptive water use (CWU) per unit production; the second is the amount of irrigation CWU per unit production. CWU in the production process can be calculated using a simple equation. Nevertheless, there are measurement issues that must be considered when determining and reporting water footprints. There are issues with calculating the irrigation CWU, especially the denominator. Not all irrigation CWU contributes to production, except in completely irrigated areas. Not all rainfall CWU contributes to production, except in areas fed by rain. One must take care when reporting the CWU for both irrigation and rainfall production.

A case study of the Moga district in the Punjab, India provides an example of increasing water stress. Smallholder farmers dominate the agricultural landscape in Moga and have benefitted from a growing dairy production, but the district has also experienced rapid groundwater depletion (in some villages the groundwater tables having gone down up to 20 metres). Research on the water footprint in this agricultural system demonstrates that intensive production systems with less rice offer higher financial and hydrological benefits and utilizing crops for feed that do not demand as much water can lower the water footprint of the system. High yielding dairy cows result in lower CWU signature but entail higher maintenance costs. Importing feed from low CWU areas reduces the overall water footprint.

Moga is just one illustrative example, however and should not be considered representative of even India, let alone Asia. Overall, the understanding about water footprint of milk production in the region is rather poor and many more location specific and production system specific studies are needed in order to understand how best to reduce the water footprint in dairy systems in Asia.

# Feed resource assessment and use in asian countries: Lessons learnt, knowledge gaps and the way forward

## Ghulam Habib

Agricultural University  
Peshawar, Pakistan

## Harinder P.S. Makkar

Animal Production and Health Division  
Rome, Italy

## Joachim Otte

FAO RAP  
Bangkok, Thailand

Since 1961, the numbers of cattle/buffalo, sheep/goats and pigs in Asia have been growing steadily and Asia currently counts 2.4 billion head of these livestock, of which 1.8 billion (75 percent) are ruminants (1.1 billion sheep and goats, 0.7 billion cattle and buffalo). In 2012, 42 percent of global meat output was produced in Asia, up from 21 percent of global output in 1980, while in the same year Asia accounted for 37 percent of all milk production worldwide, up from 15 percent in 1980. Asia's livestock production growth has thus outpaced that of the rest of the world.

Feed is a key element in livestock production, often representing up to 70 percent of total production cost. Feed is commonly the main driver of livestock production systems and can determine the financial viability of the livestock enterprise. Feed production and use impacts animal health and welfare, reproductive efficiency, land use and land use change, water use, the environment, and product quality and safety, among others. Given the importance of feed for animal production, accurate assessments of current and future supply and demand of livestock feed are needed for national food security policy formulation and planning of the livestock sector, as well as for determining environmentally sustainable stocking rates.

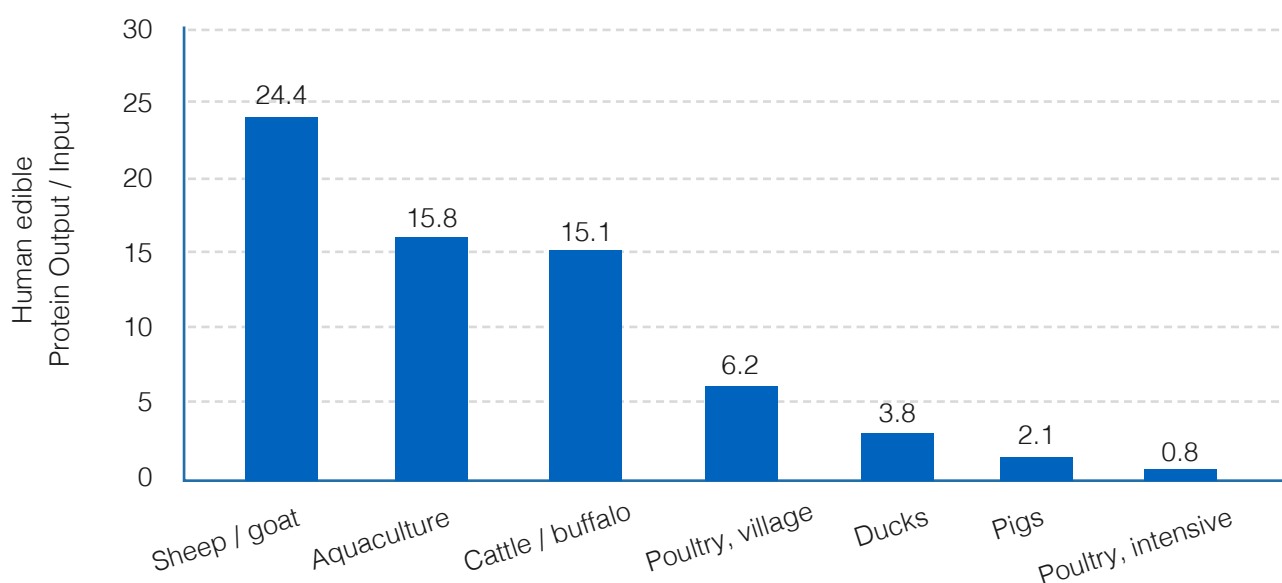
A national feed assessment is a quantitative analysis of the supply and demand for livestock feeds in a country. This quantitative assessment is part of a larger assessment system consisting of the procedures, facilities, tools, personnel, organizations, and institutions that are involved in the collection, handling, and processing of the data necessary to calculate and report the supplies of livestock feeds from all sources and for all livestock types in a country. National feed assessments provide information on feed resource availabilities that enables formulation of sound policy decisions regarding the use of national feed resources.

National feed assessments are the basis for: estimating nutrient balances, identifying potential surpluses or deficits; making better use of available feeds; facilitating evidence-based decision-making on local and external trade of feed commodities; spatial and temporal assessments of current and forecasted feed resources; generating an optimum livestock-feed relationship; designing feed regulatory policy; obtaining accurate feed versus food data; identifying feed and food safety issues; and balancing trade-offs in biomass use.



**FIGURE 1**

Human-edible protein output : human-edible protein input ratio of different livestock production systems in Asia (based on 6 countries studied so far)



Very few countries have sound information on how much feed is used and wasted in livestock production chains. In 2013, FAO provided guidelines for the preparation of feed assessments and a number of countries initiated the preparation of national feed assessments. In August 2013, an FAO-APHCA regional workshop on “Animal feed resources and their management in the Asia-Pacific region” was held in Bangkok, in which the country representatives presented preliminary results. Since then, a number of national feed assessment reports have been finalized (Bangladesh, Bhutan, India, Indonesia, Pakistan and Thailand) while several others are still under preparation (Nepal, Malaysia, Mongolia and Sri Lanka). The following are some of the highlights that emerge from a comparative analysis of the completed national feed assessment reports:

- ▶ Livestock production systems are diverse across countries and are driven by local feed resource supply. Mixed crop-livestock systems are important in Asia and are expected to play an important role in meeting the demands of animal products in Asia in the near future.
- ▶ There is a huge diversity in national feed supply among countries. Bangladesh, India and Pakistan, for example, source about 60 percent of ruminant feed from crop residues. In Thailand, roughly 50 percent of ruminant feed is from grain and oilseed by-products, while in Mongolia 90 percent of the feed is provided by pasture land.
- ▶ Based on the feed ingredients used, there is a huge

variation in the feeding systems in Asian countries. Within production systems, feeding systems give information on how different feed ingredients are used in different regions or within a region in a country at different times of the year.

- ▶ Feed deficit in terms of dry matter, crude protein and metabolizable energy is a common feature in Asian countries, and most countries in Asia import more feed ingredients than they export.
- ▶ Grain use in ruminant production systems is very small. Forage, grazing and crop residues are their main feed resource.
- ▶ Competition for feed grains will increase in the future due to expanding commercial dairy, feedlot and poultry farming.
- ▶ Most feed grains are used in intensive poultry systems and maize is the main feed grain. In some countries, e.g. Pakistan and Thailand, >70 percent of maize produced is used as feed. Several countries import maize to meet their demand for feed and food.
- ▶ Overall, grain wastage exceeds the quantity used as feed in the six Asian countries investigated so far.
- ▶ The human-edible protein output : human-edible protein input ratio is highest for sheep and goats and lowest for intensive poultry (Figure 1).



In Asia, the rising demand for animal derived food sources is producing a shift in the livestock sector from subsistence to a market-oriented with higher input needs. The drivers that are changing the feed production and feed use landscape are: land for fodder and grain production is becoming scarcer; land fragmentation is reducing overall crop productivity; feed-food-fuel competition is increasing; water availability for feed and fodder production is decreasing; and climate change is impacting several segments of the agriculture sector. These drivers call for revisiting, regular monitoring and revising of the policy, technological and institutional support options. Also there is a need to consider alternative sources of feed and to develop innovative technologies to enlarge the feed resource base and explore novel and new feed resources. Enhanced use of forages and agro-industrial by-products in animal diets would enhance economic, social and environment sustainability of livestock production systems in Asia. Livestock numbers and species as well as breed mix should be adjusted in relationship to native feed supply. More emphasis should be placed on increasing the contribution of ruminant source food products in the animal derived food basket since ruminants can be raised on feed ingredients that do not compete with human food.

National feed assessments need to be improved by better data collection systems. Equally important is the proper management of the data generated on feed

assessments, feeding systems, chemical composition and nutritional value of feed ingredients, export and import of feed ingredients and price variations. In all Asian countries considerable knowledge gaps exists on these feed and feeding related aspects. To this end, the Asia-Pacific Animal Feed Network established recently under the auspices of FAO-APHCA will help to achieve these objectives.



# Compound feed and dairy sector growth: A feed industry perspective

**Johan van den Ban**

De Heus

Viet Nam

At present, the dairy sector in Viet Nam is small, but it is growing. In 2000 there were 35,000 dairy cattle. The number grew to 186,000 in 2013 and is expected to touch 500,000 mark by 2020. Consequently, the total amount of milk produced in Viet Nam has also increased—from a little over 50,000 tons in 2000 to more than 450,000 tons in 2013. Dairy production areas have been established in both the northern and southern regions of the country. In the northern region, Moc Chau dairy company has 12,800 cows, TH True Milk has 31,000 cows, and Vinamilk has 2,000 cows. In the southern region, Ho Chi Minh (HCM) city and the Mekong Delta have a combined total of 110,000 cows. Even though large farms have been established, especially in the northern part of Viet Nam, the majority of dairy farms are small with less than 20 cows. In Viet Nam, the main dairy animals are pure Holstein Friesian (HF), which are not well adapted to the climate and must be managed carefully.

There are many opportunities for entrepreneurs to enter the dairy market in Viet Nam as there is a large market for milk and milk products. Incomes in Viet Nam have increased steadily over the past decade, leading to an increasing demand for milk and milk products, particularly in urban areas. Milk produced locally meets only 18 percent of the total demand and most milk and milk products are imported. In 2013, the value of imported dairy products stood at US\$1.03 billion. The Government of Viet Nam is supporting the development of a dairy industry by issuing favourable policies for dairy investors on land use, improving loan access and providing equipment support, among others.

The country has good infrastructure in place for milk processing. Milk production companies have invested in several processing plants, and milk collection systems are well established. In the northern region, Vinamilk, International Dairy Products (IDP) and Friesland Campina

Vietnam all have milk collection points while about 100 cooling tanks have been installed in and around Ho Chi Minh City.

There are difficulties and challenges that stand in the way of a sustainable dairy industry in Viet Nam. For example, the land area for both grazing and the production of forage for silage is very limited. Land for grass production is only sufficient to produce 30 percent of the total demand for quality grass (the main grass varieties are elephant grass, guinea grass and mulato grass). The cost of importing pure HF is high. There is a lack of suitable quality breeding stock and no regulations on the quality of that stock. Financial support to the industry is inadequate. Farmers are not skilled in the management and feeding of dairy animals and extension services are poor while the hot and humid climate presents unfavourable conditions for high yield dairy cows.

An increase in support to smallholder dairy farmers is necessary in order to make their farms more efficient and competitive. The dairy sector in Viet Nam is in a transition phase, which is seeing farmers switch from raising pigs to raising dairy cattle. This is creating a big challenge, especially in terms of feed, which is already in short supply. A major challenge is in finding ways to help smallholder dairy farmers reduce their production costs while simultaneously increasing the value of their end products.

In order to overcome the difficulties and challenges faced by the dairy sector, the Dairy4Growth project was initiated under a public private partnership. The project, which is set to operate from 2014 to 2019, is a multi-disciplinary project that involves FrieslandCampina Vietnam, De Heus, Fresh Studios, Wageningen University and The Friesian. The project currently operates in three dairy zones and includes 150 farms (average 80 cows per farm). Through research and open dialogue, the

project is attempting to: examine the socio-economic impact of dairy farming; increase the allocation of land to corn/grass rather than rice production; increase investments in infrastructure; improve access to finance; establish an innovative feed supply system and improve knowledge on nutrition and animal husbandry. The project is also involved in hands-on training and has established two demonstration farms and one research and development facility in each primary production zone.

# Modelling feed demand to monitor sustainability

**Bernhard Dalheimer**

Statistics Officer  
FAO-ESS  
Rome, Italy

The demand for animal feed can only be estimated with a sufficiently high degree of accuracy if the right methodology is utilized to gather, process and analyse the available data. Quantitative models to estimate feed demand involve numerous variables, such as energy demand, protein demand, herd composition and number of animals, among others.

FAO is working on the improvement of its model to estimate feed demand to enhance the accuracy of the estimates, capture the dynamics of the livestock sector and to broaden its scope to the estimation of 'raw material' use for other purposes. The elements of the

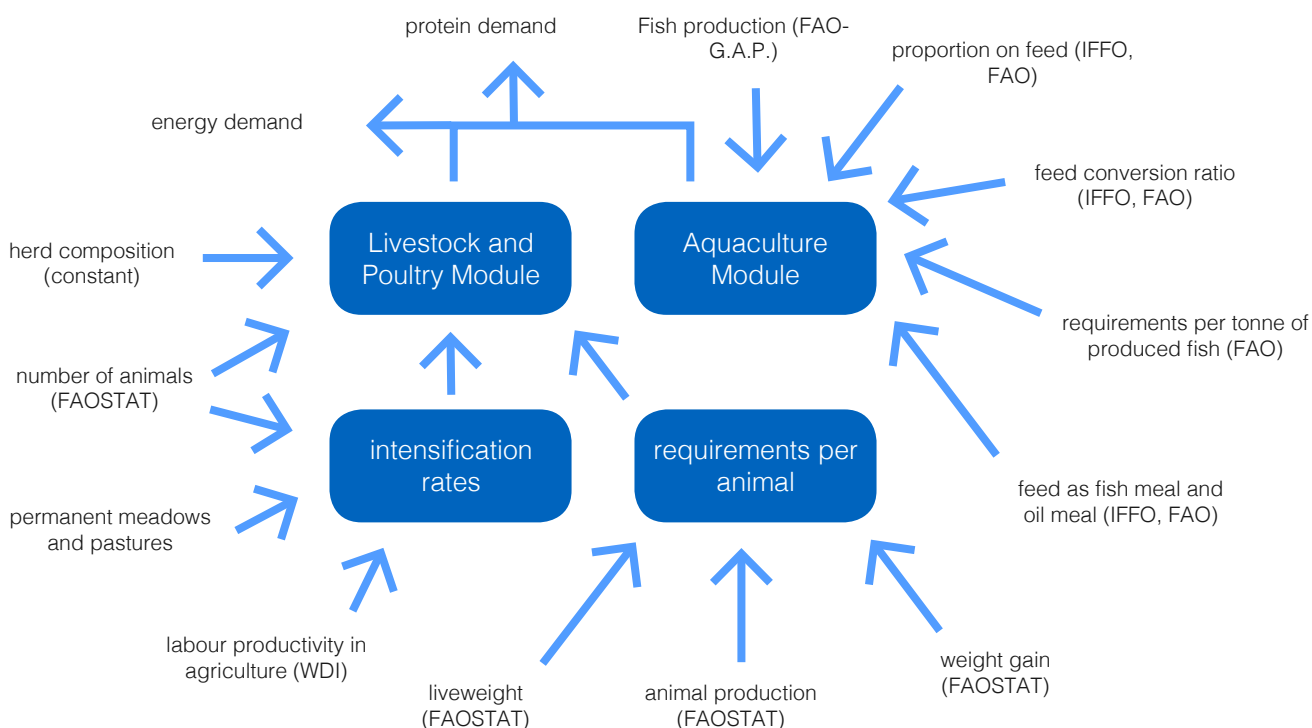
model are presented in Figure 1.

The model was used to estimate feed demand in high, middle, and low-income countries worldwide based on time series data of 225 countries from 1990 to 2011 (4728 data points). Results showed that energy and protein demand followed similar trajectories in all country groups, with the largest increase in energy/protein demand recorded in the upper-middle income country group.

Model results of feed demand (energy and protein) were validated through comparison with aggregated

**FIGURE 1**

Elements of FAO's model to estimate feed demand

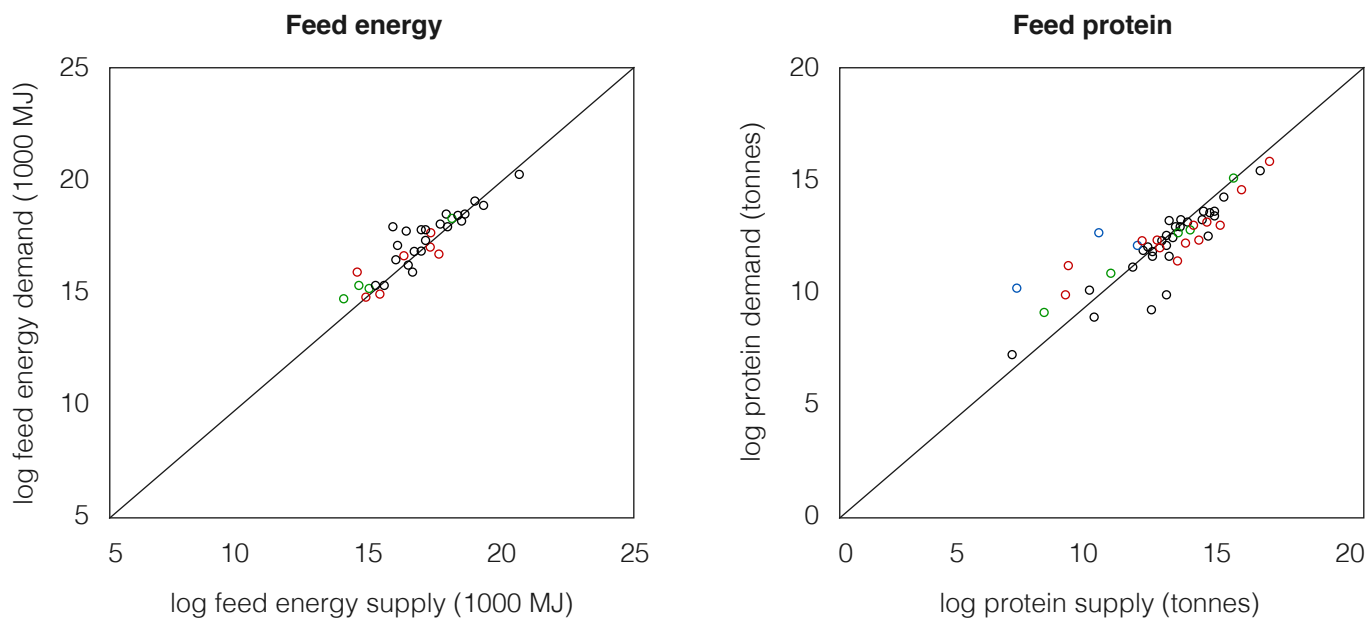


feed supply data as recorded in FAOSAT, and through a check with AMIS<sup>3</sup> country studies. The correlation coefficients were 0.92 and 0.87 for energy and protein respectively (Figure 2).

Comparisons of model output with data obtained

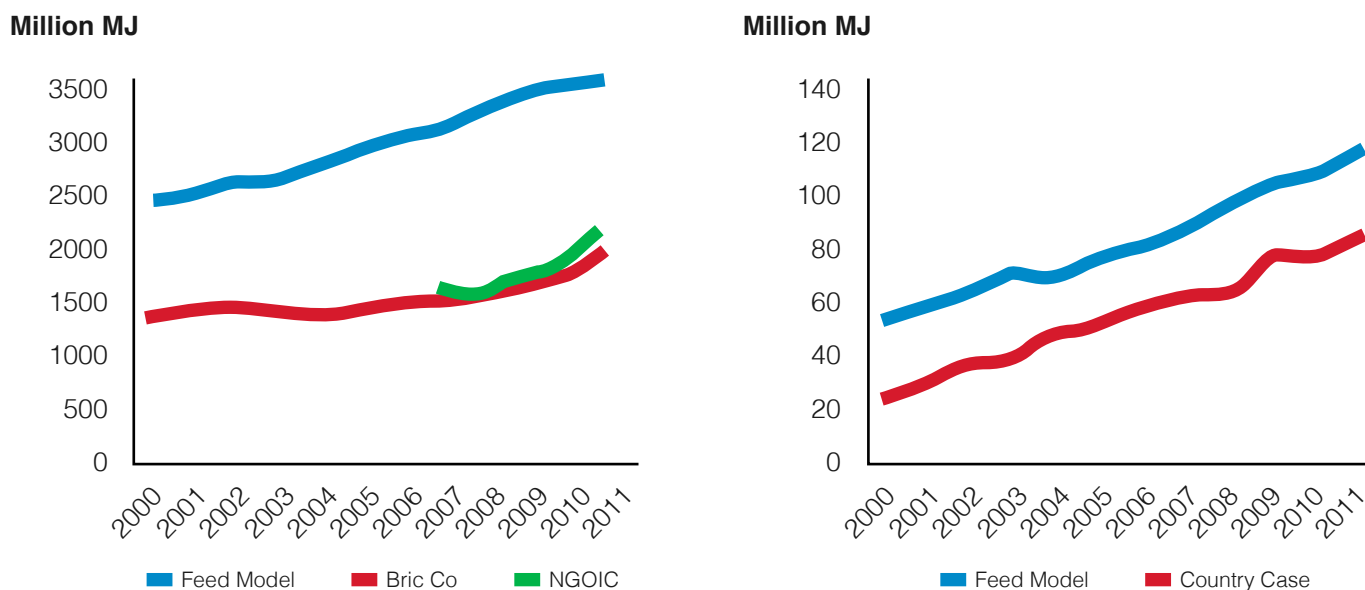
**FIGURE 2**

Correlation between estimated feed demand and feed supply as recorded in FAOSTAT



**FIGURE 3**

Comparison of feed demand predicted by FAO model and estimated feed consumption of AMIS key commodities



<sup>3</sup> AMIS is a G20 initiative to increase food market transparency and reduce the probability of food price volatility. AMIS focuses on a set of strategic variables (production, utilization, stocks and trade) that are associated with the production, distribution and consumption of wheat, maize, rice and soybeans. Participants that contribute to AMIS include all G20 members plus Spain and seven invited countries.

In light of these results, FAO will work to further improve its model for estimating feed demand. Future work will entail compilation, scrutiny and validation of all relevant data, parameters and coefficients; exploitation of further data sources and securing arrangements for regular exchange of data with data suppliers; adjustment of the model to improve accuracy and meet the demands of a dynamic and evolving situation; initiation of further country studies (especially where no studies have been done); and creation of cereal balance sheets with improved estimates of livestock feed use.

# Feed resource assessment in grasslands using satellite imaging

## Chandrashekhar Biradar

Head, Geoinformatics International Centre for Agricultural Research in Dry Areas (ICARDA)  
Amman, Jordan

An important implication of the rapid expansion of livestock populations in Asia is the need for improved assessment tools that can inform strategic planners on how best to utilize increasingly scarce resources such as feed and water. Satellite imaging is a powerful assessment tool that can assess and track grasslands and other resources that are necessary inputs to sustainable livestock production systems.

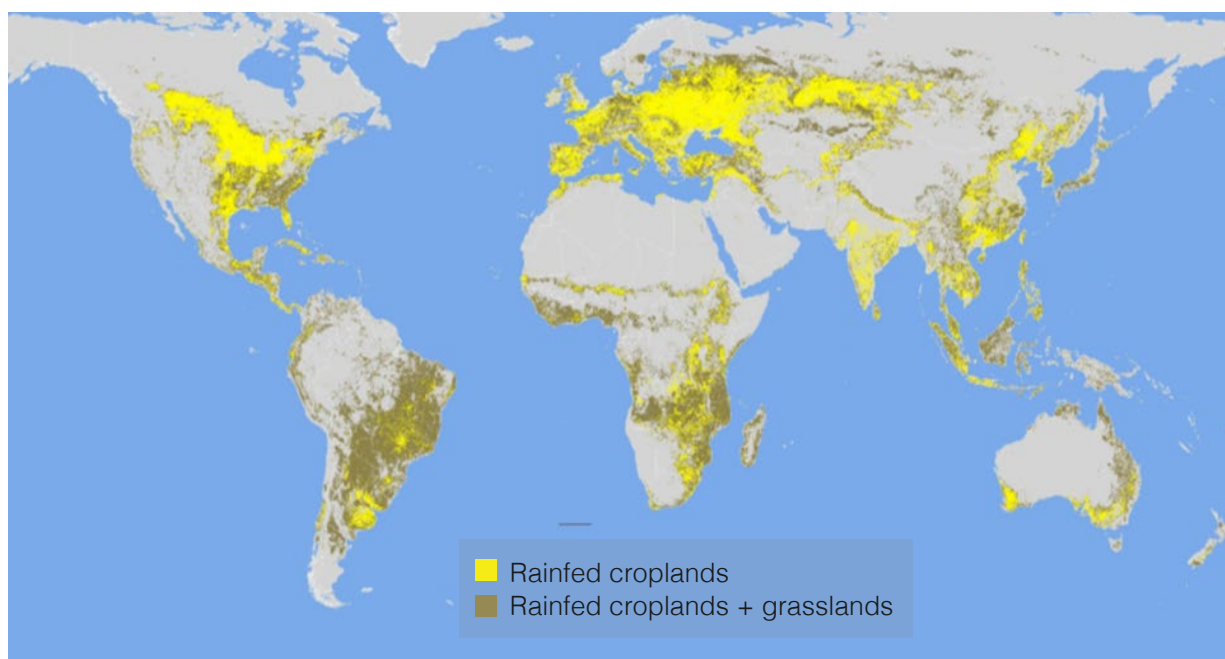
Under the umbrella of the Consultative Group on International Agricultural Research (CGIAR), ICARDA is a global agricultural research centre that works in the world's dry areas. ICARDA's research program aims to assist countries to sustainably raise the productivity of agricultural systems, improve the incomes of smallholder farmers, and strengthen nutrition and food security. ICARDA collaborates in many of the CGIAR research

programs, which are far reaching and include: gene banks; climate change; water/land and ecosystems; forest/trees and agro forestry; livestock and fish; dry land and cereals/systems; policies, institutions and markets; and wheat/grain legumes.

Geoinformatics is the science that deals with the structure and character of spatial information, its capture, its classification and qualification, its storage, processing, portrayal and dissemination, including the infrastructure necessary to secure optimal use of this information. Geoinformatics has seen numerous advances in recent years, including increased spatial/spectral/temporal resolution, increased computational speed, and improved image processing techniques, while the cost of hardware, and software and datasets has considerably decreased.

## FIGURE 1

Global distribution of rain fed agriculture (Source: Biradar et al., 2009)



The applications of geoinformatics are virtually unlimited and are used by ICARDA to support decisions regarding biodiversity and crop improvement, land and water resource management, to assess crop and livestock production and changes over time, and to inform policy and market development.

Production systems, including livestock feedstock, can be mapped with precision using satellite imagery, illustrating varieties and landraces, crops and forage, farmlands and grasslands and agro-ecosystems, among others. Satellite imaging of irrigated/surface water and croplands/vegetation worldwide have been undertaken and Figure 1 illustrates the global distribution of rain fed production systems.

Landscape change over time can also be mapped using satellite imagery. Earth observation systems for agro-ecosystem research, MODIS, VIIRS, MERIS, Landsat, Resourcesat, RapidEye, SPOT, Pleiades, WorldView, GeoEye, etc. , are capable of coarse to very high resolution. The versatile nature of the satellite sensor

with interoperable bandwidth can be scaled up or down depending on need. In terms of grassland monitoring, an integrated observation system can be created, which incorporates, weather stations, and space and air borne remote sensors, among others. Figure 2 depicts results of grassland monitoring of the Tibetan plateau from 2003 to 2008.

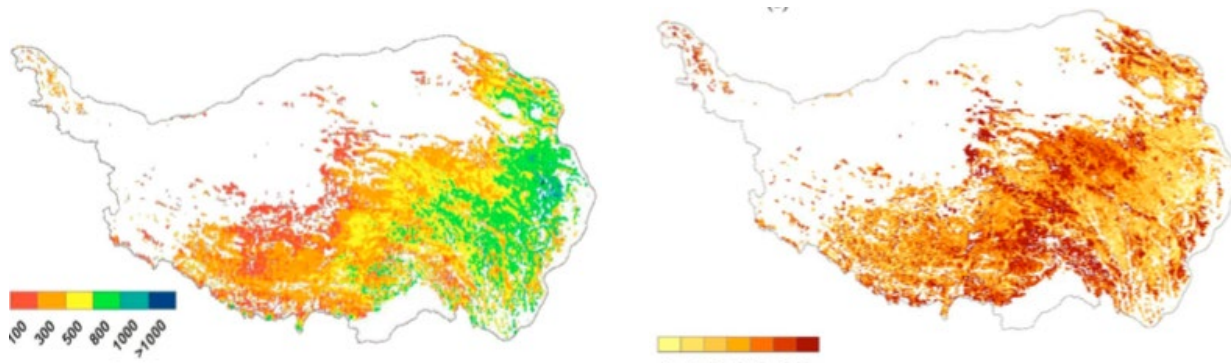
Unused potential in existing agricultural production systems can also be deduced using satellite imagery. For example, studies show that there are 15 million ha of rice-fallow land in South Asia alone, that could be put to other use.

Finally, an example of increased land use for food and forage production over time, as documented by satellite images, is illustrated in Figure 3.

With the rapid advances in information technology, geoinformatics has become an important tool for sustainable intensification of agriculture, reducing vulnerability, measuring impacts and systems innovation.

**FIGURE 2**

Spatial pattern of annual gross primary productivity (g C m<sup>-2</sup> yr<sup>-1</sup>) (left) and inter-annual variation (from <7% to >25%) of the grasslands of the Tibetan Plateau between 2003 and 2008 (Source: He et al., 2014).



**FIGURE 3**

Changing land use of the Wadi As-Sirhan basin, Saudi Arabia (from left to right: 1987, 1991, 2000, and 2012; source: NASA)



# Restoration of grasslands in Central Asia: IFAD's experience in Kyrgyzstan

## Asyl Undeland

Consultant  
International Fund for Agriculture Development  
Rome, Italy

The Kyrgyz Republic is a small landlocked mountainous country located in northeast Central Asia. Kyrgyzstan's territory is about 198 500 square kilometres, 90 percent of which is in the mountain ranges of Tian Shan and Pamir Alai, while the remaining 10 percent are valleys and lowlands. It's located at the high altitude from 500 to 7 439 meters above the sea level. More than half of Kyrgyzstan lies at an elevation higher than 2500 m (8200 ft.), and only about one-eighth of the country lies lower than 1 500 m (4 900 ft.). Mountain ranges are cut by gorges and small fast rivers. Pastures account for 86 percent of the agricultural land and cover a total area of 9.2 million ha, including winter pastures (2.1 million ha), summer pastures (4.1 million ha) and spring/autumn pastures (3.0 million ha).

The nomadic land use system has been an integral part of Kyrgyzstan's economy for centuries. Grassland ecosystems and pastoral livestock systems co-adapted and co-evolved to increase land use efficiency and sustainability. The range of diverse, vertical climatic and geographical zones determined the way livestock were grazed. In some cases tribes used to move to summer pastures to the neighbouring valleys and in this case routes were laid through rivers and passes and were used by the same tribes every year. In other cases, fertile pastures lying along a river basin were used throughout the year. In general, the annual cycle of tribal movement was repeated in the same direction and to the same lands which were informally considered owned by a specific clan or tribe.

Settled in winter time in valleys along the rivers, tribes usually started to move in May first to lands at the mountain hills and with temperature rising and grass burning under the sun, they moved up to the most remote pastures within June-July months. In July-September they stayed at the summer pastures. In September-October depending on the geographic location and

climate they used to start moving down to the valleys where they spent winters. Return down to the valleys usually started after cereals (barley) were harvested and collected from the fields. All pastures had their own natural boundaries and names which differentiated them from one another.

The pattern of movement was determined by geographic and climatic conditions in specific areas. In some areas the annual movements were repetitive up from lowland valleys in early spring to higher pasture for spring and then in June-July to highland summer pastures. In fall they moved down through the same pasture areas to the same winter location (see Figure 1, left). Some tribes used to change direction of their movement to the summer pasture every year with cycles of 3 to 5 years coming back to the same location in winter time every 3<sup>rd</sup> or 5<sup>th</sup> year and moving around on close distances (see Figure 1).

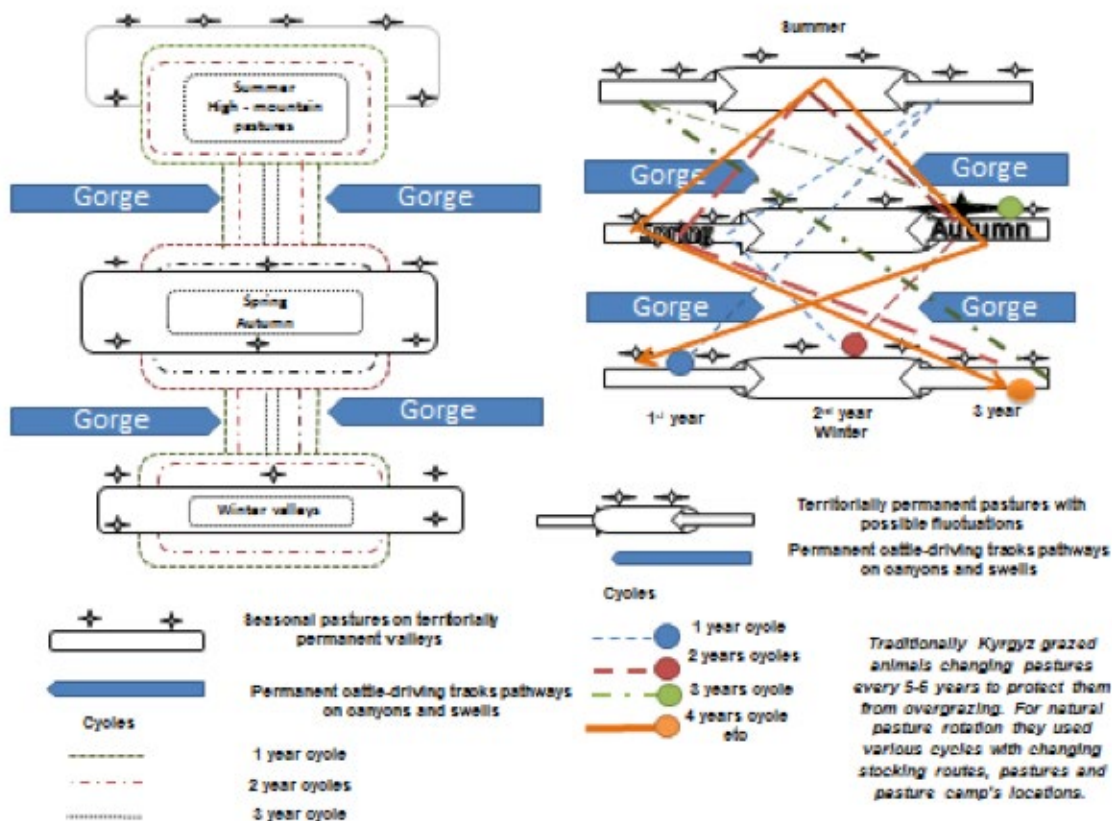
Some high mountainous summer pastures could be used a year round, because of winds blowing off snow from the mountain flanks or sun melting it down fast. Thus, some parts of tribes or some tribes stayed in the same summer pasture areas setting out camps in warmer gorges in winter and moving to higher and more open spots in the same area during summer. For example, *Aksai* pasture with area of 480 000 ha has winter and summer pastures located close to each other. These pastures and now are used for year round grazing of sheep.

Often only better off families could afford to move far from the winter settlements passing difficult gorges and passes. Movement from one pasture to another could take up to 4 days. Those families which only had small numbers of sheep and horses used foothills not far from their winter settlements for summer grazing if climate conditions were favourable. Some families or members



**FIGURE 1**

Diagrammatic representation of traditional nomadic movements in Kyrgyzstan



of families involved in cattle breeding and land cultivation also stayed behind larger groups using close by pasture lands for grazing dairy cows and sheep.

During the Soviet period, the State took ownership of grasslands and livestock. The Kyrgyz were forced to part with their decentralized nomadic form of life and join collective production units (*kolkhozes*, or collective farms, or *sovkhozes*, or state farms) controlled by the state. Allocation of pastures for grazing was determined by the authorities which also provided subsidized winter feed from outside. Mobility was restricted, and the nomadic way of life was curtailed. Grazing was managed by specialized labour (shepherds) and valuable knowledge on traditional pastoralism was lost. State emphasis on intensive beef cattle production based on home grown fodder and concentrate imported from other Soviet Republics altered the traditional herd composition. In 1991, Kyrgyzstan became independent. Soviet-style collective farms collapsed, land was privatized and livestock were distributed as “property shares.” In the absence of State subsidies, fodder became in short supply, livestock owners shifted back to grazing and the number of livestock, especially cattle, drastically declined. Fragmented management of pasture lands

by various state institutions led to rapid degradation (>70 percent of pastures near villages, >50 percent of summer pastures were degraded), productivity decline and loss of biodiversity while limited access to natural pastures resulted in conflict between various social units. Elites took advantage of the situation and captured large land areas. The rights of the displaced poor and most vulnerable were not protected through legislation or practice.

Smallholder farmers own more than 80 percent of all livestock, with an average of 2-4 cows, and 5-10 sheep per household. Most feed is provided by grasslands and livestock are mainly kept as livelihood coping strategy and cultural asset. With regard to dairy production, milk productivity is low (about 1 000-2 000 kg per dairy cow per year), dairy value chains are not developed, and net income from the dairy enterprise is often negative due to high feed cost.

The International Fund for Agricultural Development (IFAD) began interventions in Kyrgyzstan in 1996, with the aim of restoring degraded pastures and improving pastoral livelihoods. IFAD’s Livestock and Market Development Project (LMDP), which began in 2013

and is set to end in 2019, attempts to increase livestock productivity and enhance climate resilience of pasture communities in order to foster improve and equitable returns to livestock farmers. The main directions of the LMDP, to which IFAD contributes US\$57.8 million, are: (i) community-based pasture management and vulnerability reduction, (ii) improved access to livestock health and production services, and (iii) diversification and dairy value chain development.

LMDP is working with smallholder livestock farmers and addressing efficiency concerns by establishing self-help groups of like-minded farmers, or Pasture User's Unions (PUUs). Four hundred forty five PUUs have been established around the country. An important function of the PUUs is that they facilitate the traditional pattern of vertical mobility and grassland sustainability and thereby reduce vulnerability. PUUs receive a per animal fee for use of the pasture under their 'jurisdiction' which is used for pasture improvement. Through advocacy support on policy and legislation, LMDP has created a favourable environment for community-based pasture management. As a result of the "New Pasture Law," pastures now are now seen as one ecosystem and management is decentralized to the village government level and PUUs. Leases, which once fragmented land areas for use, are prohibited; land use is now based on "annual

use right tickets." These pasture reforms are promoting the sustainable use of ecosystems through traditional principles of grazing with vertical mobility. In addition, more pastoralists are able to use remote pastures. The system is more inclusive with fair access to pasture resources for all, resulting in fewer conflicts over scarce resources.

LMDP is also involved in technical interventions and the establishment of winter feed programs. It has provided support to private veterinarians and established and links between veterinarians and PUUs, leading to higher vaccination coverage and a reduction in diseased animals. LMDP is also attempting to link animal health with human health at the village level through the establishment of village health committees that work directly with PUUs.

At least partly due to IFAD's longstanding involvement in Kyrgyzstan, rural poverty has been reduced and livelihoods have improved along with living standards. Improvements to natural resource management have taken place, including land (grassland/rangeland) and water management. Target populations have witnessed better access to financial services and ownership rights to property have been formalized and strengthened. In 2013, IFAD launched a similar project in neighbouring Tajikistan.



# Milk and dairy products in human nutrition

Prepared by

**Ellen Muellhoff**

Senior Officer/Group Leader

Nutrition Education and Consumer Awareness Group  
FAO, Rome

Presented by

**Nomindelger Bayasgalanbat**

Nutrition Officer

FAO Regional Office for Asia and the Pacific  
Bangkok

Significant progress has been made in reducing undernourishment in the world during the last 20 years. Despite that progress, however, 842 million people are undernourished, and an estimated 2 billion are deficient in essential vitamins and minerals. The vast majority of these live in developing countries. The estimates also show that globally 162 million children under five years of age, or 25 percent of all children, were stunted (low height-for-age) in 2012. Despite improvements, high prevalence of stunting remains a major problem, especially in Africa and Asia where 92 percent of the world's stunted children reside. On the opposite end of the spectrum, obesity is a growing problem in the world.

FAO envisions a world free of hunger and malnutrition where food and agriculture contributes to improving the diets and living standards of all, especially the poorest and most vulnerable, in an economically, socially and environmentally sustainable way.

Globally, billions of people consume milk and dairy products every day. Consumers, industry and governments need up-to-date information on how milk contributes to human nutrition. In pursuing its mission of eradicating hunger and improving food security and nutrition for all, FAO has published a unique publication, "Milk and Dairy Products in Human Nutrition." The book evaluates current scientific knowledge on the subject from a global perspective and provides key options for governments, the private sector and others. The book asks and answers several questions.

*What key nutrients does milk provide?* Milk is an important source of dietary energy, high-quality protein and fat. It can make a significant contribution to meeting the required nutrient intakes of calcium, magnesium, selenium, riboflavin, vitamin B12 and pantothenic acid. Milk from some animal species can also be a source of

zinc and vitamins A, C, D and B6 which are associated with increased linear growth. Bioavailability of some nutrients in milk, for example calcium, is high compared with that in other foods in the diet. Studies show that, in Africa and Asia, it provides 3 per cent of the total dietary energy supply, essential macronutrients, 6 to 7 per cent of the dietary protein supply, 6 to 8 per cent of the dietary fat supply, and several essential micronutrients.

*What is the role of milk in addressing malnutrition?* The critical window for adequate child growth and cognitive development is between conception and 24 months of age and hence many recent international nutrition initiatives focus on the first 1000 days. Milk can supply components that are particularly important for supporting child growth, including protein, minerals and lactose. Dietary fat from milk is especially important in the diets of infants and young children with a very low fat intake, where the availability of other animal-source foods is limited. Skimmed milk is not recommended as a major food source during the first two years of life because it does not contain essential fatty acids and lacks fat-soluble vitamins.

*What are health risks that are associated with milk?* Although, about 60% of milk fat consists of saturated fatty acids which can increase LDL cholesterol, other components, like calcium, are associated with a reduced risk for coronary heart disease and some types of cancer. The majority of studies conclude that the consumption of low fat dairy products is generally not associated with cardiovascular disease and can even contribute to a risk reduction, while evidence on full fat milk and dairy has been inconclusive. Milk is a major contributor of ruminant trans fatty acid in the diet, but the evidence regarding this type of fat and cardiovascular disease risk is also inconclusive.

Cow milk does not contain sufficient iron and folate to meet the requirements of infants <1 year and presents high renal solute load to infants compared to breast milk. Consumption of fresh, untreated milk during this age period has been associated with loss of blood through faeces and lower iron status. According to WHO guidelines, no undiluted cow milk should be given to infants younger than 12 months unless accompanied by iron supplementation. Cheese and yoghurt may be given after six months.



#### *What is lactose intolerance?*

Lactose is the main carbohydrate in milk. Lactase is an enzyme in the body that is needed to digest lactose. Lactose malabsorption (or maldigestion) is caused by low lactase levels in the body, but does not necessarily cause symptoms. Lactose intolerance is the condition that occurs when lactose malabsorption gives rise to symptoms, such as diarrhoea, nausea, bloating and flatulence.

*What are dairy-value-added products?* Technological developments have increased the variety of dairy products available to consumers. Fermented dairy products can be better tolerated by lactose intolerant people. Specific bacteria present in fermented products have been associated with immune enhancing and cholesterol lowering properties. Milk products can be fortified with additional vitamins, minerals or essential fatty acids, according to specific needs (e.g. fortification with vitamin D to address rickets).

#### *Is there a recommendation for milk/dairy consumption?*

There are no global recommendations. In developed countries, consumption of lower fat options of dairy and milk is recommended. In terms of food-based dietary guidelines, recommendations vary across countries from 1 to 3 servings per day.

*What are the main aspects of food safety?* The safety of milk and dairy products must be ensured to protect consumers, particularly vulnerable consumers such as children for whom milk can be a beneficial dietary component, and to support the livelihoods of dairy farmers and processors. Raw or poorly processed and/or

handled milk and milk products can lead to food-borne illness in humans.

The quality of milk can be affected by microorganism contamination, chemical additives, environmental pollution and nutrient degradation. Milk is very rich in nutrients and provides an ideal growth environment for bacteria and other microbes. These can be introduced into the milk from the environment or from the dairy animals themselves. Chemical hazards can be unintentionally introduced into milk and milk products, making them unsafe and unsuitable for consumption. Milk can also be contaminated when the milking animals consume feed and/or water that contain chemicals. Other causes of contamination may be inadequate control of equipment, the environment and milk storage facilities. Pasteurization or equivalent processing of milk and milk products and the implementation of validated food-safety programmes have been proved to ensure safe milk and dairy products.

A great deal is known about the sources of hazards that can compromise the safety of milk and dairy products and the necessary controls and preventive measures to ensure product safety. The risk-reduction measures required vary with the hazard and product characteristics so that while it may not always be necessary to eliminate the hazard completely, its presence must be minimized to provide an acceptable level of consumer protection. Raw milk or raw-milk products should be individually assessed for their potential risk to public health and appropriate risk-management strategies implemented.



*What are some of the challenges and emerging issues concerning milk production?* Population growth, income growth and urbanization have led to an increase in the production and consumption of animal products. Expanded livestock production has increased the demand for feed, putting pressure on diminishing land and water resources. Climate change is putting stress on food production systems worldwide. More intensive production systems with higher concentrations of animals are raising the risk of livestock-human disease transmission. And the marginalization of smallholder farmers, who comprise the majority of farmers on the planet, has social implications.

*How can dairy industry programs contribute to development?* In developing countries, nearly one billion people live on dairy farms, smallholdings or in landless households, keeping one or more animals. Dairy industry programs can contribute to increased household food security, better nutrition and to improved rural livelihoods through income generation and employment along the dairy value chain. As market demand accelerates in the wake of rising incomes, more opportunities for the dairy industry will surface, especially in emerging African and Asian economies.

*How can links between dairy development and nutrition be enhanced?* A multi-sectoral, coordinated approach is needed. High level political commitment coupled with a strong, nutrition-enhancing promotional environment will increase the effectiveness of nutrition-sensitive dairy industry development. Social contribution by the dairy sector in the developing world is needed to better

campaign for healthy diets and put milk and dairy products within the reach of low-income populations. In the developed world, the private sector leads the dairy sector and is putting investment into developing countries. It has the potential to make a social contribution by using its considerable advertising ability to campaign for healthy diets and using its market reach and infrastructure to put milk and dairy products that boost nutrition within reach of low-income populations. However, the governments in the developing countries have a strong role to play by:

- ▶ Identifying national nutritional challenges, promoting measurement of nutritional status and providing dietary guidelines. If a strong national nutrition strategy exists, this provides a framework onto which to add a dairy programme.
- ▶ Providing policies, laws and regulations that support nutrition-sensitive dairy-industry development and the provision of safe milk and dairy products.
- ▶ Investing or promoting investment in basic infrastructure. Roads, electricity and water supplies limit the practical scope of a dairy programme.
- ▶ Promoting collaboration between the government agencies responsible for livestock industry development and those responsible for human health and social welfare.
- ▶ Promoting investment from both public and private sectors in sustainable and inclusive dairy-industry development programmes.

In conclusion, milk and dairy products can play a vital role in human nutrition in developing countries. Growing consumption of dairy and other livestock products is bringing important nutritional benefits to large segments of the population, although many millions are still not able to afford better-quality diets owing to the higher cost of dairy products. No single food can supply all of the essential nutrients. The human diet is complex. Balance and variety is fundamental to healthy eating. Some 842 million people continue to be chronically undernourished. It makes no sense to act as if agriculture and nutrition are separate. We must find ways to link the two, as stipulated in the “Zero Hunger Challenge,” endorsed by the Secretary General of the United Nations.

# Experience of Milk Vita in Bangladesh

## Khan Shahidul Huque

Chief Scientific Officer and Head  
Animal Production Research Division  
Bangladesh Livestock Research Institute

Smallholder dairy plays a vital role in supporting rural livelihoods and poverty alleviation in Bangladesh. The Bangladesh Milk Producers' Cooperative Union Ltd. (BMPCUL)—popularly known as Milk Vita, through its activities has been helping achieve these objectives and making visible contribution to the socio-economic conditions of farmers where it operates. The organization was established in 1973 on the initiative of the father of nation Bangobandhu Sheikh Mujibur Rahman and based on the recommendation of FAO & DANIDA. Milk Vita, functions under the Rural Development and Cooperatives Division (RDCCD) of the Govt. of the People's Republic of Bangladesh with a vision of dairy development through organizing farmer cooperative societies and supporting fair milk price.

Overtime, Milk Vita has built a network of almost 100,000 member farmers of 2,300 cooperative societies in 33 milk producing areas in different districts of the country. In the recent years, the organization has collected and marketed approximately 65,000

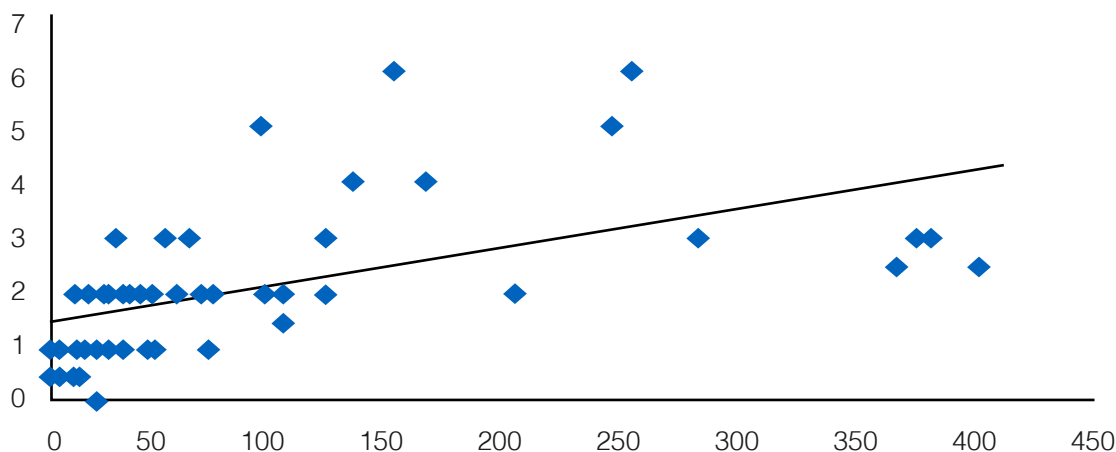
tons of liquid milk and 2,000-4,000 tons of various milk products and supported farmers with breeding, feeding, and veterinary inputs. Estimates show that average monthly net profit from dairying varied between USD78 to 300 depending on farm size. This represented a substantial contribution to household income when compared to monthly national average household expenditure of USD144.0 as derived from the Household Income and Expenditure Survey 2010 of Bangladesh. In addition, smallholder dairy made a direct contribution to household nutrition as shown in Figure 1. Consumption of milk at household level was significantly and positively related to milk production at home.

Beyond, the direct contribution to farmers' incomes, household nutrition and women empowerment, Milk Vita has been active in prompting several initiatives that contribute to social objectives and ecological sustainability. Two such initiatives are described below

**FIGURE 1**

Daily milk production and family milk consumption

kg milk/day



## Community biogas plant

As is widely known, the dung produced by dairy animals in Bangladesh is either burned as household cooking fuel or used as fertilizer in the fields. The use of dung as fuel results in high indoor particle concentrations and long term exposure to particulate matter has been associated with health deterioration. Often, however, the scale of operations in smallholder dairy systems are not sufficiently large to justify capital investment in alternative cleaner technologies.

To address this problem, Milk Vita, in partnership with in the Rural Development Academy (RDA) of Bogra has promoted community biogas plants in Baghabari milk shed area. The primary milk producers' cooperative society has been operating one of the community biogas plants with daily intake capacity of about 2000 Kg waste. It generates 80 to 130 m<sup>3</sup> gas to support supply to 40 families and daily yields of bio fertilizer of 500 to 600 Kg. The RDA procures biofertilizer at the rate of BDT 5.0/Kg dry waste. It is linked with a deep tube well of 10,000 to 15,000 litre/hour, overhead water tank of 5000 litres, and has power generation capacity of supporting 40 to 50 families. It is considered as one step service for supplying water, electricity and gas. Thus, in addition to the reduction of enteric CH<sub>4</sub> emission due to better feeding and breeding of dairy cattle, processing of their waste through a Community Bio Gas Plant helps alleviate environment pollution and contributes to health benefits for the community.

## The School Milk Pilot Programme

The Milk Vita; obliging to its social commitment and supporting the vision of A glass of Asian Milk a Day for Every Asian Child has participated in implementing school milk pilot programs in partnership with FAO and the Common Fund for Commodities (CFC). Under this program, Milk Vita has been donating pasteurized liquid milk to seven primary schools in some of their milk shed areas (covering about 2039 school children including 1037 girls). It donates 400 litres of milk daily including its cost of delivery to the schools. A similar initiative has been launched in the southern part of the country in partnership with FAO and Rabobank. The pilot has shown very encouraging results (Table 1) and Milk Vita is now looking to mobilize additional private and public resource to upscale these programs.

The school milk pilot programme is a unique example of social development. it supports child nutrition and education, and, at the same time, the development of smallholder dairy. However, a longer demonstration period is required to make visible progress and find sustainable way of milk supply. An in-built financing system from the local government or social safety net programmes of the government may be integrated with the school milk programs. This will help the development of dairy and rural community in the country.

**TABLE 1**

Impact of school milk pilot programme on child nutrition and school attendance in Bangladesh

Indicators	Schools participating in the pilot program	Control group	Statistical significance level of the difference
Average total height increase±SE, cm/6 months	2.96±1.0	1.77±0.2	p<0.000
Average total weight gain±SE, Kg/6 months	2.65±1.02	1.44±0.5	p<0.001
Attendance increase, % (before and after implementation of school milk program)	9.33	-	-
Percent increases in the rate of graduation to next level (before and after implementation of school milk program)	16.3	-	-

## Dairy production and environment pollution

There has been a passionate debate at the international level about the contribution of dairy sector on the greenhouse gas emissions. The literature has also identified region and climate specific technologies that can increase efficiency of nitrogen and energy utilization for increasing production and productivity of animals and reduce GHG emissions. Bangladesh Livestock Research Institute (BLRI) has pioneered some of these technologies in Bangladesh (in particular, impregnation of rice straw with molasses and urea). Data on live weight, daily feed intake, milk yield and fat percentage of milk from the cows of different genotypes raised in the Milk Vita area and that of similar genotypes raised in other areas were collected in the dry and wet season (Baset, 2012)<sup>4</sup>. The data were used for estimating enteric methane emission of the cows of different genotypes in different feed bases and seasons using the appropriate equation given by the IPCC (2006)<sup>5</sup>. The results show that the enteric methane emission was significantly lower in crossbred cows with good feed supply and the impact of season was found non-significant ( $p>0.05$ ). However, the emission factor per cow ( $\text{KgCH}_4/\text{year}$ ) in the good feed base or of cross genotype was significantly ( $p<0.00$ ) higher than that was raised in poor feed base or of local genotypes. These data show that Milk Vita's efforts

towards increasing productivity through better feeding and husbandry advice has also contributed towards the reduction of enteric  $\text{CH}_4$  emission per kg of milk.

## Challenges ahead

The government of Bangladesh formulated policy in 2007 for dairy development in the country, and has been supporting dairy production through the Dept. of Livestock services (DLS) and Bangladesh Livestock research Institute (BLRI) under the Ministry of Fisheries and Livestock. Milk Vita, the only public shared dairy cooperative organization of Bangladesh, has been organizing farmers into cooperatives and supporting them with inputs and milk marketing. Several private organizations have also been sharing marketing of milk and value added dairy products. In order to give further boost to the dairy industry in Bangladesh, however, the government must nurture a long term vision of dairy development at the highest political level. Development and operationalization of the strategy for realization of that vision should however be delegated to an autonomous organization with clear and authoritative mandate for setting policy priorities, institutional structures, priorities for research and extension, and appropriation of adequate financial resources.



<sup>4</sup> Baset, M. A. (2012) Milk urea nitrogen as a tool to monitor dietary protein status of dairy cows, A PhD Thesis, Dept. of Animal Sciences, Faculty of Animal Husbandry, Bangladesh Agricultural University, Mymensingh, Bangladesh.

<sup>5</sup> IPCC (Intergovernmental Panel on Climate Change, 2006). Emission from livestock and manure management



# Experience of Vinamilk in Viet Nam

## Nguyen Quoc Khanh

Executive Director  
Vinamilk JSC

Vietnam has made considerable progress in reducing rural poverty since the adoption of “Doi-Moi” in 1986. In 2013, Viet Nam’s population stood at 90 million people with a per capita GDP of US\$1,899. However, there is marked disparity between rural and urban incomes. A recent survey, for example, revealed that average income in urban areas was almost twice that in rural areas. Large differences in incomes and associated living standards between rural and urban residents are particularly evident in the highlands and northern-middle zone.

The agricultural structure in Viet Nam is highly diverse, involving an array of crops (rice, flowers, fruit, coffee, etc.) and animals (pigs, cows, chickens, fish, etc.). In 2013, Prime Minister Nguyen Tan Dung voiced his intent to accelerate the implementation of the “restructuring plan” through sustainable development, with the goal of improving the lives of smallholder farmers and reducing the income gap between the rich and poor. Unfortunately, in 2013, agricultural prices fell at a time when prices of inputs, such as fertilizers, pesticides and petroleum increased. To make matters worse the country was hit by a series of natural disasters (floods) that negatively impacted the agricultural sector. Predictably, farmers’ incomes suffered.

Currently, agriculture accounts for 19 per cent of GDP and employs roughly half the workforce. The income of farmers remains low. Rice is an important product but income from rice production is not sufficient to sustain and enhance their livelihoods. Dairy farming is taking hold in Viet Nam and has the potential to significantly improve the livelihoods of many smallholder farmers in Viet Nam.

The main breed in Vietnam is Holstein Friesian (HF), which is imported from Australia. On average, HF cows produce 25 liters of raw milk per day. The number of

dairy cows has been growing steadily. In 2001, Viet Nam had 64,703 milk cows. The number increased to over 186,000 in 2013 and is expected to cross the 500,000 mark by 2020.

Viet Nam began investing in dairy farming only in 1991, the year when Vinamilk set up its first ultra-high-temperature (UHT) production line. Vinamilk is the largest manufacturer of milk and milk products in Viet Nam. Vinamilk’s facilities and machines are imported from Sweden, Denmark, Germany, Italy, and Switzerland. Modern lines with new technology have improved product quality (e.g. the application of an aseptic package).

Milk consumption has increased over time in Vietnam, in part due to promotional programs that encourage milk to be included in the daily diet, for all ages. Promotional messages advocate drinking 2-3 glasses of milk per day (4-5 glasses per day for children). Older adults are advised to drink low-fat milk and teenagers are advised to drink full cream milk. Milk consumption in Viet Nam is projected to rise from 15 liters/person/year in 2013 to 27 litres/person/year in 2020.

In 2011, the Prime Minister issued Decision No. 641 QD-TTg, which approved a master plan to develop Vietnamese physical force and stature during the period 2011-2030. In response, a national scheme to improve the height of the Vietnamese people was initiated. Milk plays an essential role in this effort. Average height, weight and strength of Vietnamese are low compared to international averages. Average height of males is 163.7 cm (13.1 cm lower than the international average), and the average height of females is 153 cm (10.7 cm lower than international average). Over the past 35 years, the average height of Vietnamese has increased by 4 cm. However, the rate of increase is lower than neighboring countries, such as Thailand, China and Singapore.

Viet Nam has implemented a nationwide school milk program, which is a catalyst for the improvement of children's health. The program is also thought to have a positive impact on educational outcomes. The program impacts the entire dairy sector and economy. Vinamilk has been an active partner in the program, supplying milk to schools in many provinces. In Ba Ria province, the Vung Tau school milk program, which began in 2006, covers over 48,000 school children aged 3-6 years. Vinamilk supplies milk to the program.

Cooperative dairy farm programs have also been implemented in Viet Nam. In 2002, the Canadian International Development Agency invested over 20 billion VND to establish the Evergrowth Dairy Cooperative in Soc Trang province. The cooperative has geographical advantages in that it is not affected by high tides or floods, and has sufficient fresh water, grass and agricultural residues. The cooperative focuses on smallholder farmers (mostly Khmer) in the region, provides cows and technical support, and facilitates the purchase and safe storage of milk. The project has constructed a milk collection system that uses modern equipment. A similar project was launched in Soc Trang province in 2014, with an investment of 290 billion VND. The project seeks to create a situation whereby every household has an average of 5-6 cows or more. It will attempt to increase the dairy herd from 4,700 animals (current) to 17,800 animals and provide jobs to over 6,000 employees.

At present, over 80 per cent of dairy farms have a waste treatment system to reduce the environmental footprint of the sector. The milk collection price (2014) stood at 14,000 VND/kg. Dairy cows produce an average of 15 liters of milk per day. Farmers receive an income of 1.9 million VND/cow, and their lives are improving. The outlook for dairy farming in Viet Nam is positive.

# Veterinary public health risks in Asia's growing dairy sector

## Joachim Otte

Senior Animal Production and Health Officer  
FAO-RAP  
Bangkok, Thailand

Similar to all other food types, milk and milk products can cause food-borne illness. As milk is an ideal medium for the growth of bacteria and other microbes, microbial hazards are a major food safety concern in the dairy sector. However, in addition to microbial contamination, milk can also contain inanimate chemical hazards.

With respect to microbial hazards, milk can be contaminated through a variety of contamination routes: via the bloodstream in the case systemic cow diseases that lead to the excretion of the causative pathogens through milk and other body fluids (e.g., brucellosis and tuberculosis), as a consequence of udder infections, during milking with bacteria that live on the skin of cows, during and after milking with pathogens from the environment (e.g., faeces, dirt, processing equipment), or carried by vectors (insects, rodents, etc.), and through human actions (accidental/deliberate). The most common harmful microorganisms found in milk are *Brucella* (spp.), *Mycobacterium*, *Campylobacter* (spp.), *Escherichia coli* (shiga-toxin-producing), *Listeria monocytogenes*, *Salmonella* (spp.), *Staphylococcus aureus*, *Yersinia enterocolitica*, and *Cryptosporidium* (spp.). The above list is not exhaustive and many more pathogens could be added.

Chemical hazards can be introduced into the milk as a result of consumption of contaminated feed and/or water by the animals or through contamination after milking. Chemical hazards include heavy metals (lead, copper, cadmium, etc.), aflatoxins and other mycotoxins, pesticides and other agro-chemicals, drug residues (antibiotics, anti-inflammatories, etc.) and preservatives, among others.

Turning to microbial agents that can be found in milk and their impact on health, several stand out, among

them *Brucella* (spp.). Infected animals excrete the microbe through milk, urine and genital fluids. Symptoms of infection in humans include undulating fever, arthralgia, arthritis, orchitis and endocarditis. The illness is severe and not self-limiting. Bovine brucellosis is endemic in Bangladesh, China, India, Iran, Indonesia, Malaysia, Mongolia, Myanmar, Nepal and Pakistan (sero-prev.  $\geq 5\%$ ), sporadic in Bhutan, Cambodia, Lao PDR, the Republic of Korea, Thailand



and Viet Nam (sero-prev. < 1%), and absent in Australia, Japan and New Zealand. The number of cases of brucellosis in humans per 100 000/year varies significantly by country. The two Asian countries with the highest brucellosis burdens in humans are Iran and Mongolia, both with 15 cases / 100 000 per year (it should be noted that brucellosis in small ruminants contributes to the brucellosis risk in these countries.) A study from Pakistan found that, in addition to drinking unboiled milk, handling cows was a major risk factor of contracting brucellosis.

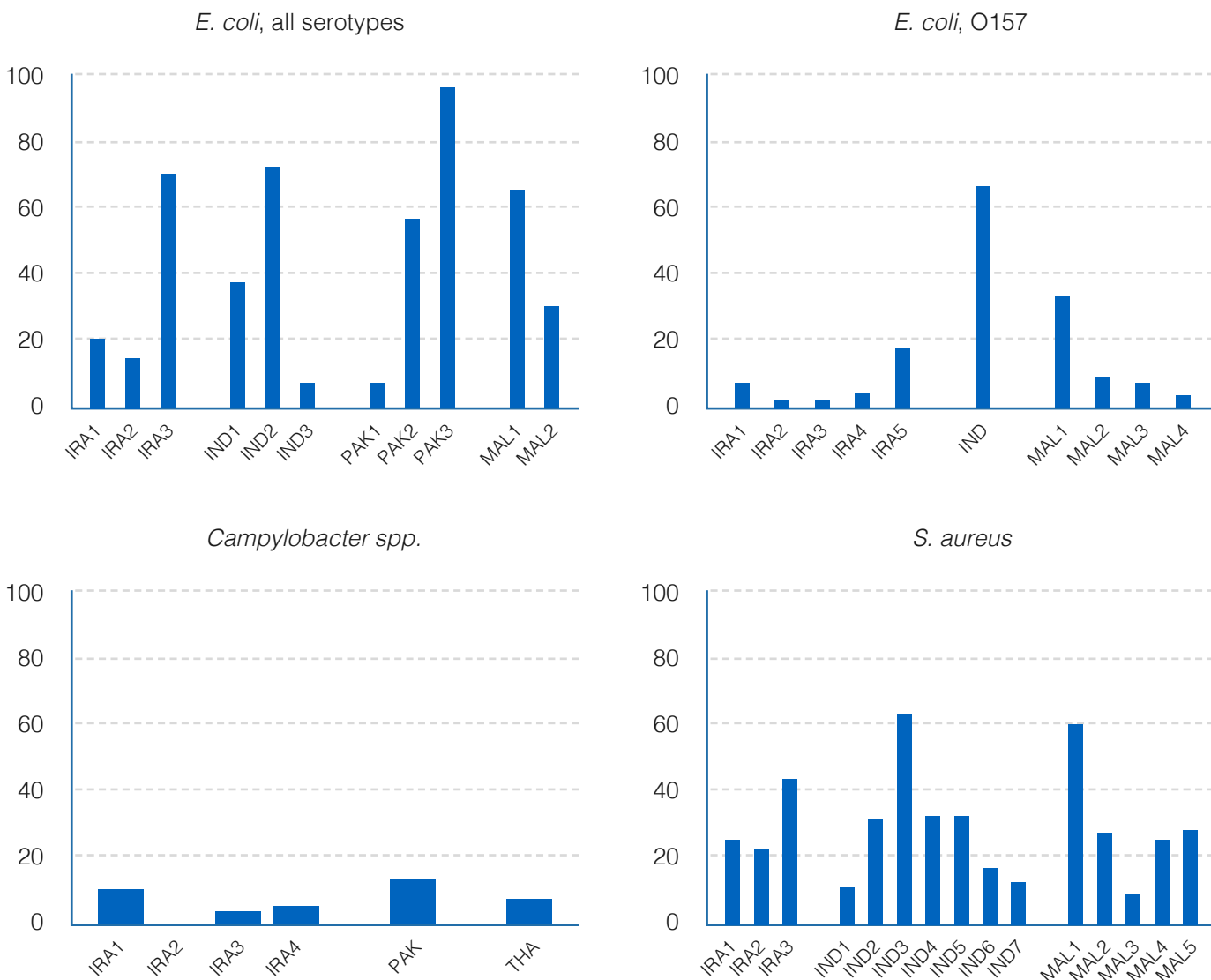
Other harmful bacteria that can be found in milk include: *Listeria monocytogenes*, a pathogen capable of growing at very low temperatures; Shiga-toxin producing *Escherichia coli*, a commensal in the lower intestine of warm-blooded animals; *Salmonella enterica*, found in the intestinal tract of many animal

species (warm and cold-blooded); *Campylobacter jejuni/coli*, present in the gut of commensal birds and other mammals; *Staphylococcus aureus*, also found on the skin of humans (and a cause mastitis); and *Cryptosporidium* (spp.), a protozoan that completes its life-cycle in one host and persists as oocysts in the environment (water). A review of studies of microbial contamination of milk and milk products in Asian countries reveals that virtually all studies found the above bacterial pathogens in a sizeable proportion of raw milk samples, while they were less frequently found in milk products and to a very low extent in pasteurized or boiled milk. An overview of raw milk contamination rates with selected microorganisms found in various studies is presented in Figure 1.

Moving on to chemical contaminants in milk, two categories of contaminants stand out: aflatoxins and

**FIGURE 1**

Contamination rates (percent positive samples) of raw milk (each bar represents an independent study) reported in various Asian countries



heavy metals. Aflatoxins are a class of toxins produced by molds: *Aspergillus flavus* and *A. parasiticus*. The maximum residue limit (MRL) in milk in the USA is 500 nano-grams/l while in the EU it is 50 nanograms/l). Aflatoxins can damage the liver, leading to necrosis, cirrhosis and cancer, and suppress the immune system. Acute poisoning results in abdominal pain, vomiting, convulsions, edema and haemorrhaging; chronic poisoning impairs growth and development and can result in liver cancer. In Asia, aflatoxin-contaminated milk is very prevalent. Most studies found that more than 20 percent of milk samples had aflatoxin levels above the EU MRL while a much lower proportion of studies found milk samples with aflatoxin levels exceeding the US MRL.

Heavy metals that are found in milk include cadmium, copper, chromium and lead, among others. With respect to lead, industrial production processes, road traffic, coal and gas-fired power stations can act as sources of contamination of feed. In humans, lead accumulates in the kidneys, liver and bone marrow, and interferes with the development of the nervous system. Symptoms of contamination can include abdominal pain, headache, anaemia, seizures and coma. The effects on the kidneys and blood are reversible, but those on the nervous system are not. With regard to lead in milk, a major source is lead is contaminated feed. Studies in Pakistan and India found that more than half of tested milk samples had lead concentrations above the USA and EC MRL of 20 microgram/l (Figure 2). (In a number of studies milk samples were purposively collected from areas expected to be heavily exposed to lead contamination.)

Potential exposure to hazards associated with milk is linked to the amount and quality of milk and milk products consumed. In the Asian region, average annual consumption of whole milk (raw and pasteurized) is highly variable and ranges from a low of 1.8 litres per capita in Lao PDR to a high of 137 litres in Mongolia (this includes milk from a variety of domestic animals), while the corresponding figures for milk products (e.g. cheese, yoghurt) range from 0.4 kg in Lao PDR and Cambodia to 71 kg in Pakistan (FAOSTAT) (see Figure 3).

Ingesting contaminated milk is very likely to add to the burden of gastrointestinal disease (GID), which is very high in many Asian countries (> 500 DALYs / 100 000 in 8 of 16 countries), but quantitative attribution is very difficult. A recent study in the State of Minnesota in

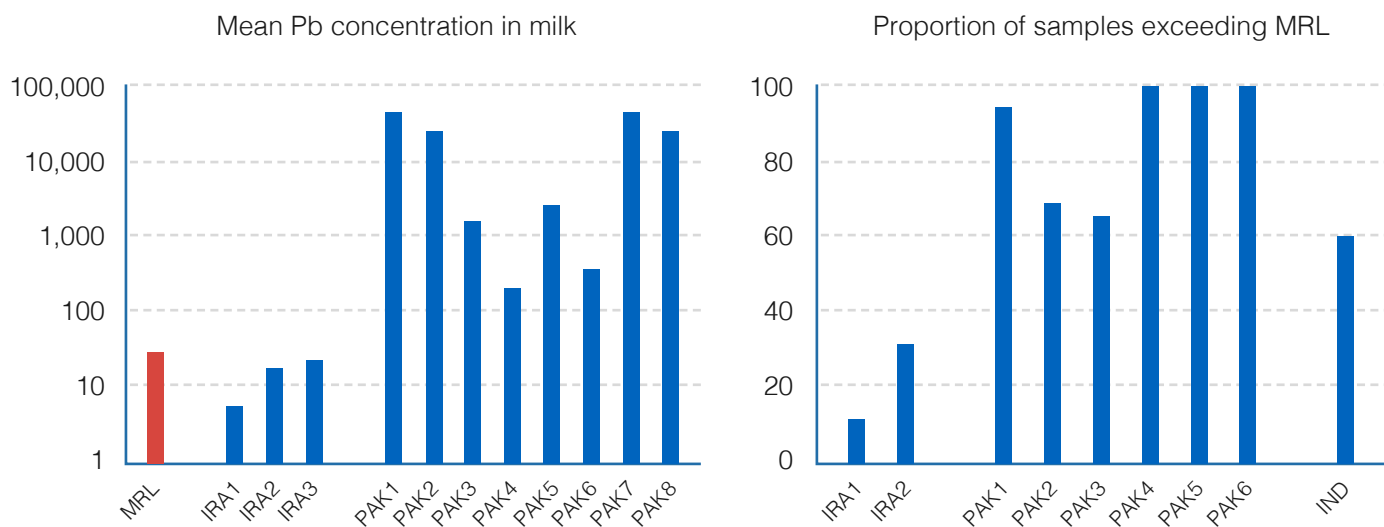


the USA found that, out of a total of 14,399 GID cases registered between 2001 and 2012, 3.7 percent were associated with exposure to raw milk consumption. This figure does not appear very alarming. In children below the age of 5 years, however, 75 percent of cases could be linked to raw milk exposure. Thus, even in the USA where regulations on milk production and handling are very strict, consuming raw milk is not without risk, particularly not for young children.

The widespread presence of pathogenic microbes in milk produced in Asia is a significant challenge to the dairy sector that must be met with aggressive action. Firstly, there is a need to control brucellosis in dairy animals, something that makes sense in terms of farm profit and human health. Second, it is important to improve hygiene along the entire dairy chain, starting from the feed provided to dairy animals. Third, chemical residues in milk must be monitored, particularly in “hot spots”, that is, areas that are close to industrial zones or known to be contaminated with dangerous chemicals. Part of the solution could be to locate dairy systems in “clean areas” that are “free” of dangerous chemicals. Finally, there must be spots checks to uncover milk adulteration, a malpractice that is common in many countries.

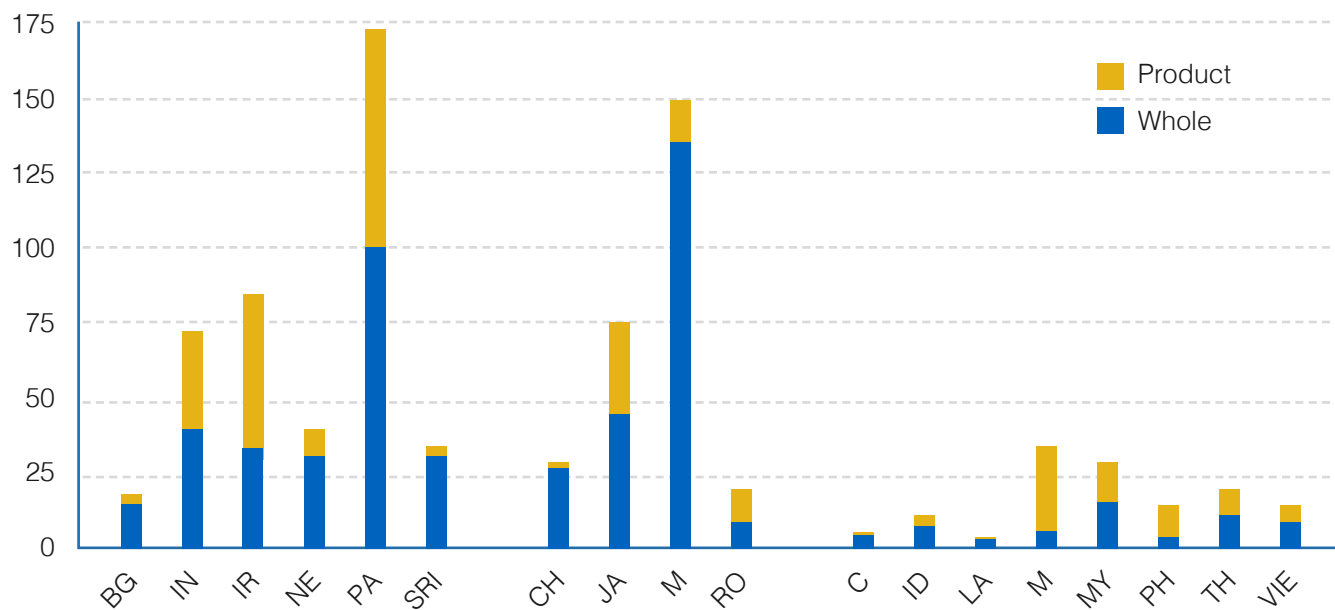
**FIGURE 2**

Contamination of raw milk with lead (each bar represents an independent study) reported in various Asian countries



**FIGURE 3**

Average consumption (whole and milk products) (kg person<sup>-1</sup> year<sup>-1</sup>) in South, East, and Southeast Asian countries (source: FAOSTAT)



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# PANEL SESSIONS



# Panel 1: Natural resources and the environment

## Moderators

### **Jeroen Dijkman**

Senior Livestock Officer, FAO Rome

### **Vinod Ahuja**

Livestock Policy Officer, FAORAP

## Panellists

### **Eric Kempt-Benedict**

Stockholm Environment Institute, Bangkok

### **Mark Powell**

Research Soil Scientist-Agroecology, US Dairy Forage Research Centre, University of Wisconsin-Madison, USA

### **Upali Amarasinghe**

Senior Researcher, International Water Management, Institute

### **Brian Lindsay**

Development Director, Global Dairy Agenda for Action, Belgium

Dairy sector is a source of high value food and has many other economic and social functions. However, its resource use implications are large. The sector is a large user of agricultural land, through grazing and the use of feed crops, and plays a major role in climate change, management of land and water, and biodiversity. The natural resources that sustain agriculture, such as land and water, are becoming scarcer and are increasingly threatened by degradation and climate change. In the Asia-Pacific region for example, livestock exploit 1.2 billion ha of rangeland, corresponding to nearly 70 percent of all 'agricultural' land in the region and, globally, livestock account for 8 percent of the total use of fresh water. Furthermore, livestock are responsible for nearly half of the global non-CO<sub>2</sub> GHG emissions (methane and nitrous oxide) directly attributable to agriculture.

Asia is a very heterogenous region with widely varying income levels, prospects for future economic growth, production and marketing systems, and technical and institutional capacities. This diversity is also reflected in the consumption and production trends of livestock products, the trading patterns, and the aspirations of countries in meeting multiple needs from the sector. Finding the right balance amongst these multiple needs requires better policies, institutions and regulations. There is no size that fits all and hence regulators and policy makers need to weigh the entire range of economic, environmental, social and health issues associated with livestock production and manage the conflicts and trade-offs. Policy-makers need to understand the different options with their pros and cons in a decision-making context strongly influenced

by regional and global interdependencies. Economics and ecology are transcending national borders and an understanding of what is happening at the global, regional, national and local levels is critical to relevant and appropriate decision making.

In the light of the foregoing, this panel discussed the key challenges related to the environmental and resource implications of growing dairy production in the region. It was generally agreed that there are areas where the environmental impact of a growing dairy industry, however, can be significantly reduced without sacrificing social and economic gains. Some of these include improving surface and groundwater quality, mitigating greenhouse gasses and arresting agro-ecosystem degradation. As a preliminary step in the direction of a sustainable dairy industry, it is important to first understand the biophysical, social and economic factors that lead to undesirable environmental outcomes, and the actions necessary to produce the positive, desired outcomes one seeks and minimize the negative, undesirable outcomes.

A critical question in this context is-- what practice change is required to facilitate desired environmental, social and economic outcomes (the triple gain). It is clear that there is "no one size fits all" solution and that there are limitations (e.g., biological) on what can be done in terms of innovation and continuous improvement efforts. Strategies need to be tailored to specific bio-physical and socio-economic features of the prevailing dairy production systems. There are tactical decisions that must be made with regard to the use of feed (an increasingly critical variable)



and nutrients. Recommendations on what to feed dairy cows have large impacts on profitability, manure chemistry and environmental outcomes. Feed supplements may need to be subsidized and made available during periods of feed shortages (drought), and manure land spreading may need to be restricted based on topographic features and weather.

On the issue of how innovation and investment in practice change could be stimulated, it is important to focus first on the biophysical outcomes that we are trying to change and refine our understanding of the processes and socio-economic and cultural influences that control outcomes. Long-term public investment, such as cost-sharing of farm structures and practices that improve environmental outcomes may be necessary. Environmental outcomes need to be included into the analyses of profitability.

Success on practice change demands significant, long-term public investments that are accompanied by frequent, direct technical support. In order to move forward in the direction of sustainability, it is important to undertake long-term, integrated, trans-disciplinary research (e.g., combining animal nutrition, environmental science, and public policy) and making the findings available to all strategic players. Effective practice change demands wide participation by stakeholders among others and to stimulate innovations towards sustainability, it is essential to facilitate multi-stakeholder engagement processes. These processes must be open, collaborative, and contributory. Positive results will demand behavioural changes among target populations which require awareness, willingness and ability to change. Most important, however, it must be recognized that most economic agents respond to economic incentives rather than arguments built around social suasion.

All participants agreed that meeting the growing demand for milk and milk products in Asia is a significant challenge that demands a viable, cost-effective and sustainable solution. Natural resources must be preserved and decent livelihoods across the industry must be ensured. It was further agreed that a dairy sustainability framework that involves global and regional elements is necessary in order to guide the sustainability journey. There was general agreement that the framework should focus on eleven sustainability issues: GHG, soil nutrients, waste, water, soil, biodiversity, market development, rural economies,

working conditions, product safety/quality and animal welfare.

## Panel 2: Sustainable animal diets: from concept to implementation

### Moderators

#### Harinder Makkar

Livestock Production Officer  
FAO Rome

### Panellists

#### Mark Powell

Research Soil Scientist-Agroecology, US Dairy Forage Research  
Centre, University of Wisconsin-Madison, USA

#### Manget Ram Garg

General Manager, National Dairy Development Board  
Animal Nutrition Group, Anand, Gujarat, India

Animal feed and feeding is pivotal to livestock production. Animal productivity, health and welfare, product quality and safety, producers' income, but also land use and land use change, water pollution and greenhouse gas emissions, are affected to a great extent by diet selection and how a diet is fed to livestock. Livestock are responsible for 8 percent of the global human water use, over 90 percent of which is used for feed crop production. In addition, 33 percent of the total arable land area is dedicated to feed crop production. Currently, 33 percent of the cereals produced are used as feed and this proportion is projected to increase to 50 percent by 2050. Forty-five percent of all GHG emissions from the livestock sector is directly related to the production, processing and transport of feed. Thus, for sustainable animal production, sustainability of the animal diets is vital.

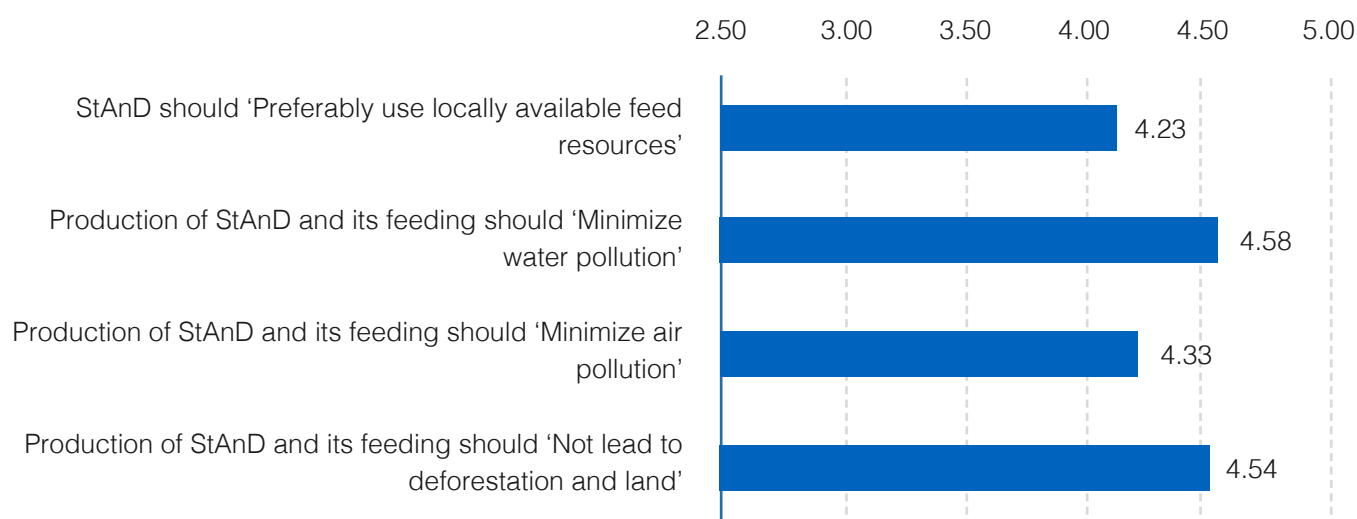
### Sustainable animal diets: concept and survey results

A concept of *sustainable animal diets* (StAnD), has been developed through various consultative processes (<http://www.fao.org/docrep/018/i3331e/i3331e.pdf>). The concept integrates the importance of protecting the environment, efficient use of natural resources, socio-cultural benefits, and ethical integrity and sensitivity, in addition to currently recognized nutrition-based criteria of producing safe and economically viable feed. The concept is based on the *Three-P* dimensions of sustainability (*Planet, People and Profit*), complemented by a further vital aspect of animal nutrition, namely the ethics of using a particular feed.

In order to further refine the StAnD concept and to translate the concept into action, FAO conducted a

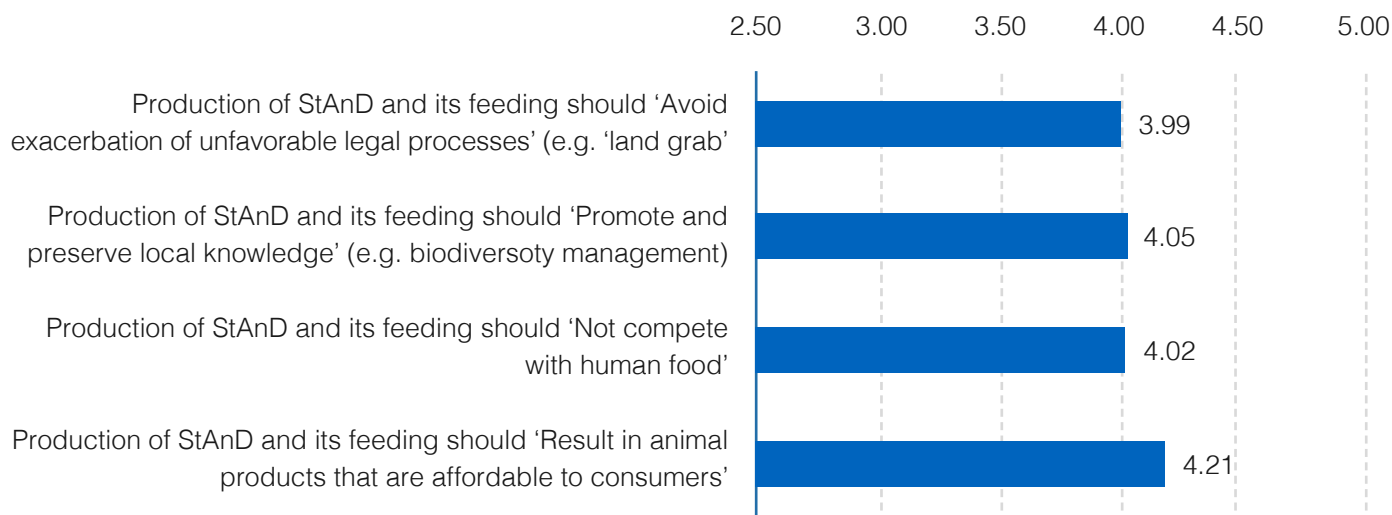
### FIGURE 1A

Relative importance of StAnD elements in Planet dimension of sustainability



## FIGURE 1B

Relative importance of StAnD elements in People dimension of sustainability



survey of stakeholders. Through a questionnaire, help was sought from stakeholders, both to prioritize the main constituent elements of the concept, and to assess their views on how best to translate the concept into action by integrating its elements/components into sound management practices. A total of 1 195 respondents returned the questionnaire. The top listed elements in *Planet and People* dimension of sustainability are presented in Figures 1a and Figure 1b (the rating scale was: 1 = not important, 2 = somewhat important, 3 = reasonably important, 4 = important, 5 = extremely important).

The top ranked elements in *Profit* dimension of sustainability are that production of StAnD and its feeding should: a) enhance benefit : cost ratio for all stakeholders, b) take into account environment and social costs of negative externalities, and c) not enhance volatility in the price of feed ingredients. With regards to the question 'who should lead the initiative towards implementation of StAnDs', respondents ranked farmers and their associations and scientists highest (Figure 2).

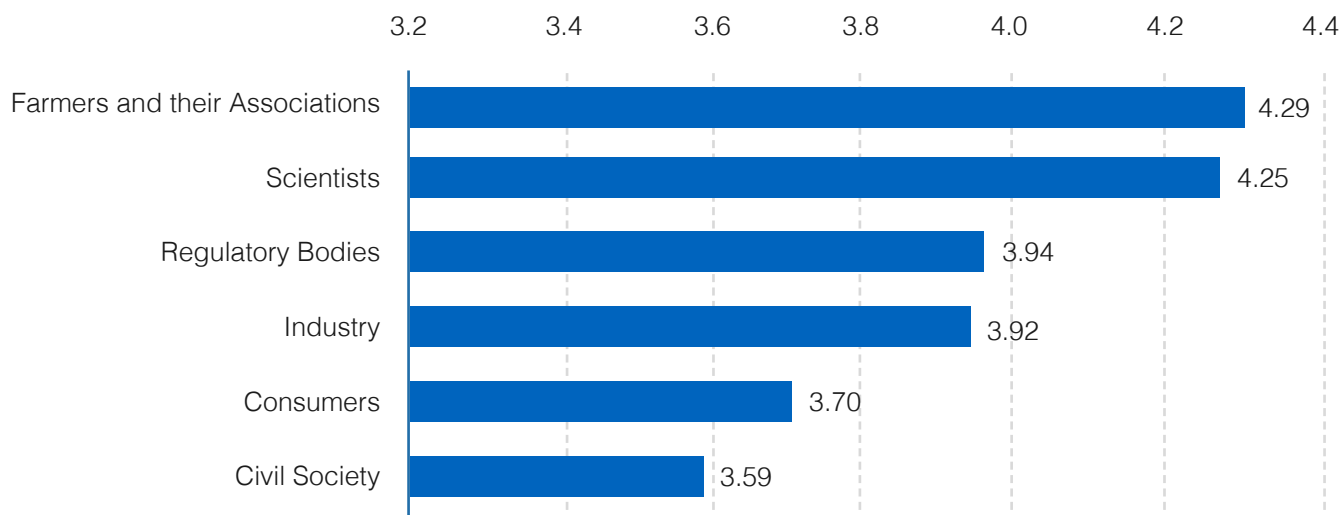
A criterion i.e. reuse food waste in animal diets after ensuring its safety that cuts across all dimensions of sustainability was ranked very high by the respondents. Finally, the three most important actions to be taken to make StAnDs become a reality were: (i) make consumers aware of their benefits, (ii) develop guidelines / good practices for StAnDs, and (iii) achieve broad stakeholder engagement.

### Salient points from the discussion

The panelists and the floor agreed that, with regard to the critical variable of animal feed, maintaining the status quo is not an option. However, in order to move beyond the status quo, it was also agreed that, in addition to (i) protecting the environment and natural resources, (ii) being socio-culturally acceptable and in harmony with animal welfare and food security concerns, (iii) being free from deleterious components and generating animal products that are safe for human consumption, a sustainable diet framework of action must promote economic growth. With respect to specific aspects of animal feeding, it was argued that the provision of a properly balanced ration could reduce the cost of feeding, improve productivity, reduce methane and water use per kg of product and also reduce the amount of nitrogen excreted into the environment. It was also argued that for ruminants grain feeding may not be necessary or non-food grade grains could be used and that more emphasis should be placed on developing and using strategic, locally available feed supplements in order to improve productivity and reproductive efficiency. In addition, use of areca nut sheath, pineapple leaves and waste, cocoa pods, moringa leaves, by-products of the biofuel industry, among others for animal feeding needs to be promoted. In countries that produce silk, there is the possibility of using silkworm pupae, which are a by-product of the silk worm industry as protein sources in animal feed. It was also stressed that it is important to reduce feed wastage especially due to mycotoxins and

**FIGURE 2**

Relative importance of various actor groups for the implementation of StAnDs



burning of crop residues in the fields and to make use of feed resources that do not compete with human food. These examples are consistent with the StAnD concept and will contribute towards its implementation.

On the subject of academia's contribution to bringing about practice change and the implementation of the SAD concept, it was pointed out that, in the United States, trans-disciplinary, dairy-nutrition-environmental research on StAnDs had already led to verifiable reductions in both water and air pollution by the dairy sector. Furthermore, refinement of animal diets had resulted in the production of animal excreta that are less harmful to the environment. Research, conducted in partnership with the feed industry, had not only improved water and air quality, but also increased profits and benefited society. There is thus evidence that the StAnDs approach can provide "triple win" opportunities.

It was felt that further implementation of the StAnDs concept, as outlined and advocated in the opening paper of this section by the moderator, could substantially improve water and air quality in both the developed and developing world, including Asia. Examples mentioned were enhancing digestibility of fiber, which leads to higher energy output out of foliage and less need for grain, and basing animal diets on plants that fix atmospheric nitrogen, which would have a huge impact on carbon-nitrogen dynamics.

It was acknowledged that academia is creating a vast body of knowledge but that academia can do a better

job in engaging stakeholders in research design and technology transfer and in creating awareness for the need of bringing about practice change. Academics should not just talk about their publications; rather, they must reach out to a variety of stakeholders in order to make their findings relevant. Furthermore, it was argued that academia should work with producers to establish baselines against which to assess progress in the implementation and outcomes of practice change.

In closing, in terms of implementing the StAnDs concept, it was agreed that the results of the FAO survey on StAnD should form the basis for bringing practice changes; and partnerships between academia, the feed industry and extension services, among others, would have a positive impact on dairy producers, fostering the formation of a sustainable dairy industry in Asia.



# Panel 3: Dairying as an instrument of inclusive economic development

## Moderators

### **Vinod Ahuja**

Livestock Policy Officer  
FAORAP

### **Jeroen Dijkman**

Senior Livestock Officer  
FAO Rome

## Panellists

### **A.K.Srivastava**

Director, National Dairy Research Institute, Karnal, India

### **Geoff Walker**

Chief of Party, Bangladesh Dairy Enhancement Project, Bangladesh

### **Luu Van Tan**

Dairy Development Manager, FrieslandCampina Vietnam

As noted in the introduction section, the consumption of milk and milk products has grown rapidly in Asia and the Pacific region and this growth is expected to continue in the foreseeable future. OECD-FAO Agricultural Outlook estimates that the demand for milk and milk products in the region will touch almost 320 million tonnes by the year 2021. This means the region will need to increase milk availability by another 40-50 million tonnes within this decade.

Two more characteristics of Asia Pacific region are of specific relevance in the context of growing demand for milk and milk products. First, the region is home to two thirds of the world's poor and undernourished people and in some countries the proportion of undernourished children exceeds half the total child population. Second, over 80 percent of dairy animals in the region are raised by small-scale farmers who are a critical and unique ingredient in the region's dairy landscape.

The existence of a vibrant smallholder-managed dairy sector combined with a favourable medium term market outlook is, potentially, good news since the poor in general have a higher stake in smallholder dairy production than in crop production. Furthermore, animals are typically more equitably distributed than land in many of these areas and dairying is also more labour intensive than crop production and provides a remunerative outlet for family labour. These characteristics could imply that growth in smallholder dairy can emerge as an instrument of inclusive economic development with concomitant nutrition related benefits.

On the other hand, there is an ongoing debate in the

region about the ability of smallholder dairy producers to respond to a growing market that demands higher quality, consistent and diverse products. Some observers argue that scope of technology infusion on small farms is limited and hence the region must strive towards building and promoting larger dairy farms, even as the industrialized countries re-evaluate the desirability and sustainability of such production system. Others however argue that small farmers can meet the demands of market but need public policy and organizational support that build capacity and facilitate access to services, finance and technology. There is also growing evidence that whilst the ownership of dairy animals may provide a steady source of income, it is often, on its own, not enough to lift families out of poverty. Notwithstanding this debate, investment in the further development of both smallholder and industrial scale dairy in the region continues apace.

In the light of the foregoing, this panel discussed the key challenges that must be addressed to ensure that the potential social, economic and environmental benefits of the growth in demand for dairy products in Asia are best exploited. There was some degree of consensus that while investment in large dairy systems will perhaps continue in response to market forces, smallholder systems would need public policy and investment support to enable them to compete fairly in an increasingly dynamic, complex and differentiated market. Further, the governments must ensure a level playing field between small, medium and large players in the market.

In order to facilitate inclusive economic development, a point was made that the industry must work closely

with smallholders and smallholders must work closely with the industry. Dairy practitioners must rethink standard approaches and more integration along the entire dairy chain may be necessary. At the same time, it is important to exercise caution when introducing structures to the dairy sector that are not found in developed dairy economies. There was consensus that creating a sustainable dairy industry in Asia demands a development approach that drives up profitability, and that the profit motive is an important means to address matters related to sustainability.

Can smallholders compete with large producers? This question was partially addressed using an example from the growing dairy industry in Viet Nam, where more than 80 per cent of dairy farm and milk production is from smallholder farms (3-5 milking cows/farm). In Viet Nam, milk quality is good and the price for milk that is paid to farmers is quite high (60 US cents/kg). Most smallholder farms are located in semi-urban regions where land is limited. There is a large demand for fresh milk and the growth of dairy farming is market driven. Private companies have invested in comprehensive milk collection systems (direct collection – chilling – quality control – transport) and direct contracts with local farmers has resulted in better quality and a higher milk price paid to farmers. An incentive payment is applied to encourage farmers to take action to improve both the quality and yield of milk in rural areas. Well-trained extension teams are providing farmers with training and farm services. Coordination and cooperation among strategic players is increasing. There are, however, constraints that are impacting smallholder farmers in Viet Nam: land is limited, especially in existing farming regions where the dairy herd cannot increase; the government has no long-term master plan and governmental regulations on milk in the milk chain from farm to factory are lacking; high feed cost is pushing the cost of production upward, putting downward pressure on profitability; the level of coordination/alignment and communication between the public sector and the private sector for dairy development is insufficient; and information on dairy husbandry and professional farm/cow management needs to be improved.

It was noted that, in Viet Nam, a family farm business with 30-40 milking cows represents the future of dairy farming, and that dairy farms must be quality and safety oriented (environmental friendly). On the question as to whether or not smallholder dairy farmers can compete with large-scale producers, it was noted that one essential variable is the quality of milk. If smallholder



dairy farmers can produce high quality milk at a fair market price, then they can compete.

## Panel 4: Multi-stakeholder action for sustainable dairy

### Moderators

#### **Neil Fraser**

Chair, Global Agenda for Sustainable Livestock

### Panellists

#### **Saeed Bancie**

Regional Director-East Africa. Heifer International, Little Rock, USA

#### **Nico van Belzen**

Director General, International Dairy Federation

#### **Rob Gregory**

Regional Programme Director, Humane and Sustainable Agriculture (Asia-Pacific) Thailand

With an increasing world population, growing scarcity of natural resources, and accelerating climate change, the road towards sustainability is increasingly challenging. The livestock sector exemplifies these challenges and the necessity for joint action: it not only needs to supply growing amounts of safe food and support rural livelihoods, but it must also deal with growing resource scarcity and reduce its environmental footprint. From intensive dairy to dry land pastoralism, livestock systems face highly diverse challenges that require different responses. Such actions need to reconcile the requirements of a wide array of different stakeholders, and to provide benefits to all.

Already, stakeholders are joining forces to make livestock more sustainable. Novel forms of partnership are being developed around the world, and dialogue is at the heart of such partnerships. Capitalizing on the strength of different actors, dialogue enhances the understanding of development issues. But more importantly, consensus can be built amongst all concerned on the path towards sustainable food security. It forms the basis for stakeholder commitments to action and on-the-ground improvements.

One example of this is the Global Agenda for Sustainable Livestock, supported by FAO. This partnership of key representatives from governments, the private sector, civil society and academia, aims to catalyse and guide the continuous improvement of livestock sector practices.

It was agreed that given the size and complexity of the task, joining forces is a necessity. This sentiment was best captured by one panelist who said “separately we can try, but together we can achieve.” There was

some agreement that one way to reach the collective goal of a sustainable dairy industry in Asia may be to position development efforts under the umbrella of the Global Agenda for Sustainable Livestock. The Agenda evolved out of the pressing need to provide quality livestock products to a growing human population in a sustainable manner. It accepts that poverty, inequality, food security and health needs, as well as environmental issues (e.g. climate change) can be addressed through the development of a sustainable livestock sector.

Some reflections were offered on the nature of the Agenda and its initial focus. It was noted that the Agenda is a multi-stakeholder partnership that is open, voluntary, inclusive, consensual and knowledge based. It is, in effect, “a collaborative approach to sustainability in the global livestock sector.” The Agenda builds consensus on the path towards sustainability and catalyzes coherent and collective practice change through dialogue, consultation and joint analysis. Initially, the Agenda sought to catalyze and guide the continuous improvement of livestock sector practices towards more efficient, safe and responsible use of natural resources, enhance the sector’s environmental performance, and generate significant economic and social benefits that would contribute to food security, income generation and poverty reduction. More specifically, the Agenda focused on closing the efficiency gap, restoring value to grasslands, and recovering and recycling nutrients and energy from manure.

The Agenda embraces the notion that sustainability is a process of continuous practice change that addresses social, economic and environmental objectives

simultaneously. The Agenda addresses sustainable livestock sector development through three integrated themes: equity and growth, climate and resources, and health and nutrition. It attempts to effect positive practice change by supporting/implementing joint analyses and assessments, facilitating multi-stakeholder dialogue at the international and local levels, identifying and providing necessary tools and guidance, and supporting/promoting innovation and local practice change. The Agenda is comprised of stakeholder clusters (public/private sector, research/academia, NGOs, social movements and donors) that work through focus area groups on various areas, such as efficiency, grassland and waste, among others. The Livestock Environmental Assessment and Performance Partnership (LEAP), which was founded in 2012 with the purpose of improving the environmental performance of livestock supply chains, is also an important Agenda partner. Even though the Agenda is made up of diverse groups, they share the common belief that for a sustainable livestock sector there is “no single answer, no single organization and no single stakeholder group.”

Under the umbrella of the Global Agenda for Sustainable Livestock, novel forms of partnership are being developed around the world, such as the East Africa Dairy Development (EADD) project. The EADD project began in 2008 and has since then connected more than 203,778 smallholder farmers across Kenya, Rwanda and Uganda to a larger circle of institutions and services that give them the collective resources and necessary infrastructure to earn a living raising cows and selling milk. Target populations have increased their incomes, allowing them to educate their children, access healthcare and invest in businesses. A core component of the success of EADD is that it partners with dairy producer organizations that are built around milk bulking and chilling hubs. Smallholder dairy farmers are given access to these hubs. Women have increasingly taken on more leadership roles in the community and an increase in youth involvement in the sector.



Since its inception, EADD has grown to be one of the leading market-oriented development initiatives in eastern Africa. The project is increasing dairy production and improving net income for farmers. All EADD hubs are on a path to sustainability in terms of cash flow, governance, leadership and technical capacity. Awareness and capacity building efforts have resulted in women taking on active leadership roles. Perhaps the main lesson learned from the EADD project is that the road to a sustainable dairy system is paved with careful planning, widespread dialogue on critical issues, and cooperation among a wide range of strategic players.



# CONCLUDING SESSION



The concluding session sought to synthesize some of the key messages from the presentations and panel discussions and articulate some elements of what may comprise the dairy development strategy for Asia and the Pacific region. The growing importance of Asia in the global production and consumption of milk and the changing landscape of dairy sector was recognized. It was further recognized that average farm size (number of dairy animals) in the region remains small in comparison to dairy farms in the developed world and that presents a unique opportunity to contribute to socio-economic development.

## Asia-Pacific Feed Resource Network

Realizing the importance of animal feeds and feeding for sustainable animal production, APHCA and AGA have taken initiatives during the past one year to establish an Asia-Pacific Animal Feed Network (APAF-N). The network aims at linking researchers, institutions, feed companies and other stakeholders in the livestock supply chain and to provide facts, figures and information about feed resources and their efficient management in support of sustainable development of the livestock sector. The overall objective is to provide a mechanism for cooperation among all actors dealing with livestock feeding.

It was recognized that the sustainability of the network is heavily driven by the availability of funding and resources. Therefore, one of the key activities of the network will be to generate outputs / provide services that create value for the livestock industry and can therefore be marketed and generate income to support the Network. For the year 2014, FAO-RAP in cooperation with APHCA is acting as both funding and institutional partners for the Network. The Bangladesh Agricultural University will provide the working environment for the Network Coordinator. Once the databases and methodologies have been developed and consolidated, a process envisaged to take at least three years, the network can work independently by generating its own budget through provision of services to the livestock industry.

## Dairy Asia and the elements of a regional dairy development strategy

Extensive discussion took place on establishing a multi-stakeholder platform to facilitate regional cooperation and collaboration. There was consensus that such a platform would add substantial value towards promoting ground level action in pursuit of sustainability objectives.

The elements of such a platform—identification of willing partners, agreement on an organizational structure, commitment of resources, monitoring and accountability mechanism etc.—must however be discovered through an open, voluntary and iterative process. It was pointed out that the organizations present in the meeting—FAO, NDDDB, APHCA, IDF, WSPA, in particular, bring unique and complementary strengths and are best positioned to creating such a platform. The stakeholders agreed to continue the dialogue on formation of Dairy Asia platform as a parallel process to the development of regional dairy development strategy.

As regards the dairy development strategy, the participants recalled that recognizing the unique and central role of small producers in Asia's dairy landscape and the potential of smallholder dairy in generating inclusive economic growth, food security and nutrition, APHCA, FAO, and the Common Fund for Commodities (CFC), had initiated a stakeholder consultation process in 2007 to distil lessons from Asian experiences and to outline elements of a strategy for future development. The consultative process culminated in a *regional dairy strategy and investment plan for smallholder dairy development* and elaborated a strategic vision for smallholder dairy development—**Asian milk for health and prosperity**, known as the **Chiang Mai Declaration**. The strategy outlined following strategic objectives

- A glass of Asian milk a day for every Asian child.
- Regional self-reliance and enhanced dairy food security.
- Smallholders better linked to markets and enabled to become commercial dairy entrepreneurs.
- More efficient, productive, profitable and responsible (socially and environmentally) dairy chain
- Regional and national recognition of the multiple benefits of smallholder dairy

In order to address the challenges and objectives, the strategy had identified interventions under four mutually reinforcing pillars—(i) *Pillar 1*: Human resource development and knowledge management, (ii) *Pillar 2*: Improving the productivity and competitiveness of smallholder milk producers, (iii) *Pillar 3*: Strengthening the linkages between farmers and consumers to deliver a quality product at a fair price, and (iv) *Pillar 4*: Enhancing the enabling environment

The strategy recognized that smallholder dairy development can be successful under a wide range of situations, but the approach and interventions need to be tailored to the local situation. It has to be

recognized that in some cases certain systems, or in fact SDD systems in general, may not be feasible. Key success factors are linked to the nature of risk inherent to dairying. The risks and opportunities (differentiated by market demand, production practice, geography, and access to markets, inputs and services) are also influenced by more macro or broader issues such as trade regulations, government agriculture and investment policies, and institutional support. The smallholder dairy development strategy was designed with the explicit objective of transforming smallholder milk producers in rural communities. Potential direct beneficiaries included some 200 million smallholder families, or nearly 1 billion people including women dairy operators. Within the target group, the strategy placed special emphasis on the empowerment of women by ensuring they have equal opportunities under all the strategy pillars.

The meeting recognized that the elements of the strategy enshrined in the *Chiang Mai Declaration* remain as relevant as ever. At the same time, however, there is growing realization in recent years of increasing resource scarcity, climate change, growing pressure on feed resources and rising feed prices. This necessitates integrating sustainability concerns more explicitly in the regional strategy. Such integration must however consider sustainability in its full complexity encompassing all its pillars—economic, ecological, and social. The meeting recognized that partial solutions will not produce the desired results. For example, any efforts towards conservation that ignore the need for economic development, food security and livelihoods are unlikely to succeed. Conversely, socio-economic development will not be sustainable if it does not maintain the ability of the ecosystem and society to adapt to short and long-term changes. This complexity necessitates consideration of sustainability as a societal issue and requires integrated efforts by stakeholders to capitalize on the strength of dairy production systems in Asia and to minimize the potential negative impact of rapid growth in demand and supply of milk and milk products in the region. It is also imperative that such efforts be realistic, equitable, and conscious of the region's ecological, socio-economic and cultural dimensions.

Although the participants did not articulate a new vision statement, there was consensus on the need to formulate a new vision that would foster multi-stakeholder collaboration to achieve sustainable dairy sector growth through market-based solutions while

at the same time positioning the sector as a positive driver of food security, environmental sustainability and equitable economic growth in the region. Substantial discussion took place on the various elements that need to be reflected in the new strategy document. The elements identified by the participants are listed below

1. Increase the productivity sustainably to meet the increasing demand
2. Improve food quality and safety while reducing post-harvest losses
3. Promote institutional structures to integrate small producers in the modern value chain
4. Promote publicly supported school milk programs linked to local dairy operations
5. Enhance consumer education to enable them make more informed choices
6. Strengthen stakeholder capacity to cope with production and and market risks
7. Minimize environmental footprint and improve mitigation/adaptation to climate change
8. Enhance the enabling environment
9. Support equitable growth, livelihoods and entrepreneurship;
10. Improve access to services, markets, and institutional structures;
11. Pilot new farming and feeding systems through applied research and development;
12. Facilitate and promote networking among all strategic players for access to services, experience, knowledge and technology;
13. Facilitate Public Private Partnerships in investment and service provision;

## Next steps

Following the broad agreement on the elements of the regional dairy development strategy, the participants agreed on the following next steps

1. Preparation of a drafting Regional Dairy Development Strategy document.

Based on the elements of a strategic framework identified above a core drafting group will prepare the draft regional strategy document for Asia and the Pacific. Members of the drafting group will include

- Vinod Ahuja, Livestock Policy Officer, FAO RAP
- Joachim Otte, Senior Animal Production and Health Officer, FAO RAP
- Jeroen Dijkman, Senior Livestock Policy Officer, Global Agenda of Action for Sustainable Livestock
- Naiten Wangchuk, Chief Livestock Officer, Government of Bhutan
- Lesley Lambert, Chief Policy Advisor and Head of Policy, Humane and Sustainable Agriculture World Animal Protection, London
- Steve Staal, Regional Representative for East and Southeast Asia, International Livestock Research Institute, Manila, Philippines
- Sommart, Associate Professor, Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Thailand
- One nominee from National Dairy Development Board of India
- One nominee from Milk Vita, Bangladesh
- One nominee from the Private Sector
- John Moran, Profitable Dairy Systems, Australia
- One nominee from Global Dairy Agenda of Action
- AK Srivastava, Director, National Dairy Research Institute, Karnal, India

## 2. Draft strategy peer review

The draft document would be subjected to rapid peer review before it is shared with wider group of stakeholders. The peer reviewers would include

- Mark Powell, Research Soil Scientist, USDA Agricultural Research Service, US Dairy Forage Research Centre. University of Wisconsin-Madison, Madison, USA
- Harinder Makkar, Livestock Production Officer, FAO, Rome, Italy
- Nominee from IDF

## 3. Further Consultations

Following the peer review, the draft strategy would be shared with other stakeholders. Following stakeholder groups were identified for further consultations

### a. IDF National Committees

- Animal Production and Health Commission for Asia and the Pacific (APHCA)
  - An e-consultation Dairy Asia websites and Asia Dairy Network
  - ASEAN Working Group on Livestock
- Finalization of the strategy document December 2014
  - Launch of the Strategy document at another smaller multi-stakeholder meeting in January 2015.

# ANNEXES



## Annex 1: Video links for keynote addresses and technical presentations

Speaker	Description
<b>Jack Holden</b> Sustainability and Social Responsibility Manager, Fonterra Co-operative Group;	Dairy farm profitability through environmental sustainability <a href="http://www.youtube.com/watch?v=Y4SFeeBZ5SE">http://www.youtube.com/watch?v=Y4SFeeBZ5SE</a>
<b>T. Nanda Kumar</b> Chairman, National Dairy Development Board, India	Society, equity and livestock in Asia: Aspirations, reality and dilemmas with specific reference to dairy <a href="http://www.youtube.com/watch?v=rRfiMekDdtE">http://www.youtube.com/watch?v=rRfiMekDdtE</a>
<b>Carolyn Opio</b> Natural Resources Officer, FAO, Rome	Environmental performance of the dairy sector <a href="http://www.youtube.com/watch?v=hSR-x1Q2HpM">http://www.youtube.com/watch?v=hSR-x1Q2HpM</a>
<b>Upali Amarsinghe</b> Senior Researcher, IWMI – Hyderabad Regional Office.	Water footprint of the dairy sector <a href="http://www.youtube.com/watch?v=d_44TWUu-UI">http://www.youtube.com/watch?v=d_44TWUu-UI</a>
<b>Ghulam Habib</b> Agricultural University, Peshawar, Pakistan	Feed resource assessment and use in Asian countries: Lessons learnt, knowledge gaps and the way forward <a href="http://www.youtube.com/watch?v=nvwiS-2DJkw">http://www.youtube.com/watch?v=nvwiS-2DJkw</a>
<b>Johan van den Ban</b> De Heus, Viet Nam	Compound feed and dairy sector growth: A feed industry perspective <a href="http://www.youtube.com/watch?v=lw_wSKEy-04">http://www.youtube.com/watch?v=lw_wSKEy-04</a>
<b>Bernhard Dalheimer</b> Statistics Officer, FAO, Rome	Modelling feed demand to monitor sustainability <a href="http://www.youtube.com/watch?v=n91RmHlzYGE">http://www.youtube.com/watch?v=n91RmHlzYGE</a>
<b>Chandrashekhara Biradar</b> Head, Geoinformatics, ICARDA, Amman, Jordan	Feed resource assessment in grasslands using satellite imaging <a href="http://www.youtube.com/watch?v=xRDoOaMoE84">http://www.youtube.com/watch?v=xRDoOaMoE84</a>
<b>Asyl Undeland</b> Consultant, IFAD, Rome	Restoration of grasslands in Central Asia: IFAD's experience in Kyrgyzstan <a href="http://www.youtube.com/watch?v=0gCTIjiEsuA">http://www.youtube.com/watch?v=0gCTIjiEsuA</a>
<b>Nomindelger Bayasgalanbat</b> Nutrition Officer, FAORAP, Bangkok	Milk and dairy products in human nutrition <a href="http://www.youtube.com/watch?v=PXqxK-IRP3g">http://www.youtube.com/watch?v=PXqxK-IRP3g</a>
<b>Shahidul Huque</b> Chief Scientific Officer, BLRI	Experience of Milk Vita in Bangladesh <a href="http://www.youtube.com/watch?v=AvHVy5-A6u0">http://www.youtube.com/watch?v=AvHVy5-A6u0</a>
<b>Nguyen Quoc Khanh</b> Executive Director, Vinamilk	Experience of Vinamilk in Viet Nam <a href="http://www.youtube.com/watch?v=1HSxT1223cQ">http://www.youtube.com/watch?v=1HSxT1223cQ</a>
<b>Joachim Otte</b> Senior Animal Production and Health Officer, FAO-RAP, Bangkok	Veterinary public health risks in Asia's growing dairy sector <a href="http://www.youtube.com/watch?v=uaBBTxMrzxE">http://www.youtube.com/watch?v=uaBBTxMrzxE</a>
<b>Vinod Ahuja</b> Livestock Policy Officer, FAO RAP	Elements of a regional dairy strategy for Asia and the Pacific <a href="http://www.youtube.com/watch?v=A69pVFblzuY">http://www.youtube.com/watch?v=A69pVFblzuY</a>

## Annex 2: Participants list (in alphabetical order)

### **Saeed Bancie ABUBAKARI**

Regional Director-East Africa  
Heifer International  
1 world Avenue, Little Rock  
AR 72202, USA  
E-mail: [Saeed.bancie@heifer.org](mailto:Saeed.bancie@heifer.org)

### **Ngamnet AEKTASAENG**

Research Associate  
Stockholm Environment Institute (SEI)  
15th floor, Witthayakit Building  
Chulalongkorn University  
254 Chulalongkorn Soi 64, Pathumwan  
Bangkok 10330, Thailand  
Email: [ngamneraektaeng@sei-international.org](mailto:ngamneraektaeng@sei-international.org)

### **Vinod AHUJA**

Livestock Policy Officer  
FAO Regional Office for Asia and the Pacific  
Maliwan Mansion, 39 Phra Atit Rd.  
Bangkok, Thailand  
E-mail: [Vinod.ahuja@fao.org](mailto:Vinod.ahuja@fao.org)

### **David ALCOCK**

Managing Director – South East Asia  
Tetra Pak Vietnam JSC  
The Metropolitan Building  
District 1, Ho Chi Minh City, Vietnam  
E-mail: [David.alcock@tetrapak.com](mailto:David.alcock@tetrapak.com)

### **Upali AMARASINGHE**

Senior Researcher  
IWMI – Hyderabad Regional Office  
No401/5, C/O ICRISAT  
Patancheru, 502324  
Andra Pradesh, India  
E-mail: [u.amarasinghe@cgiar.org](mailto:u.amarasinghe@cgiar.org)

### **Upali AMARASINGHE**

Senior Researcher  
IWMI – Hyderabad Regional Office  
No401/5, C/O ICRISAT  
Patancheru, 502324  
Andra Pradesh, India  
E-mail: [u.amarasinghe@cgiar.org](mailto:u.amarasinghe@cgiar.org)

### **Johan Van Den BAN**

Project and Business Development Manager  
De Heus Animal Nutrition, Vietnam  
Vietnam  
E-mail: [jban@deheus.com](mailto:jban@deheus.com)

### **Nomindelger BAYASGALANBAT**

Nutrition Officer  
FAO Regional Office for Asia and the Pacific  
Maliwan Mansion, 39 Phra Atit Rd.  
Bangkok, Thailand  
E-mail: [Nomindelger.Bayasgalanbat@fao.org](mailto:Nomindelger.Bayasgalanbat@fao.org)

### **Nico van BELZEN**

Director General  
International Dairy Federation (IDF)  
Blvd. Auguste Reyers 70/B  
1030 Brussels, Belgium  
E-mail: [nvanbelzen@fil-idf.org](mailto:nvanbelzen@fil-idf.org)

### **Chandrashekhhar BIRADAR**

Head-Geoinformatics  
International Centre for Agricultural Research in  
Dry Areas (ICARDA)  
Bldg. no. 15, Khalid Abu Dalbough St. Abdoun  
Amman 11195, Jordan  
Email: [c.biradar@cgiar.org](mailto:c.biradar@cgiar.org)

### **Tom BLACK**

Counsellor (Agriculture)  
Embassy of Australia  
37 South Sathorn Road  
Bangkok 10120

### **Christopher F. BRUTON**

Executive Director  
Dataconsult Ltd.  
54 Soi Santipharp, Nares Road  
Bangkok 10500, Thailand  
E-mail: [chris@dataconsult.co.th](mailto:chris@dataconsult.co.th)

**Apinya BUAKLA**

Research Officer  
Department of Agriculture  
Embassy of Australia  
37 South Sathon Road  
Bangkok 10120  
E-mail: [Apinya.Buakla@dfat.gov.au](mailto:Apinya.Buakla@dfat.gov.au)

**Sukanya CHAICHUEN**

Thai Feed Mill Association  
Room 170, 17th floor, Thai CC Tower  
889 south Sathon Road, Yan Nawa, Sathon  
Bangkok 10120, Thailand  
E-mail: [sukanya\\_2120@yahoo.com](mailto:sukanya_2120@yahoo.com)

**Chockchai CHAIMONGKOL**

Chief of Research and Dairy Development  
Dairy Farming Promotion Organization of  
Thailand  
160 Mitraphab Road, Muak Lek District  
Saraburi 18180, Thailand  
E-mail: [chockchai.c@dpo.go.th](mailto:chockchai.c@dpo.go.th)

**Tritsadee CHAOSUANCHAROEN**

Director General  
Department of Livestock Development,  
Phaya Thai Road, Ratchathewee  
Bangkok, Thailand

**Muhammad Munir CHOWDHURY**

Managing Director  
Bangladesh milk Producers' Co-operative Union  
Ltd. (Milk Vita)  
139-140, Tejgaon Industrial Area  
Dhaka-1208, Bangladesh  
E-mail: [mmunirc@gmail.com](mailto:mmunirc@gmail.com)

**Narongsak CHOWJAIMEESUK**

Assistant Manager  
Thai Feed Mill Association  
Room 170, 17th floor, Thai CC Tower  
889 south Sathon Road, Yan Nawa, Sathon  
Bangkok 10120, Thailand  
E-mail: [nutpiero@gmail.com](mailto:nutpiero@gmail.com)

**Bernhard DALHEIMER**

Statistician and Economist  
FAO Headquarters  
B459, Vaile delle Terme di Caracalla, 00153  
Roam, Italy  
E-mail: [Bernhard.dalheimer@hotmail.com](mailto:Bernhard.dalheimer@hotmail.com)

**Jeroen DIJKMAN**

Senior Officer (Livestock sector policy), FAO  
Viale delle Terme di Caracalla  
E-mail: [Jeroen.dijkman@fao.org](mailto:Jeroen.dijkman@fao.org)

**Tuyen DINH (THEO)**

Technical Manager  
De Heus Animal Nutrition, Vietnam  
Vietnam  
E-mail: [theo-tuyen@deheus.com.vn](mailto:theo-tuyen@deheus.com.vn)

**Neil FRASER**

Chair, Guiding Group  
Global Agenda for Sustainable Livestock  
75 Wadestown Road  
Wellington 6012, New Zealand  
E-mail: [Neil.fraser@fao.org](mailto:Neil.fraser@fao.org)

**Teruhide FUJITA**

Adviser  
Japan Livestock Technology Association  
3-20-9, Yushima, Bunkyo-ku  
Tokyo 113-0034, Japan  
E-mail: [terufujita@aol.com](mailto:terufujita@aol.com)

**Premalal G.G.C.**

Senior Research Officer  
Department of Animal Production and Health/  
Veterinary Research Institute  
Gannoruwa, Peradeniya,  
Sri Lanka  
Email: [Chandrasiri.premalal.premalal@gmail.com](mailto:Chandrasiri.premalal.premalal@gmail.com)

**Myrna GALANG**

University Researcher and  
Head, Information Management and Technical  
Services Unit  
Animal and Dairy Sciences Cluster,  
College of Agriculture,  
University of Philippines Los Baños  
Los Baños, Laguna



**Manget Ram GARG**

General Manager  
National Dairy Development Board (NDDDB)  
Animal Nutrition Group  
NDDDB, PB No.40, Anand 388001  
Gujarat, India  
E-mail: [mrgarg@nddb.coop](mailto:mrgarg@nddb.coop)

**Francesco GIBBI**

Project Manager  
Common fund for Commodities (CFC)  
Stadhouderskade 55  
1072 AB, Amsterdam  
Netherlands  
E-mail: [fgibbi@yahoo.it](mailto:fgibbi@yahoo.it)

**Rob GREGORY**

Regional Programme Director  
Humane and Sustainable Agriculture (Asia-Pacific)  
World Society for the Protection of Animals C/O  
WSPA Thailand  
7th Floor, Olympia Thai Plaza  
444 Ratchadapisek Road  
Samsen Nok, Huay-Kwang  
Bangkok 10310, Thailand  
E-mail: [RobGregory@wspa-asiapacific.org](mailto:RobGregory@wspa-asiapacific.org)

**Ghulam HABIB**

Professor  
Agricultural University, Peshawar, Pakistan  
House #243, Street-13, Sector-F5, Phase-6  
Hayatabad, Peshawar, KPK  
Pakistan  
E-mail: [habibnutr@gmail.com](mailto:habibnutr@gmail.com)

**Khin HLAING**

Secretary  
Myanmar Dairy Association  
Conor of Bayintnaung Road & Sethmusaywar  
Street, West Gyogone Ward  
Yangon, Myanmar

**Jack HOLDEN**

Sustainability & Social Responsibility Manager  
Fonterra  
327 Ferntree Gully Road  
Mt Waverley 3149, Victoria, Australia  
E-mail: [jack.holden@fonterra.com](mailto:jack.holden@fonterra.com)

**Khan Shahidul HUQUE**

Chief Scientific Officer (CSO) & Head,  
Animal Production Research Division  
Bangladesh Livestock Research Institute (BLRI)  
Savar, Dhaka 1341, Bangladesh  
E-mail: [kshuque58@gmail.com](mailto:kshuque58@gmail.com)

**Khan Shahidul HUQUE**

Chief Scientific Officer (CSO) & Head,  
Animal Production Research Division  
Bangladesh Livestock Research Institute (BLRI)  
Savar, Dhaka 1341, Bangladesh  
E-mail: [kshuque58@gmail.com](mailto:kshuque58@gmail.com)

**Suchart JARIYALERTSAK**

Deputy Director  
Dairy Farming promotion Organization of  
Thailand  
101 Paholyothin Road, Jatuchak District  
Bangkok 10900, Thailand  
E-mail: [suchart.j@dpo.go.th](mailto:suchart.j@dpo.go.th)

**Oranooj JIRAWATTANANURUK**

Chief of Policy and Planning Department  
Dairy Farming Promotion Organization of  
Thailand  
101 Paholyothin Road, Jatuchak District  
Bangkok 10900, Thailand  
E-mail: [oranooj.j@dpo.go.th](mailto:oranooj.j@dpo.go.th)

**Eric KEMP-BENEDICT**

SEI Asia Centre Director  
Stockholm Environment Institute  
15th floor, Witthayakit Building  
Chulalongkorn University  
254 Chulalongkorn Soi 64, Pathumwan  
Bangkok 10330, Thailand  
E-mail: [eric.kemp-benedict@sei-international.org](mailto:eric.kemp-benedict@sei-international.org)

**Keo Keriya**

Embassy of Cambodia  
Thailand

**Nguyen Quoc KHANH**

Executive Director  
Vinamilk JSC  
Vietnam  
E-mail: [nqkhanh@vinamilk.com.vn](mailto:nqkhanh@vinamilk.com.vn)

**Khwanchai KREAUSUKON**

Dean  
Faculty of Veterinary Medicine  
Chiangmai University  
Moo 4, Mae Hea, Muang  
Chiang Mai 50100, Thailand  
E-mail: [dean.vet@cmu.ac.th](mailto:dean.vet@cmu.ac.th)

**Buncha KULPASERTSRI**

Thail Feed Mill Association  
Bangkok, Thailand

**T Nanda KUMAR**

Chairman  
National Dairy Development Board  
Anand – 388 001,  
Gujarat, India  
E-mail: [chairman@nddb.coop](mailto:chairman@nddb.coop) ; [tvb@nddb.coop](mailto:tvb@nddb.coop)

**Helen LEITCH**

Senior Livestock Specialist  
The World Bank  
70 Lodhi Estate  
New Delhi 110 003, India  
E-mail: [hleitch@worldbank.org](mailto:hleitch@worldbank.org)

**JB Liang**

Research Fellow  
Institute of Tropical Agriculture  
Universiti Putra Malaysia  
43400 Serdang, Malaysia  
Email: [jbliang@upm.edu.my](mailto:jbliang@upm.edu.my)

**Brian LINDSAY**

Development Director  
Global Dairy Agenda for Action

**Brian LINDSAY**

Development Director  
Global Dairy Agenda for Action  
Regional Office – Ridgeway Cottage, Tetbury  
Lane, Crudwell, Wilts, SN16 9 HB, England  
E-mail: [brian@lindsay-consulting.com](mailto:brian@lindsay-consulting.com)

**Chaiyan LOHAPANWONG**

President  
Thai Dairy Industry Association (TDIA)  
E-mail: [chaiyan.l@cpmeiji.com](mailto:chaiyan.l@cpmeiji.com)

**Harinder MAKKAR**

Livestock Production Officer  
FAO  
Viale delle Terme di Caracalla  
Rome, Italy  
E-mail: [harinder.makkar@fao.org](mailto:harinder.makkar@fao.org)

**Sujarit MAYALARP**

President  
CP-MEIJ I Co.,Ltd.  
1 C.P. Tower 2, 30th Floor  
Rachadapisek Road, Din-Dang  
Bangkok 10400, Thailand  
E-mail: [sujarit.may@cpmeiji.com](mailto:sujarit.may@cpmeiji.com)

**James MCVITTY**

Trade Strategy Manager  
Fonterra  
#15-06 One George Street  
Singapore 049145, Singapore  
E-mail: [James.mcvitty@fonterra.com](mailto:James.mcvitty@fonterra.com)

**Marianne MONTICELLO**

Agriculture Assistant  
Office of the Special Agriculture Representative  
Embassy of the Philippines  
Bangkok 10110, Thailand  
Telephone : (662) 259 0139 to 40  
Email: [marianne.montecillo@yahoo.com](mailto:marianne.montecillo@yahoo.com)

**John MORAN**

Coordinator, Asia Dairy Network/  
Advisor Profitable Dairy Systems  
24 Wilson Street, Kyabram  
Victoria 3620, Australia  
E-mail: [jbm95@hotmail.com](mailto:jbm95@hotmail.com)

**Chloé MOULINS**

Deputy Economic Counsellor  
Economic Department  
French Embassy in Thailand  
Charn Issara Tower I (22nd Floor)  
942 Rama IV Road  
Bangkok 10 500 - Thailand

**Win MYINT**

Director  
Livestock Breeding and Veterinary Department  
Ministry of Livestock, Fisheries and Rural  
Development  
Nay Pyi Taw, Myanmar  
E-mail: [dr.winmyint123@gmail.com](mailto:dr.winmyint123@gmail.com)

**Togtokhbayar NOROVSAMBUUGIIN**

Scientific Secretary  
Mongolian State University of Agriculture  
School of Biological Resources and  
Management  
E-mail: [Toogji\\_1229@yahoo.com](mailto:Toogji_1229@yahoo.com)

**Wasana Adi NUGRAHA**

Third Secretary  
Economic Affairs  
Embassy of the Republic of Indonesia  
Petchburi Road 600-602, Ratchatewi  
Bangkok 10400, Thailand  
E-mail: [adeveronica@gmail.com](mailto:adeveronica@gmail.com)

**Arthit NUKOONKIT**

General Manager  
CP-MEIJ I Co., LTD.  
2/9 Moo 4, Phaholyothin Road  
Nongnak, Saraburi 18230, Thailand  
E-mail: [Arthit.nuk@cpmeiji.com](mailto:Arthit.nuk@cpmeiji.com)

**Jaruwat NUTDECHANAN**

Department of Livestock Development,  
Phaya Thai Road, Ratchathewee  
Bangkok, Thailand

**Carolyn OPIO**

Natural Resources Officer  
FAO, Rome  
Viale delle Terme di Caracalla  
E-mail: [carolyn.opio@fao.org](mailto:carolyn.opio@fao.org)

**Netra Prasad OSTI**

Chief (Senior Scientist, Animal Nutrition and  
Feeding)  
Animal Nutrition Division  
National Animal Science Research Institute  
Khumaltar Lalitpur, Nepal  
Email: [n\\_osti@yahoo.com](mailto:n_osti@yahoo.com) ; [ostinp@narc.gov.np](mailto:ostinp@narc.gov.np)

**Joachim OTTE**

Senior Animal Production and Health Officer  
FAO Regional Office for Asia and the Pacific  
Maliwan Mansion, 39 Phra Atit Rd.  
Bangkok, Thailand  
E-mail: [Joachim.Otte@fao.org](mailto:Joachim.Otte@fao.org)

**Oran PRANYAJAN**

Thai Feed Mill Association,  
Bangkok Thailand

**Pornsil PATCHRINTANAKUL**

President  
Thai Feed Mill Association  
Room 170, 17th floor, Thai CC Tower  
889 south Sathon Road, Yan Nawa, Sathon  
Bangkok 10120, Thailand  
E-mail: [Pornsil2724@gmail.com](mailto:Pornsil2724@gmail.com)

**Pornpimol PATTAMANONT**

Department of Livestock Development,  
Phaya Thai Road, Ratchathewee  
Bangkok, Thailand

**Thumrongsakd PHONBUMRUNG**

Regional Coordinator  
Smallholder Dairy Development Programme  
FAO Regional Office for Asia and the Pacific  
Maliwan Mansion, 39 Phra Atit Rd.  
Bangkok, Thailand  
E-mail: [Thumrongsakd.Phonbumrung@fao.org](mailto:Thumrongsakd.Phonbumrung@fao.org)

**Vichien POLVATANASUG**

Vice President  
Milk For Thai Organization  
129 Soi Sukhumvit 62 yaek 1  
Bangchak, Prakhanong  
Bangkok 10260, Thailand  
E-mail: [vichienp28@hotmail.com](mailto:vichienp28@hotmail.com)

**Kanokkarn POOSUWAN**

Department of Livestock Development,  
Phaya Thai Road, Ratchathewee  
Bangkok, Thailand  
E-mail: [knkpoosuwan@hotmail.com](mailto:knkpoosuwan@hotmail.com)

**Rujipas PPORNKUNTHAM**

Embassy of the Federal Republic of Germany,  
Bangkok, Thailand

**Mark POWELL**

Research Soil Scientist-Agroecology  
USDA Agricultural Research Service  
US Dairy Forage Research Center  
University of Wisconsin-Madison  
Madison, WI 53706, USA  
E-mail: [mark.powell@ars.usda.gov](mailto:mark.powell@ars.usda.gov)

**C.S. PRASAD**

Director  
National Institute of Animal Nutrition and  
Physiology (ICAR)  
Hosur Main Road  
Bangalore-560030, India  
E-mail: [cadaba\\_prasad@yahoo.co.in](mailto:cadaba_prasad@yahoo.co.in)

**Sakchai PREECHAJARN**

Agricultural Specialist  
Office of Agricultural Affairs  
US. Embassy  
Bangkok, Thailand  
E-mail: [Sakchai.Preechaj@fas.usda.gov](mailto:Sakchai.Preechaj@fas.usda.gov)

**Veerasak PUNYAPORNWITHAYA**

Dean's Representative for IT  
Faculty of Veterinary Medicine  
Chiangmai University  
Chiang Mai 50100, Thailand  
E-mail: [Pveerasak.r@gmail.com](mailto:Pveerasak.r@gmail.com)

**Brent RAPSON**

First Secretary (International Development)  
New Zealand Embassy  
M Thai Tower, 14th Floor  
All Seasons Place, 87 Wireless Road  
Bangkok, Thailand  
E-mail: [brent.rapson@mfat.govt.nz](mailto:brent.rapson@mfat.govt.nz)

**Mr. Md. Azizur RAHMAN**

Counsellor  
Embassy of Bangladesh  
House No 47/8, Ekamai Soi 30  
Sukhumvit 63, Klongton Nua  
Watthana, Bangkok 10110

**Somboon RATTAPORN**

Thail Feed Mill Association  
Bangkok, Thailand

**Suvichai ROJANASTHIEN**

Associate Professor  
Faculty of Veterinary Medicine  
Chiangmai University  
Chiang Mai 50100, Thailand  
E-mail: [suvichai.rojanasthie@cmu.ac.th](mailto:suvichai.rojanasthie@cmu.ac.th)

**Suvichai ROJANASTHIEN**

Associate Professor  
Faculty of Veterinary Medicine  
Chiangmai University  
Chiang Mai 50100, Thailand  
E-mail: [suvichai.rojanasthie@cmu.ac.th](mailto:suvichai.rojanasthie@cmu.ac.th)

**Sinchai RUENGPABUL**

Expert Dairy Extension  
Department of Livestock Development,  
Phaya Thai Road, Ratchathewee  
Bangkok, Thailand

**Nopparat RUNGUTHAISRI**

Senior Researcher,  
Chula Unisearch,  
Chulalongkorn University,  
Bangkok , Thailand

**Wuttichai SARIKIT**

Marketing Section Chief  
Betagro PCL.  
46 Petchaheung Road, Prapadaeng  
Samutprakarn 10130, Thailand  
E-mail: [wuttichaisa@betagro.com](mailto:wuttichaisa@betagro.com)

**Pornchai SAWASSUKSOPCHAI**

Managing Director  
Dutchmill Co. Ltd.  
98 Sathorn Square Office Tower #29  
Silom, Bangkok 10500

**Win SEIN**

Vice Chairman  
Myanmar Livestock Federation  
524 B, Merchant Street, Kyauk Tada  
Township Yangon, Myanmar  
E-mail: [hoisoonco.ltd@gmail.com](mailto:hoisoonco.ltd@gmail.com)

**Tjeppy D. SOEDJANA**

Senior Researcher, Livestock Policy and Modeling  
Indonesian Center for Animal Research and  
Development/ICARD  
Ministry of Agriculture  
ICARD, Jalan Raya Pajajaran Kav. E-59  
Bogor 16151, Indonesia  
E-mail: [tjeppyds@indo.net.id](mailto:tjeppyds@indo.net.id)

**Kritapon SOMMART**

Associate Professor  
Department of Animal Science  
Faculty of Agriculture  
Khon Kaen University, Thailand

**Vishnu SONGKITTI**

APHCA Liaison Officer  
FAO Regional Office for Asia and the Pacific  
Maliwan Mansion, 39 Phra Atit Rd.  
Bangkok, Thailand  
E-mail: [Vishnu.Songkitti@fao.org](mailto:Vishnu.Songkitti@fao.org)

**Maesa SRIAMPORN**

Environmental Officer  
Betagro Group  
323 Moo 6, Vibhavadi Rangsit Road  
Tung Song Hong, Laksi  
Bangkok 10210, Thailand  
E-mail: [Maesas@betagro.com](mailto:Maesas@betagro.com)

**Anil Kumar SRIVASTAVA**

Director & Vice-Chancellor  
National Dairy Research Institute  
Deemed University  
Karnal-132001, India  
E-mail: [dir.ndri@gmail.com](mailto:dir.ndri@gmail.com)

**Steve STAAL**

Regional Representative for East and Southeast Asia  
International Livestock Research Institute  
C/O IRRI, DAPO Box 7777  
Metro Manila, Philippines  
E-mail: [s.staal@cgiar.org](mailto:s.staal@cgiar.org)

**Juthathip SUBHASWASDIKUL**

Senior Development Programme Coordinator  
New Zealand Embassy  
M Thai Tower, 14th Floor  
All Seasons Place, 87 Wireless Road  
Bangkok, Thailand  
E-mail: [juthathip.subhaswasdikul@mfat.govt.nz](mailto:juthathip.subhaswasdikul@mfat.govt.nz)

**Piyawan T. SUKONPATHIP**

Embassy of Japan  
Email: [piyawan.s@bg.mofa.go.jp](mailto:piyawan.s@bg.mofa.go.jp)

**Luu Van TAN**

Dairy Development Manager  
Dairy Development Program  
Friesland Campina Vietnam  
Binh Hoa Ward, Thuan An District  
Binh Duong Province, Vietnam  
E-mail: [tan.luuvan@frieslandcampina.com](mailto:tan.luuvan@frieslandcampina.com)

**Nivit TANGLERTPAIBUL**

Environmental Officer  
Betagro Group  
323 Moo 6, Vibhavadi Rangsit Road  
Tung Song Hong, Laksi  
Bangkok 10210, Thailand  
E-mail: [nivitt@betagro.com](mailto:nivitt@betagro.com)

**Md. Hasib Khan TARUN**

Chairman  
Bangladesh milk Producers' Co-operative Union Ltd.  
(Milk Vita)  
139-140, Tejgaon Industrial Area  
Dhaka-1208, Bangladesh  
E-mail: [Chairman.milkvita@yahoo.com](mailto:Chairman.milkvita@yahoo.com)

**Surin THANALERTKUL**

Trade Commissioner  
Embassy of Canada  
15th Floor, Abdulrahim Place 990 Rama IV Road  
Bangkok 10500, Thailand

**Prayuth THANAPONGCHAROEN**

Technical Veterinarian  
Betagro PCL.  
46 Petchaheung Road, Prapadaeng  
Samutprakarn 10130, Thailand  
E-mail: [prayutht@betagro.com](mailto:prayutht@betagro.com)

**Luong Huu THANH**

Head of Environmental Biology Department  
Institute for Agricultural Environment  
Hanoi, Vietnam  
E-mail: [huuthanhvasi@gmail.com](mailto:huuthanhvasi@gmail.com)

**Thanawat TIENSIN**

Department of Livestock Development,  
Phaya Thai Road, Ratchathewee  
Bangkok, Thailand  
E-mail: [ttiensin@gmail.com](mailto:ttiensin@gmail.com)

**Noppadon TUNVICHIE**

Director in-charge  
Dairy Promotion Organization of Thailand  
101 Paholyothin Road, Jatuchak District  
Bangkok 10900, Thailand

**Mohammad Mohi UDDIN**

Assistant Professor  
Department of Animal Nutrition  
Faculty of Animal Husbandry  
Bangladesh Agricultural University  
Mymensingh-2202, Bangladesh  
E-mail: [muuddin\\_bau@yahoo.com](mailto:muuddin_bau@yahoo.com)

**UGYEN**

Senior Livestock Officer  
National Center for Animal Nutrition  
Department of Livestock  
Ministry of Agriculture & Forests  
Bumthang, Bhutan  
E-mail: [ugyen@gmail.com](mailto:ugyen@gmail.com) ; [ugyen@moaf.gov.bt](mailto:ugyen@moaf.gov.bt)

**Asyl UNDELAND**

Consultant  
International Fund for Agriculture Development  
42/5 M, 4th Lane, Kandawattha Road,  
Batteramulla, Sri Lanka  
E-mail: [aundeland@yahoo.com](mailto:aundeland@yahoo.com)

**Chanyapach UNHAJATA**

Embassy of Japan  
Email: [chanyapach.u@bg.mofa.go.jp](mailto:chanyapach.u@bg.mofa.go.jp)

**Le Thi Phi VAN**

Senior Researcher  
Institute of Policy & Strategy for Agriculture &  
Rural Development (IPSARD)  
E-mail: [lethiphivan@gmail.com](mailto:lethiphivan@gmail.com)

**Pravee VIJCHULATA**

Dairy Advisor  
K.U. Dairy Center  
Kasetsart University  
50 Paholyothin Road  
Bangkok 10900, Thailand  
E-mail: [agrpvv@ku.ac.th](mailto:agrpvv@ku.ac.th)

**John WADE**

Agricultural Counsellor  
US. Embassy  
Bangkok, Thailand

**Geoff WALKER**

Chief of Party,  
Bangladesh Dairy Enhancement Project  
Land O'Lake, International Development Division  
A2, House 36, Road 18, Block J Banani  
Dhaka 1213, Bangladesh  
E-mail: [Geoff.walker@idd.landolakes.com](mailto:Geoff.walker@idd.landolakes.com)

**Naiten WANGCHUK**

Chief Livestock Officer  
Department of Livestock  
Ministry of Agriculture and Forest  
Thimphu, Bhutan  
E-mail: [naitenw@gmail.com](mailto:naitenw@gmail.com)

**Amphon WARITTHITHAM**

Director  
Livestock Industry Development Center  
Department of Livestock Development  
122 Houy Kaew Road, Chang Phuak  
Chiang Mai 50300, Thailand  
E-mail: [Amphon\\_ans@hotmail.com](mailto:Amphon_ans@hotmail.com)

**Geert WESTENBRINK**

Policy Coordinator  
DG-Agro of the Netherlands Ministry of  
Economic Affairs  
E-mail: [g.westenbrink@minez.nl](mailto:g.westenbrink@minez.nl)

**Axel Wildner**

Counselor ( Food, Agriculture and Consumer  
Protection  
The Embassy of the Federal Republic of Germany  
9 South Sathorn Road, Bangkok 10120  
E-mail: [axel.wildner@diplo.de](mailto:axel.wildner@diplo.de)

**Brendan WILKINS**

Farm Management Service Manager  
Tetra Pak (Thailand) Ltd.  
1042 Soi poosin (Sukhumvit 66/1),  
Sukhumvit Rd.  
Bangchak, Prakanong  
Bangkok 10260, Thailand  
E-mail: [Brendan.wilkins@tetrapak.com](mailto:Brendan.wilkins@tetrapak.com)

**Weerasak WONGSOMBAT**

President  
Milk for Thai Organization  
129 Soi Sukhumvit 62 Yaek 1  
Bangchak, Prakanong  
Bangkok 10260, Thailand  
E-mail: [milkforthaicoordinator@hotmail.com](mailto:milkforthaicoordinator@hotmail.com)

**Narongrit WONGSUWAN**

Assistant Director of DPO  
Dairy Farming Promotion Organization of Thailand  
E-mail: [narong\\_won@yahoo.com](mailto:narong_won@yahoo.com)

**Liu De WU**

South china agricultural university  
Wushan street, Tianhe, Guangzhou, Guangdong  
483,Wushan, Tianhe, Guangzhou, Guangdong  
Email: [dwliu@scau.edu.cn](mailto:dwliu@scau.edu.cn)

**Veeris WUTHIRONARITH**

Assistant Vice President  
Charoen Pokphand Group Co., Ltd.  
313 C.P. Tower, 14th floor, Silom Road  
Silom, Bang Rak  
Bangkok 10500, Thailand  
E-mail: [v-ris.w@cpf.co.th](mailto:v-ris.w@cpf.co.th)

**Young-Han YOU**

The Embassy of the Republic of Korea  
23 Thiam-Ruammit Road, Ratchadaphisek, Huay Kwang  
Bangkok 10320

**Secretariat****Thanawan AMPAIPANVIJIT**

Administrative Officer  
APRACA  
Bank for Agriculture and Agricultural Cooperatives  
(BAAC)  
Bangkok, Thailand  
E-mail: [thanawan@apraca.org](mailto:thanawan@apraca.org)

**Unchana STEANE**

Accountant  
APRACA  
BAAC  
Bangkok, Thailand  
E-mail: [unchana@apraca.org](mailto:unchana@apraca.org)

**Charatkae CHEAWTHUNYAKIT**

International Relations Officer  
Faculty of Veterinary Medicine  
Chiangmai University  
Chiang Mai 50100, Thailand  
E-mail: [charatka@gmail.com](mailto:charatka@gmail.com)

**Tuanchai LAISAKUN**

FAORAP  
Maliwan Mansion  
39 Phra Atit Rd.,  
Bangkok, Thailand  
E-mail: [tuanchai.laisakun.@fao.org](mailto:tuanchai.laisakun.@fao.org)

**Suarjar LEWCHALERMVONGS**

FAORAP  
Maliwan Mansion  
39 Phra Atit Rd.,  
Bangkok, Thailand  
E-mail: [SuArjar.Lewchalermvongs@fao.org](mailto:SuArjar.Lewchalermvongs@fao.org)

**Yupaporn SIMUANGNGAM**

APHCA IT Clerk  
FAORAP  
Maliwan Mansion  
39 Phra Atit Rd.,  
Bangkok, Thailand  
E-mail: [Yupaporn.Simuangngam@fao.org](mailto:Yupaporn.Simuangngam@fao.org)

نمنا