Strengthening potato value chains

TECHNICAL AND POLICY OPTIONS FOR DEVELOPING COUNTRIES

Strengthening potato value chains

TECHNICAL AND POLICY OPTIONS FOR DEVELOPING COUNTRIES

Coordinated by
Nicolaus Cromme
Common Fund for Commodities
Amsterdam, The Netherlands

Adam B. Prakash
Trade and Markets Division
FAO, Rome, Italy

NeBambi Lutaladio
Plant Production and Protection Division
FAO, Rome, Italy

Fernando Ezeta
International Potato Center
Lima, Peru

PUBLISHED BY
the Food and Agriculture Organization of the United Nations
and the Common Fund for Commodities.
Rome, 2010

ISBN 978-92-5-106627-0

managing.director@common-fund.org
Common Fund for Commodities
Stadhouderskade 55
1072 AB Amsterdam
The Netherlands

copyright@fao.org
Food and Agriculture Organisation of the United Nations
Viale delle Terme di Caracalla
00153 Rome
Italy

Table of contents

Acknowledgements

This publication is based on the proceedings of the workshop "Strengthening Potato Value Chains in Developing Countries" held in November 2008, in Rome, Italy, and hosted by the Food and Agriculture Organization of the United Nations (FAO) and the Common Fund for Commodities (CFC). The workshop was held within the context of the International Year of the Potato (IYP), which was facilitated by the FAO Plant Production and Protection Division (AGP), in partnership with the International Potato Center (CIP).

The workshop was designed to review the current state of potato value chains in developing countries and identify the key constraints to a better functioning value chain, especially the role of the seed sector in providing the chain with a consistent quality product. It also provided a forum for discussing opportunities to re-engineer value chains to enhance food security and rural development, to counter cereal price inflation and to identify how development agencies, national authorities and the private sector can support value chain activities. The valuable contributions made at this forum by many individual participants are very much acknowledged. Their inputs and discussions were fundamental in developing a series of technical and policy options that will now help lay the foundation for sustainable potato-based systems and value chains.

We warmly recognize the contribution of those present at the workshop, including: Alpha Diallo, (EUCORD, Guinea), Berga Lemaga (CIP, Uganda), Jon Tong Gon and Kim Myong Dok (Academy of Agricultural Sciences, DPR Korea), Peter Joyce (United States Potato Board), Karma Nidup (Department of Agriculture, Bhutan), Brian Moir (FAO/ESTM), Prem Gaur (Retired Agricultural scientist, India), Fengyi Wang (CIP, China), Kurt Manrique (CIP, Peru), Peter Gildemacher (Royal Tropical Institute, Netherlands), Mieke Ameriana (Indonesian Vegetables Research Institute), Ganesh Ghettri (Department of Agriculture, Bhutan), Hans Peeten (NIVAP, the Netherlands) and Henk Knipscheer (Winrock, Brussels).

Special thanks to those who coordinated the workshop and the production of this publication, namely: Nicolaus Cromme (CFC), Adam Prakash and NeBambi Lutaladio (FAO). Thanks to Nancy Hart for providing editing support, Giulio Sansonetti for publication design and to Joanne Morgante for impagination, graphs and charts. Finally, and above all, the financial support from the Common Fund for Commodities that helped organize the workshop and made this publication possible is highly appreciated.

Abbreviations and acronyms

ACIAR	Australian Centre for International Agricultural Research
AGP	Plant Production and Protection Division (FAO)
APHIS	Animal Plant and Health Inspection Service (USA)
ARM	*L'Agence de Régulation des Marchés* (Senegal)
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AUMN	*L'Association des Unions Maraîchères des Niayes* (Senegal)
CAPAC	*Cadenas Productivas Agrícolas de Calidad en el Perú*
CET	Common external tariff
CFC	Common Fund for Commodities
CIP	International Potato Center
CIPC	chlorpropham
CNY	Chinese yuan
COMESA	Common Market for Eastern and Southern Africa
CPRI	Central Potato Research Institute (India)
CSO	Civil society organization
EIAR	Ethiopian Institute of Agricultural Research
EU	European Union
EUCORD	European Cooperative for Rural Development
FAO	Food and Agriculture Organization of the UN
FAPA	District agropastoral farms (Guinea)
FFS	Farmer Field School
FIGG	FAO Intergovernmental Group on Grains
FPFD	Farmer Federation of Fouta-Djallon (Guinea)
FYM	Farmyard manure
GTZ	German Technical Cooperation
ICB	International commodity body
IGG	Intergovernmental Group (FAO)
INCOPA	Innovation and Competitiveness of Peru's Potato Sector Project
IPM	Integrated pest management
IRR	Internal rate of return
IS	Innovation system
IYP	International Year of the Potato
KARI	Kenya Agricultural Resource Institute
KR2	Kennedy Round II
LC	Life cycle
LDC	Least-developed country

LIBOR	London Interbank Offered Rate
MASL	Metres above sea level
MoA	Ministry of Agriculture
NARO	National Agricultural Research Organisation of Uganda
NGO	Non-governmental organization
NPV	Net present value
PMCA	Participatory market chain approach
RGoB	Royal Government of Bhutan
R&D	Research and development
RMB	Renminbi (Chinese yuan)
SDC	Swiss Agency for Development Cooperation
SME	Small- and medium-sized enterprises
SNPV	National Service for Vegetable Protection (Guinea)
SPOMAC	Sweet Potato Market Chains Club (Uganda)
SSA	Sub-Saharan Africa
SWOT	Strengths, weaknesses, opportunities and threats analysis
TCP	Technical Cooperation Programme (FAO)
UNCTAD	UN Conference on Trade and Development
UNDP	UN Development Programme
UNCDF	UN Capital Development Fund
UNIDO	UN Industrial Development Organization
UPOV	International Union for the Protection of New Varieties of Plants
USDA	US Department of Agriculture
USPB	United States Potato Board
WFP	World Food Programme
WTO	World Trade Organization

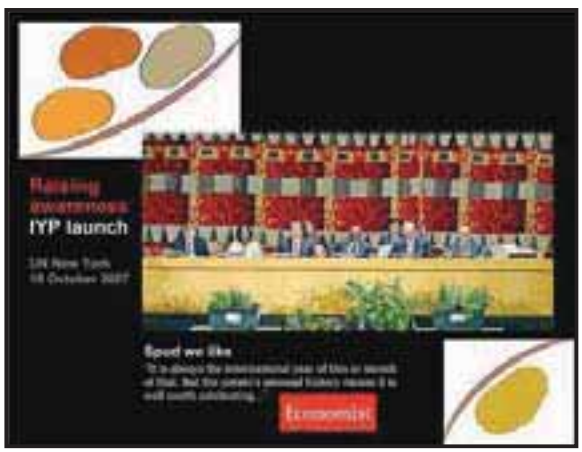
Foreword by FAO
The International Year of the Potato

NeBambi Lutaladio
Senior Officer and Secretary of the International Year of the Potato
Plant Production and Protection Division, FAO

Given the upheaval in international food markets throughout much of 2008, the arrival of the year could not have been timelier. Although there had been increasing awareness of the importance of potato as a source of food, employment and income, the International Year of the Potato encouraged policy-makers, agronomists and economists to re-evaluate the potato in its role as an ideal crop to sustain food security through crisis. After all, potato prices are determined mainly by local production costs and can constitute an effective substitute for costly grain imports. All of this contributed to shifting the perception of the potato from that of an ordinary food for the poor to one that recognizes the tuber's solid nutritional benefits and its role in counteracting the effects of cereal price inflation.

This also led to growing awareness that realizing the full potential of the potato depends on a renewed commitment to potato research. In November of the International Year, the Common Fund for Commodities (CFC) and FAO co-sponsored a workshop, "Strengthening Potato Value Chains in Developing Countries", at FAO headquarters in Rome. Hailed as one of the International Year's major events, CFC and FAO used it as an opportunity to launch a new research agenda for potato in the developing world, targeted towards providing critical improvements along the potato value chain.

Workshop participants recognized that efforts to enhance the potato value chain will be successful only if there are substantial levels of public and private investment in the sector. This includes supporting breeding programmes for delivering clean and high quality potato seed tuber, good agricultural practices, infrastructural improvements and initiatives to support and coordinate activities along the chain.



The International Year of the Potato gave impetus to this effort. It raised awareness of the need for a coalition of stakeholders and for increased scientific support to work toward improving the productivity, profitability and sustainability of potato-based systems, and encouraged a renewed sense of responsibility on the part of the international community for agriculture and rural development. It also provided opportunities to report on the current status of potato value chains, on the key constraints to better functioning potato value chains, and on how value chains can be re-designed to enhance rural development, improve livelihoods and counter food price inflation in developing countries.

Above all, this global recognition of the importance of the potato presented a unique opportunity for all stakeholders along the value chain to work together toward a shared goal. By spreading awareness, the overall success of the International Year was to catalyze potato development programmes beyond 2008, to make a real and sustained contribution to the fight against hunger and poverty. A publication elaborating on best practices for sustainable potato production was released in 2009. This publication presents the work of those who participated in the workshop and contributed to raising awareness about the important role of potato.

FAO and the International Year of the Potato

As the United Nation's lead agency for agriculture and rural development and for the International Year of the Potato, FAO was a key partner in the year's activities – advising on policies and strategies to modernize the potato sector, sharing its extensive knowledge of potato-based systems, promoting appropriate technologies for sustainable intensification of production, and forging links among decision-makers, producers, processors and marketing chains. This type of support is essential, if potato sectors are to thrive in developing countries.

Foreword by CFC
Potato and Commodity Development

Guy Sneyers
CFC Chief Operations Officer

Worldwide more than 320 million tonnes of potatoes are being cultivated annually on 20 million hectares of land. This ranks the potato at number four among the worlds' most important staple food crops. However, the pace of expansion in global potato cultivation – production of which has doubled in the past 20 years – far exceeds that of higher ranked crops such as maize and wheat. At the same time potato production in the traditional potato growing regions of Europe has been steadily declining, but this decline has been more than offset by simultaneous rapid growth in Asia, Africa and Latin America. Today, more than one half of global potato production originates from Developing and Least Developed Countries, up from a share of just 11 percent in 1960.

Despite these impressive increases in total production, potato yields in non-traditional potato producing countries are still far below their agro-ecological potential. Crop husbandry is still poor, because farmers are not fully aware of good agricultural practices for this newly introduced crop. Potato yields also suffer severely due to the use of inappropriate varieties and post-harvest losses. Since potatoes are usually cultivated from earlier generation seed potatoes, crop diseases are passed on from one year to another and from one region to another. A functioning supply system for healthy seed potatoes rarely exists, as it requires a high level of organization amongst various supply chain actors.

Until recently, in many Developing and Least Developed Countries, the potato was relatively unknown and mostly regarded as a subsistence crop. However, today the market is expanding rapidly as potatoes are increasingly popular as a source of affordable food for growing urban populations. In addition, a more affluent middleclass has developed a preference for potatoes in processed forms such as fries and crisps. This growing domestic market presents a valuable opportunity for smallholder farmers. Planting potatoes is in many ways attractive to farmers with little resources and limited means to manage risk: given the right agro-ecological conditions, the plant has a short growth cycle and can be easily integrated into existing agricultural systems. Potatoes have a high per area production potential, can be stored relatively easily and, most importantly, can both be used as a staple food crop for household consumption and food security or sold as a cash crop. Thus, the twin role of potato provides a path out of subsistence farming and poverty with little risk exposure to farmers.

As a reflection of the increasing popularity of the potato in Developing and Least Developed

Countries, the Common Fund for Commodities has registered steadfast growth in its potato project portfolio. The overarching objective of all CFC interventions is to address the formidable challenge of establishing a functioning and efficient potato value chain, which requires the collaborative interaction of all stakeholders - from tissue culture laboratories, to seed multipliers, to producers, to processors and finally to the end users. CFC projects share a common design element in piloting initiatives to demonstrate that integrated potato sector development can have a significant poverty impact.

The workshop presentations summarized in this publication are mostly based on experiences made in CFC potato sector development projects. In line with our policy to disseminate the information generated by CFC financed projects as widely as possible, it is our expectation that this publication will be instrumental to make impressive results and experiences of CFC pilot projects in the potato sector available to a wider audience. We hope that extension workers, researchers, policy makers and others involved in the development of the potato sector will find this document most useful and relevant.

Introduction
The role of potato in developing country food systems

Adam Prakash
Economist
Trade and Markets Division, FAO

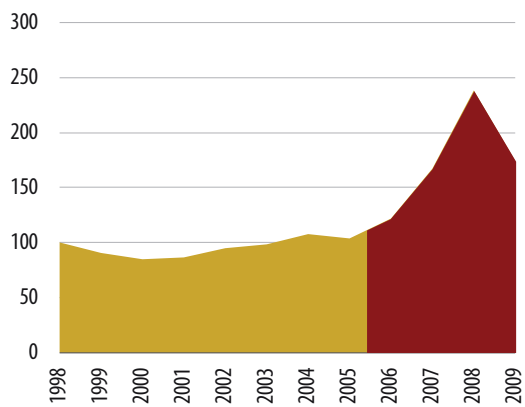
Potato and food price inflation

Commodity prices soared to all time highs between 2007 and 2008, brought about by intense competition for reduced international supplies of cereals and other agricultural commodities. However, by mid-2008, those same prices had fallen back sharply.

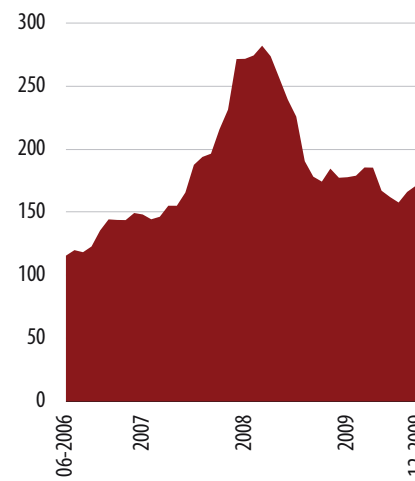
This type of volatility in commodity pricing brings with it food security risks and social unrest, particularly in low-income countries. Overcoming such risks requires adopting both short- and long-term strategies. For example, diversifying the crop base to focus on nutritious and versatile staple foods which are less susceptible to the temperament of international markets is a long-term strategy that could ease the strain of food price inflation and import dependence. The potato is one such staple food.

At the height of the price spikes, FAO surveyed the depth and breadth of food

FAO cereal price index 1998-2009



Monthly FAO cereal price index (Sept. 06-Oct. 09)



price inflation in more than 70 of the most vulnerable countries in the world. It found price inflation was higher and more widespread for cereals than for potato and other root crops. This is because the potato is insulated from international shocks.

Unlike major cereal commodities, potato is thinly traded in global markets. Only a fraction of its total production enters foreign trade. Potato prices are determined by local demand and supply conditions, not the vagaries of international markets. In addition, since potato is absent in major international commodity exchanges, it is not at risk of the ill-effects of speculative activity. Consequently, potato is a highly dependable food security crop that can help ease future turmoil in world food supply and demand.

Global potato economy

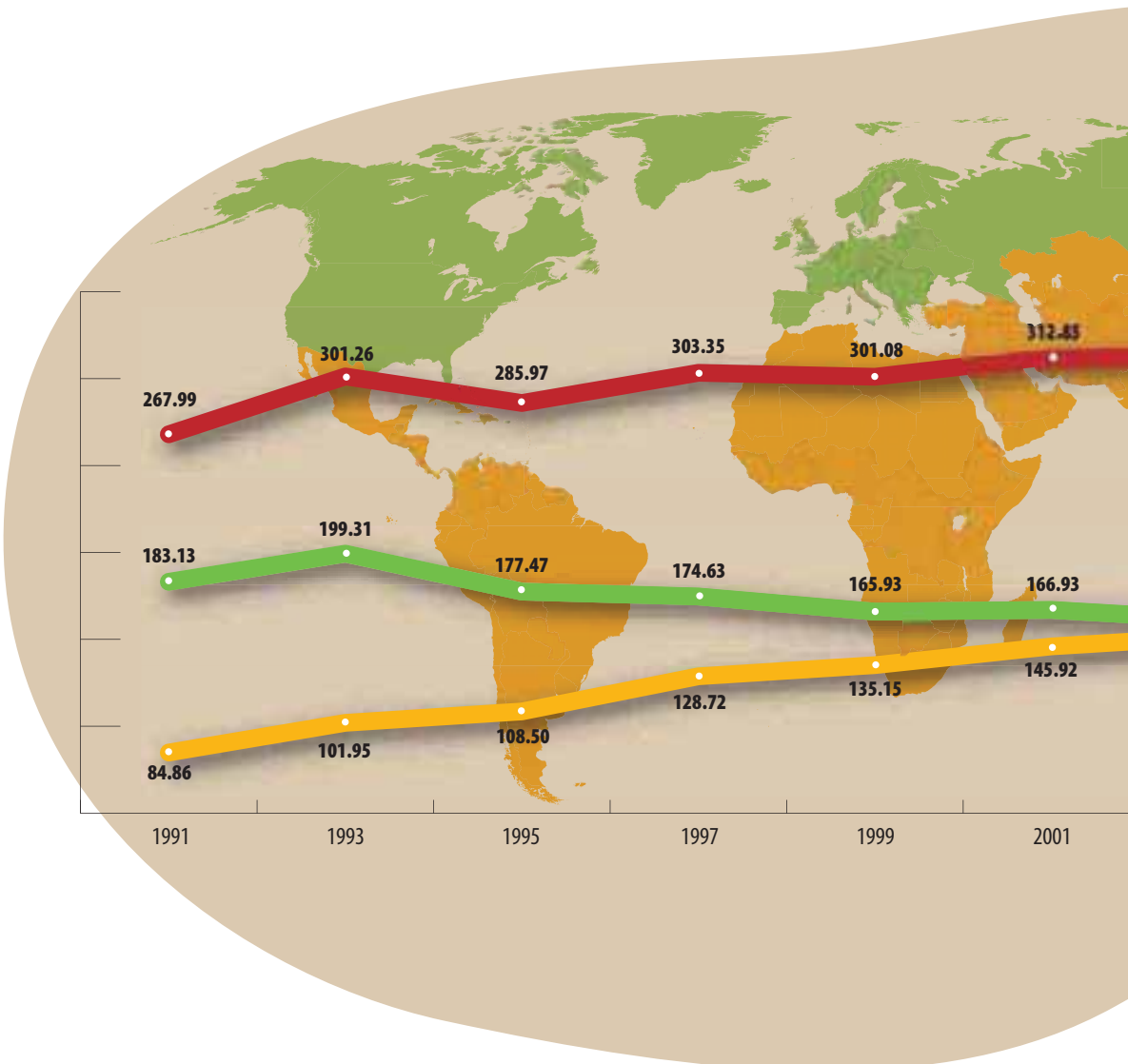
Production

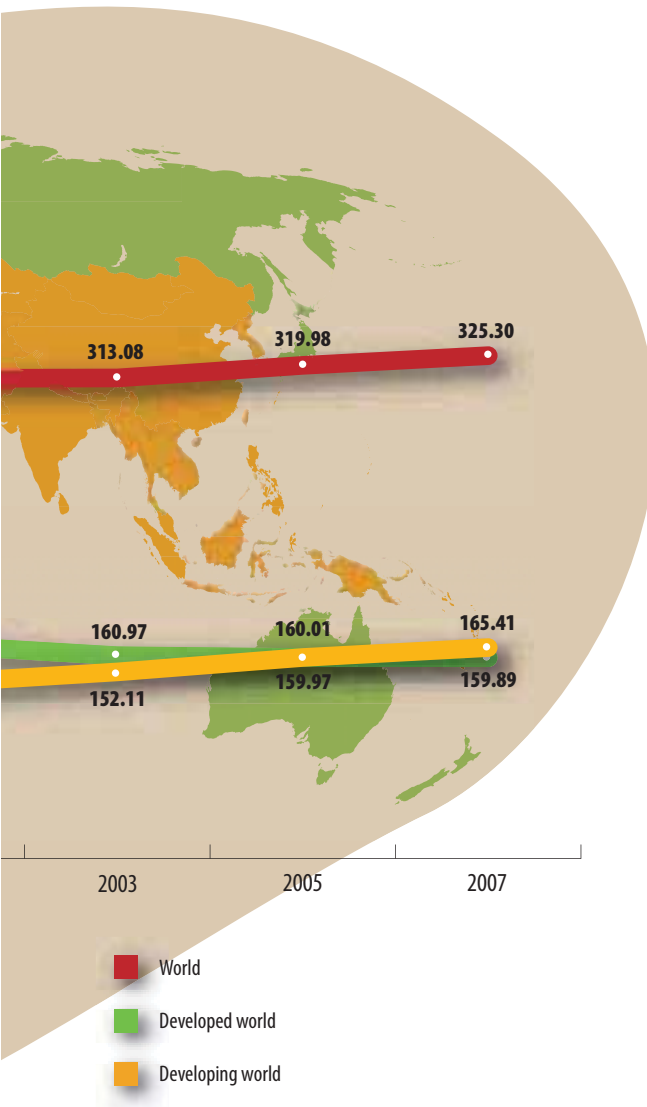
Potato is the world's number one non-grain food commodity. It is cultivated on almost 20 million ha, producing 320 million tonnes in 2007. However, the world potato sector is undergoing major changes.

Until the early 1990s, most potatoes were grown and consumed in Europe, North America and countries of the former Soviet Union. Since then, there has been a dramatic increase in potato production and demand in Asia, Africa and Latin America where their combined output rose from less than 30 million tonnes in the early 1960s to more than 165 million tonnes in 2007. This rapid growth in potato production was in sharp contrast to slowing rates of expansion of other major food crops, such as maize and wheat.

According to FAO, the developing world's potato production exceeded that of the developed world for the first time in 2005. Emerging countries have recently realized potato's potential in food security. In fact, almost a third of all the world's potatoes are harvested in China and India. In China, the world's biggest potato producer, authorities are reviewing proposals for potato to become the country's major food crop to alleviate poverty. In India, authorities are considering plans to double potato output by 2015. Worldwide potato production is projected to expand 2–3 percent annually during the next decade, with developing countries, especially those situated in sub-Saharan Africa, as the main engines of growth.

Top potato producers, 2007



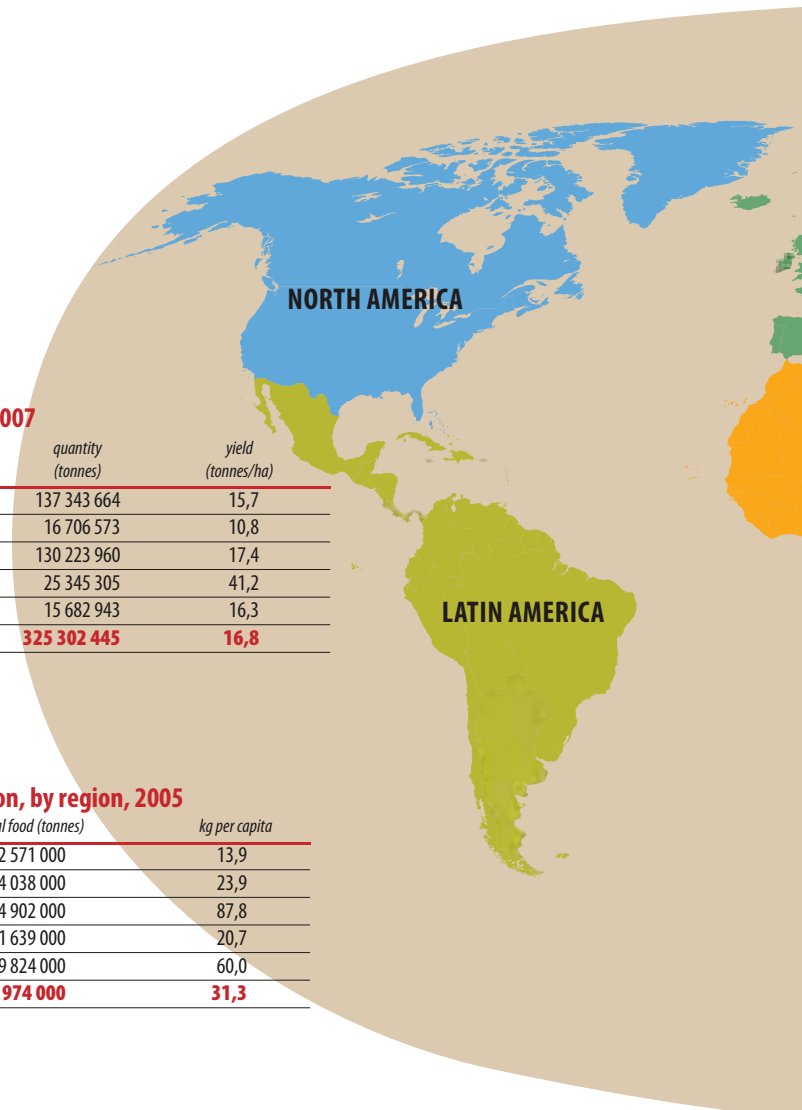


Top potato producers, 2007

		tonnes
1	China	72 040 000
2	Russian Federation	36 784 200
3	India	26 280 000
4	United States of America	20 373 267
5	Ukraine	19 102 000
6	Poland	11 791 072
7	Germany	11 643 769
8	Belarus	8 743 976
9	Netherlands	7 200 000
10	France	6 271 000

Source: FAOSTAT

Potato production and consumption, by region



Potato production, by region, 2007

	harvested area (hectares)	*quantity (tonnes)*	*yield (tonnes/ha)*
Africa	8 732 961	137 343 664	15,7
Asia/Oceania	1 541 498	16 706 573	10,8
Europe	7 473 628	130 223 960	17,4
Latin America	615 878	25 345 305	41,2
North America	963 766	15 682 943	16,3
World	**19 327 731**	**325 302 445**	**16,8**

Source: FAOSTAT

Potato consumption, by region, 2005

	total food (tonnes)	*kg per capita*
Africa	12 571 000	13,9
Asia/Oceania	94 038 000	23,9
Europe	64 902 000	87,8
Latin America	11 639 000	20,7
North America	19 824 000	60,0
World	**202 974 000**	**31,3**

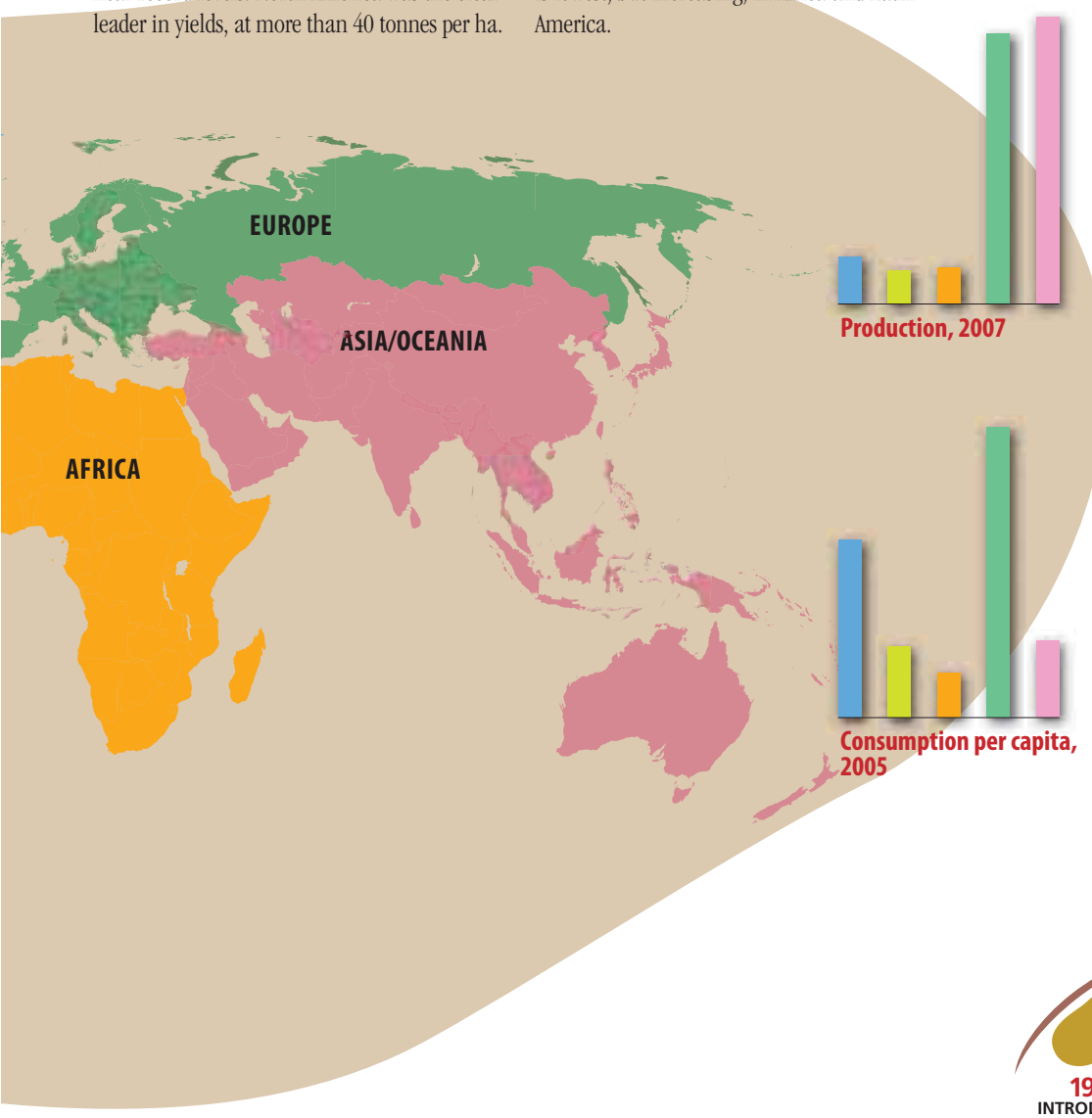
Source: FAOSTAT

Production concentration

Asia and Europe are the world's major potato producing regions, accounting for more than 80 percent of world production in 2007. While 2007 potato harvests in Africa and Latin America were far smaller, production was at or near record levels. North America was the clear leader in yields, at more than 40 tonnes per ha.

Consumption

Asia consumes almost half of the world's potato supply, but its huge population means that consumption was a modest 24 kg per person in 2005. The heartiest potato eaters are Europeans, while per capita consumption is lowest, but increasing, in Africa and Latin America.



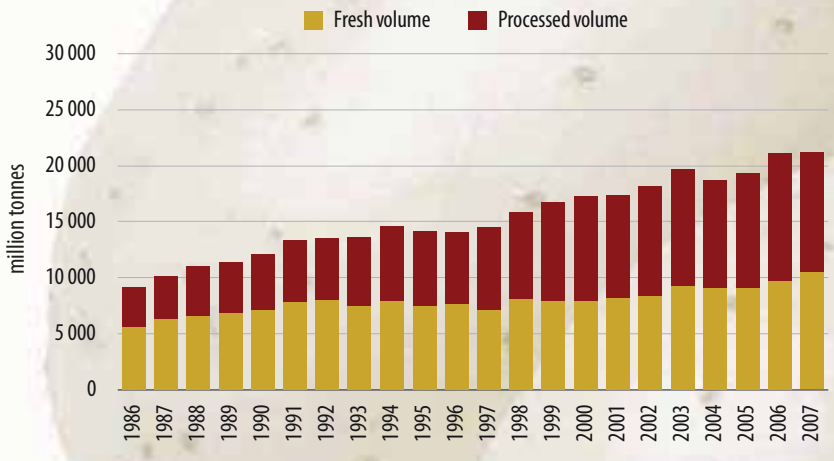
Trade

International trade in potatoes and potato products remains thin relative to production. Only 6 percent of output (21 million tonnes) is traded, although trade has more than doubled in volume since the mid-1980s. This growth has been due to unprecedented international demand for processed foods, particularly frozen and dehydrated potato products.

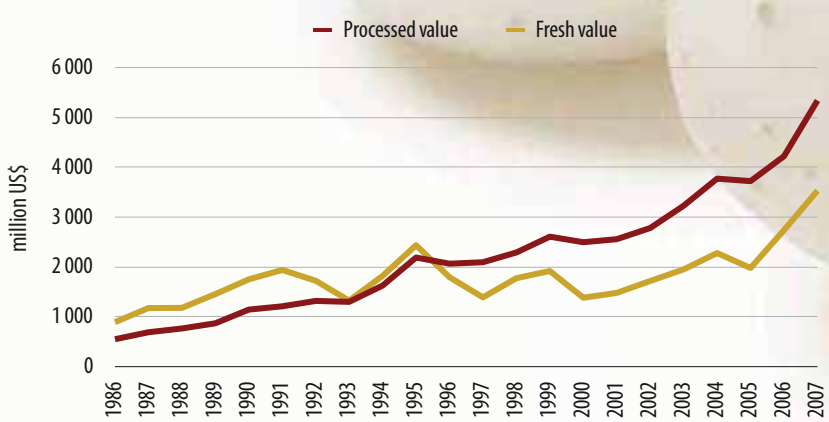
In contrast, international potato trade has almost quadrupled in value since the mid-1980s. Global transactions are worth close to US$96 billion, again dominated by processed potato products.

To date, developing countries have not been beneficiaries of this trade expansion. As a group, they have emerged as leading net importers of the commodity.

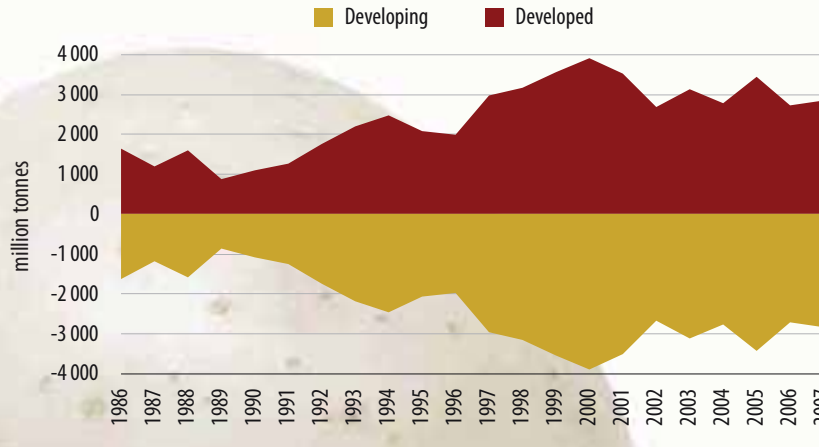
Global potato trade volume (tuber equivalent) 1986-2007



Global potato trade volume (tuber equivalent) 1986-2007



Global net trade (tuber equivalent) 1986-2007



Trade issues

Most countries use *ad valorem* import tariffs to protect domestic potato markets. They also restrict access to markets through sanitary and phytosanitary measures and technical barriers to trade.

Import tariffs on potatoes and potato products are applied by most countries. The binding rates agreed under the aegis of the World Trade Organization vary considerably. Potato provides a classic example of "tariff escalation", whereby importing countries protect processing industries by levying higher duties on processed products than on raw material. Tariff escalation prevents countries from diversifying their export base into higher-value processed products, keeping them "trapped" as providers of raw material.

Countries wishing to supply potato commodities to the international market – especially to the more lucrative developed country markets – also face considerable hurdles in the form of food health standards and technical regulations.

The Doha Development Round of World Trade Organization (WTO) negotiations recognizes the negative impacts of tariff escalation. It includes important provisions aimed at ensuring that standards and regulations do not become *de facto* barriers to trade or hidden protectionist policies, and that they put public health concerns foremost.

Unfortunately, negotiations pertaining to the Doha agenda have suffered a series of setbacks and, in 2009, almost a decade after its inception, the prospect of a binding agreement remained bleak. The most significant differences were between developed countries and developing countries but there was also contention against and between the EU and US over their use of agricultural subsidies that are perceived as trade barriers.

WTO bound tariff (%)

Product	*Trade-weighted average*	*Maximum*
Fresh potatoes (inc. seed)	29	378
Frozen potatoes	16	414
Potato flour	38	446
Potato starch	109	550

The importance of potato in developing country food systems

Potato and food security

Many of the poorest producers in developing countries and most undernourished households depend on potatoes as primary or secondary sources of food and nutrition. The crop produces large quantities of dietary energy and has relatively stable yields under conditions in which other crops may fail.

Potato crops are suited to places where land is limited and labour is abundant, which characterizes many of the poorest developing countries. Potato crops are also highly adaptable to a wide variety of farming systems. Their short and highly flexible vegetative cycle, which brings yields within 100 days, fits well with double cropping and intercropping systems. In addition, potatoes are ecologically adaptable. They can be grown at almost any altitude or climate, ranging from the barren highlands of the Andes Mountains to the tropical lowlands of Africa and Asia.

Importantly, potatoes produce more nutritious food more quickly, on less land and in harsher climates than most other major crops. Up to 85 percent of the plant is edible human food, compared with around 50 percent for cereals.

Beyond food security . . .

Potato cropping is rapidly becoming a valuable source of cash income, as potatoes are increasingly used by the food processing sector to meet the increasing demand of the fast food, snack and convenience food industries. The increased demand for processed products is itself a result of growing urban populations, rising incomes, diversification of diets and the substantial time required to prepare the fresh tuber for consumption.

The structural transformation of rural-based economies into more urbanized societies has opened new market opportunities to participants in the potato value chain. Such opportunities can both increase incomes and create employment in the sector.

Overcoming value chain challenges

Key challenges

Potato's adaptability opens it to a range of specific uses. However, it also has potential to play a broad role in developing country food systems. This requires establishing an efficient value chain, but first the following key challenges must be overcome.

- **Market integration.** Owing to institutional constraints, farmers in developing countries typically are not innovative when it comes to marketing their products. In the poorest countries, potatoes are usually marketed through fragmented chains that lack coordination and information exchanges, giving rise to high supply risks and high transactions costs.
- **Production initiatives.** Average yields remain far too low for small-scale potato producers to produce marketable surpluses. Thus, sufficient quantities of quality seed are essential to meet the needs of potato growers, processors and traders. For farmers to capitalize on the potential gains from using quality seed will require improvements in technology, irrigation, fertilizer use, storage facilities, transport and infrastructure.
- **Producer groups.** With few buyers relative to sellers, the farmgate price of potato is often based on very limited negotiation. Smallholder farmers often do not have the market savvy or access to market information needed to negotiate appropriate prices with buyers. Unfair pricing as a result of uneven bargaining power can lead

to producers failing to respond to market incentives, and can stifle farmers' drives to invest in increased productivity. This makes the formation of producer groups to share expertise and to strengthen bargaining power within the chain essential.

- **Public and private support.** Agriculture policies and resources have traditionally focused on cash crops for export and on cereals, leaving potato and other root crops at the periphery. Readdressing this imbalance – with policy-makers providing more support – and seeking substantial levels of public and private investment is critical if the potato sector is to thrive. Such investment would include breeding programmes, infrastructural improvements and commercialization initiatives that are all geared towards strengthening the value chain.

Key beneficiaries

Developing efficient potato value chains and increasing potato production would have huge potential benefits for developing countries.

- **Countries with low dietary diversity and high dependency on cereal imports**
  Taking the lead from cassava, governments have recently launched initiatives to reduce costly wheat imports by encouraging the consumption of bread that is made of wheat and potato flour, such as the *papapan* that is produced in Peru.
- **Countries with low dietary diversity and high export**
  During the 2007–2008 food crisis, when commodity prices spiked, several rice-producing countries imposed export bans on rice in order to protect against food shortages and to shield their economies from domestic food price inflation. However, their actions only served to exacerbate global rice price inflation.

When consumers can rely on a broad base of staples in their national food baskets, external changes in commodity prices do not have such impact on the food security in either cereal importing or exporting countries.

Food security and profit maximization

The challenge going forward will be to provide the necessary incentives to sustain potato production in an increasingly volatile world, without thwarting drives for greater cost efficiency and productivity. A boom followed by a bust in cereal prices could easily undermine investments in potato sectors, if consumers revert back to purchasing inexpensive, subsidized imported cereals. A volatile macro-economic environment could also have negative repercussions. For instance, the retrenchment in bank lending that was witnessed in the financial crisis of 2008–2009 undermined efforts to commercialize the sector and improve the value chain.

As producers, farmers, of course, seek to maximize their profits. However, from a welfare perspective, profit maximization is not necessarily compatible with food security maximization, since profit-seeking behaviour does not guarantee food availability at an affordable price. An investment in potato cultivation can be considered insurance against international market turbulence and, more so, a food security safeguard.

The world's population is expected to grow by a third over the next 30 years. More than 95 percent of that increase will be concentrated in developing countries, where pressure on land and water is already intense. With such strain on the world's resources, it is plausible that crises and price spikes will always be around the corner. With the international community faced with ensuring food security for present and future generations, it is critical to recognize the important role that potato can play in efforts to meet those challenges.

SECTION 1

Adding value:
Structure, coordination and support of links in the chain

Sectoral initiatives to improve the production, processing and marketing of potato and potato products are diverse across countries and regions. Their success will conceivably depend on an individual country's stage of agro-industrial development and the state of its agro-ecological environment. Therefore, an important task is to gather, consolidate, evaluate and categorize information on these initiatives in order to form different potato value chain typologies and profiles.

This section pulls together such information to offer a broad-based view of the potato sector. It begins with a definition of the value chain theory and its application, and presents a series of case studies that represent an overview of the current state of the potato value chain in developing countries and the constraints that they face. The section also looks at the role that development agencies, national authorities and the private sector are playing in strengthening value chain activities and their potential to add more support in the future.

Value chain theory and application

Brian Moir
Senior Economist
Trade and Markets Division, FAO

Conceptual issues

Although value chains can be defined in a variety of ways, the classical definition is of a system made up of two components:

- a sequence of activities such as production, processing and transport; and
- a network of functional relationships that work together to reach an objective.

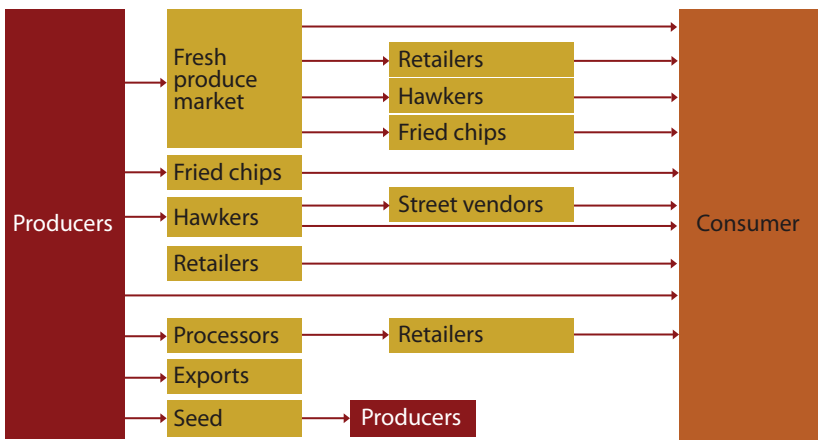
These components interact through dynamic linkages such as contractual arrangements and coordination, and determine opportunities for investment along the value chain.

Value chain analysis

The underlying objective of value chain analysis is essentially to characterize, describe and understand a chain and, in turn, to evaluate its performance. However, there is also a prescriptive dimension – the analysis also can be used to promote improved performance through appropriate public policies and private firm strategies.

Value chain analysis provides a framework that can bring better understanding of the links among producers, exporters and

Example potato value chain in South Africa



global markets. This framework focuses on constraints to competing in the market, clarifyies the relationships among the value chain actors, and highlights how the benefits are distributed among buyers, exporters and producers.

The framework also allows for evaluation of chain performance by distinguishing the strengths and weaknesses associated with different activities and linkages and identifying barriers to chain development. In turn, this information can be used to prioritize interventions that can be made along the chain to improve performance.

In practice, value chain analysis can cover a range of chain issues, such as market access problems for small producers, the relative merits of different types of contractual relationships between enterprises, and the distribution of power and benefits along the value chain. Building from this acquired information, value chain analysis can then be used to promote solutions to enhance chain performance by, for example, promoting enterprise development, raising food quality and safety standards or improving competitive performance.

Drivers of chain performance

Analysis must begin by identifying the main drivers of the value chain and then assessing the extent to which these drivers contribute, positively or negatively, to the chain performance. For analytical convenience, performance drivers can be considered under the following broad themes.

- **Enabling environment** – refers to all the policies, institutions and support services that form the general setting under which enterprises are created and operate.
- **Technologies** – are essential determinants of value chain performance through their association with production, processing and distribution along the chains. These include the methods, processes, facilities and equipment used in chain operations plus those applied to research and development. This theme also includes consideration of technology adaptability and adoption patterns.
- **Market structure** – has a large impact on chain performance and the conduct and performance of individual firms (business operations) at each stage of the value chain. This includes determining whether existing markets are competitive or concentrated, i.e. whether they are oligopolies or monopolies.
- **Chain coordination** – determines the harmonization of the physical, financial and information flows along the value chain. Well functioning coordination enhances value chain performance.
- **Managing business operations** – is necessary at every stage along the value chain if individual firms are to allocate resources efficiently, respond to consumer needs and adapt to market changes.
- **Inputs** – directly affect performance, deeming it necessary to determine the availability and cost of inputs – namely land, labour and capital – at every stage in the value chain.
- **Product demand** – is paramount. Value chains cannot perform if demand does not exist.

Strengths, Weaknesses, Opportunities and Threats Analysis (SWOT)

SWOT analysis is a strategic planning method used to evaluate the strengths, weaknesses,

opportunities and threats involved in a project or business venture. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favourable and unfavourable to achieving that objective.

The SWOT analysis can be used to identify the drivers of value chain performance. SWOT analysis assumes that opportunities and threats arise from factors external to the value chain, while strengths and weaknesses are associated with internal elements.

The user of SWOT analysis first identifies drivers of chain performance by separating information from the analysis into current influences – strengths and weaknesses – and potential developments – opportunities and threats. The SWOT analysis determines how these influences and developments will positively or negatively affect the performance of the value chain.

Application of value chain theory

Chain delimitation

Value chains have neither a clear beginning nor a well defined end. Neither are they isolated from the rest of the economy nor confined to simple geographical boundaries. In addition, they are not static. However, applying value chain theory to a particular value chain requires setting some form of limits, so it is important to define the following dimensions when initiating the analysis.

- **Product dimension** – requires a decision on the focus of the analysis. This means determining if the analysis will concentrate on a single commodity (e.g. potatoes), a group of commodities (e.g. vegetables) or on the final product(s) of the chain (e.g. chips or potato flour).
- **Components dimension** – requires identifying and/or working with all of the activities that are performed along the chain. This includes both on-farm and off-farm, and upstream and downstream activities, starting from the primary production stage.
- **Geographical dimension** – requires understanding where the value chain starts and where it ends. This allows setting a geographic border in terms of whether the chain will be international, national or regional within a specific country. In reality, it is difficult to establish specific geographical limits when many of the inputs used by a value chain are sourced internationally.

Although chain delimitation is not a simple process, consideration of the aforementioned dimensions offers some guidance. Ultimately, the delimitation will depend on the specific objectives of the analysis as well as the resources available.

Chain mapping

With the value chain delimited, the next step is mapping the sequence of activities and the network of functional relationships within the chain. This requires identifying:

- **Activities** – the main activities between the start of production and the sale of the final product to the customer;
- **Enterprises** – the types of enterprises that carry out each successive function; and

- **Outlets** – the distinct marketing channels or final outlets, such as supermarkets, wholesale markets and food processors.

Chain mapping also requires determining the governance relationships between adjacent enterprises in the chain. This can include the unrestricted market relationships typically found between commodity producers and other value chain participants, the persistent network relationships among independent firms which are more prevalent in downstream sectors, and vertical integration in which the successive value chain stages are found in a single enterprise.

Chain mapping is an iterative process requiring the analyst to question the analysis continually as it evolves. Experience has shown that it is often advisable to start with a simplified value chain map and gradually refine it as knowledge is gained during the analysis.

Mapping as an iterative process

During the chain mapping, analysts can refine the process by continually questioning at each step.

- Are there too few or too many stages?
- Would it be better to expand/reduce some stages (i.e. add/reduce detail)?
- Are the different marketing channels/ segments correctly represented?
- Are linkages adequately characterized?
- Is the chosen product category causing problems because it is too narrowly or too broadly defined?
- Is it adequate for the intended use – are the constraints to adding value being identified?
- Is more information needed? From whom? Where? How can it be collected?

Availability of information

Invariably, all the information needed to carry out a thorough mapping of the value chain will not be readily available. Determining data requirements and appropriate data collection techniques will depend on the objectives of the approach. Traditionally, data collection techniques range from simple reviews of existing studies and statistical data to rigorous, probabilistic sample surveys. However, conducting surveys is often costly and time consuming.

Alternatively, a rapid appraisal method can be used. With this approach, interviews are carried out with key informants to analyze the value chain. These informants are asked to provide details of other key informants who could add further detail to the analysis and who, in turn, also provide details of other key informants – the so-called snowball approach. Rapid appraisal methods are particularly attractive due to the nature of the information required, the time efficiency of the information-gathering processes and the lower costs. For this reason, chain mapping is often carried out in a workshop situation.

Evaluating performance and adding value

The analysis of the gathered information should allow an overall assessment of the performance of a value chain and identify potential areas for adding value. The value in a chain is determined by what process or processes each actor undertakes. By moving into markets or products that have higher end-prices, producers are able to add value.

There are a number of ways value can be added within chains.

- **Product transformation.** Products can be processed into more highly priced products. However, further processing may mean that the product will face higher import duties as a result of tariff escalation on processed products. This could limit any benefit of adding value through product transformation.
- **Price premiums.** Products can be differentiated on the basis of factors that command price premiums including location (e.g. geographical indicators), production standards (e.g. certified organic status), and service (e.g. reputation for reliable delivery or flexible response to changing customer requirements).
- **Marketing and services.** Value can be added by specializing in niche activities that are difficult to undertake or in which few actors are involved, thereby reducing the level of price competition. In addition, value can be added through offering services or intangibles such as guaranteed quality, innovative capacity or reliable supply as part of the final product.

The potato value chain in West Africa

Alpha Diallo
International Coordinator
European Cooperative for Rural Development (EUCORD), Guinea

Guinea

Since potatoes were first introduced in Guinea during the early 1920s, they have shown excellent results in the central plateau region of the Fouta-Djallon. This has been due to the support of projects financed by the EU Commission (EC), the arrival of district agropastoral farms (FAPAs) in 1978, as well as the support from FAO, the UN Development Programme (UNDP) and UN Capital Development Fund (CDF) projects from 1987 to 1993. During the same period, several projects were implemented by French and Italian non-governmental organizations (NGOs) in the Timbi-Madina subprefecture.

Production zone

Fouta Djallon has an average annual temperature of 23 °C, with lows reaching 4 °C in certain areas. This region has a tropical climate with two humid seasons accompanied by 1 500–2 000 mm of rain for six months of the year.

Potato producers

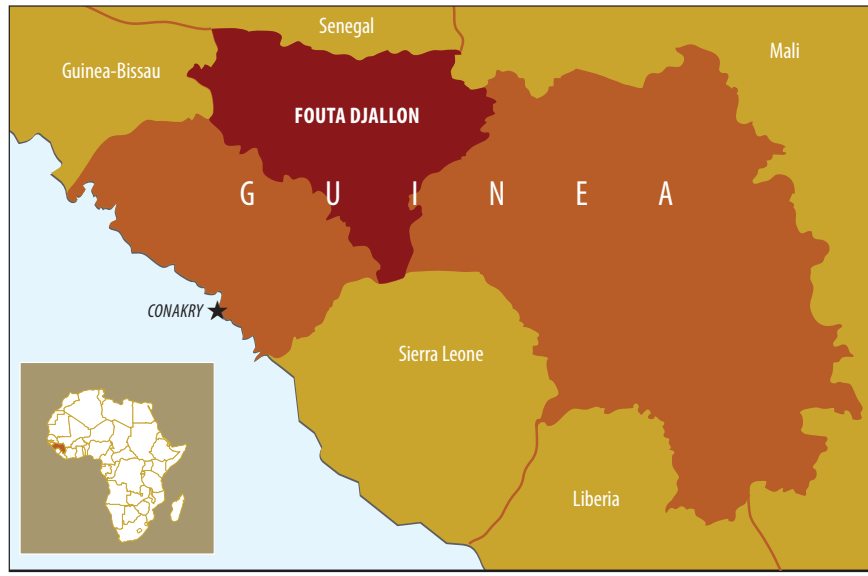
The Farmer Federation of Fouta-Djallon (FPFD) is Guinea's most important rural organization for potato producers. The majority of producers belong to groups affiliated with FPFD, although more and more private sector producers are investing directly in the production of potatoes in Guinea. On average, each group consists of 25 producer members, of whom 52–80 percent are typically women. Each member typically grows potatoes on 0.5–2.0 ha. It is mainly the women who provide the manual labour and carry out the post-harvest operations.

Production systems

Potatoes are cultivated on the Guinean plains and basins in rotation with rice, corn and legumes. On the plains, potatoes are a rainy season crop, planted between May and June, while in the basins they are mostly cultivated during the dry season, planted between November and December. On the central plateau of Fouta-Djallon, potatoes are starting to be cultivated during the off-season to benefit from the last rains and, thus, are planted between September and August on lands with *n'dantari* soils, a particular type of soil found in Guinea which cover more than 100 000 ha on the central plateau.

The main seed potato varieties, introduced in Guinea by French and Dutch firms, are Trinate, Bintje, Nicola, Désirée, Maradona, Spunta, Mundial, Ajiba and Elodie. The Nicola and Spunta varieties were originally adopted by the majority of producers. However, as a result of the favourable ecological conditions of the zonal microclimates plus the high cost of inputs and evolving consumer demand, producers have welcomed the recent introduction of more productive varieties and the emergence of seed multipliers.

Guinea and the location of Fouta Djallon



Potato producers in Guinea generally use pre-germinated seedlings that are imported or obtained after the sorting of potatoes intended for local consumption. The majority of small producers prepare their own land manually. Organic fertilizers are applied with planting densities of 70×30 cm or 70×40 cm. The usual crop management activities, including harvesting and packing, are done manually. Pest and disease treatments are applied as a preventive measure to control outbreaks such as tinea and termites.

In 2007, despite increased production costs, profits were attained with average yields of 12 tonnes per ha during the rainy season and 18 tonnes per ha during the dry season in irrigated fields. In general, the average yield for the most fertile basins was 18 tonnes per ha during the rainy season and 20 tonnes per ha during the dry season. Under ideal conditions, the introduction of new varieties by a Common Fund for Commodities (CFC) project on Potato Value Chain Development in West Africa (Guinea and Senegal) has provided the potential to increase yields substantially, to 27–38 tonnes per ha.

Infrastructure and equipment

Farmer groups give priority to gravity-driven irrigated installations in order to avoid the costly purchase of motor pumps and associated high operating costs. However, in many instances, the absence of a natural gradient precludes gravity-

driven irrigation systems, and motorized pumps are often necessary to pump water from the streams and rivers to the potato plots and fields.

Storage facilities, built with the support of projects, are used by FPFD and a few other unions. However, most private producers and non-affiliated groups use infrastructure that is not ideal for storing and handling potatoes. Generally, appropriate technical standards cannot be met because the market infrastructure is lacking.

Supply of seeds and mineral fertilizers

FPFD is the principal importer of seed potato in Guinea. Currently, the Nicola (Class A) variety imported from France is the most widely used. Private producers also import this Class A variety at approximately 15–20 tonnes per year. The quantity of second and third generation seed used by small producers is more difficult to estimate, but the needs of these potato producers remain important.

The experiences gained with the support of projects and locally driven operations to produce seed potato have been encouraging. Among the projects supporting multiplication from seeds imported from Europe (namely France, Belgium and Holland), the following have had the greatest positive impact.

- FAO project *"Appui à l'intensification de la production de la pomme de terre"*, which ended in March 2007, supported seed multipliers of Nicola, Spunta, Konsul, Arnova and Kondor varieties.
- CFC project on Potato Value Chain Development in West Africa (Guinea and Senegal) is introducing more productive varieties in Fouta Djallon as a follow-up to the above FAO project. During the 2007 rainy season, 76 tonnes of seed potato were produced with the support of the project. Certain varieties already have proven to result in substantially higher yields.

Mineral fertilizers are supplied by the FPFD, donations under the Kennedy Round II (KR2) programme of Japan, and private businesses based in Labé. The quantity used per ha varies from 600–800 kg. Mineral fertilizers are typically combined with organic fertilizers from compost and poultry farms and applied at a rate of 4–5 tonnes per ha.

Costs

The annual variation in production costs mostly results from changes in the cost and use of seeds and fertilizers, and associated irrigation costs. Seasonal production costs also vary considerably. In 2007-2008, production costs of potato in the Fouta Djalon, Guinea reached 20 million GNE (US$4 024) per ha during the rainy season and 30 million GNE (US$6 036) per ha during the dry season (with irrigation).

Seed remains the main production cost. Seed purchase represents 40–60 percent of total production costs with costs being higher in areas where water is pumped. Based on market observations in recent years, the cost of inputs is rising by some 5–10 percent per year.

Marketing

Women are the most active in the commercialization process and more often act as the wholesale dealers for both export and urban market sales. Prices received by producers for their potatoes depend on the period of production and the distance for delivery. Prices

are highest for potatoes sold during the August and September inter-season, and during the December-to-May dry season when the rainy season potato supplies have been depleted.

With the recent introduction of new varieties into Guinea through the CFC project, yields increased substantially in 2008 with gross sales increasing to 2 000 GNE (US$0.40) per kg. This resulted in increased profitability along the value chain with both producers and wholesalers making a net profit of 250–350 GNE (US$0.05–0.07) per kg.

For export markets, transport costs and the need for appropriate handling remain a major constraint. Improvements in these areas would have a significant impact on the competitiveness of potatoes originating from Fouta Djallon in regional markets.

Future steps

Guinea has the potential for a highly competitive and efficient potato supply chain in the region, but proper financial support is needed to strengthen the chain. The steps would include:

- improving infrastructure including introduction of drip irrigation systems to guarantee the quality of seed potato, construction of improved warehouses for storage, etc.;
- increasing mechanization of harvesting and grading operations;
- improving seedling supply and support for rapid multiplication of seedlings to meet need for supply of high quality seed;
- fostering cooperation to ensure continued progress in enhancing yields, provide better crop protection and introduce new varieties, by setting up opportunities for various public departments to work together, including research and development organizations and the National Service for Vegetable Protection (SNPV);
- setting up the necessary organizational structure needed to take responsibility for phytosanitary controls and seed certification;
- improving technologies that result in better pest control, reduce production costs and improve yields.

Any financial support should be accompanied by direct support to producers and their associations. This should also include training for producers to improve their technical competencies and strengthen their negotiating skills.

Senegal

Potato was first introduced into Senegal around the beginning of the twentieth century by Europeans who settled in the country. Over time, producers in Senegal acquired knowledge and expertise to enable them to become major vegetable suppliers for the Dakar, Rufisque, Thies and St. Louis markets. Specifically, potato development in Senegal has been strengthened by knowledge acquired in:

- development of techniques to improve crop productivity;
- selection of adapted varieties;
- development of affordable methods of conservation and storage;
- selection of varieties that are resistant to important diseases, such as *Altériana solani, Rhizoctonia s*. and Virus Y);
- development of techniques to fight against destructive insects;
- seed multiplication techniques and improved seed systems of national programmes;

Senegal and the location of Niayes (coastal stretch from Dakar to St. Louis)

- experience in local production of seedlings, including *in vitro* propagation.

Support to projects

Around the turn of the millennium, Senegal adopted a development strategy for potato production, in order to limit the country's dependence on European imports but was held back by constraints within the supply chain and the availability of appropriate seed potato. Now, the Senegalese government recognizes the need to increase production. In 2007, the government received a 50 million CFA (US$115 000) grant for the purchase of seed which, unfortunately, did not produce the intended results. Often there were problems with the seeds arriving in poor condition or too late for the season. Now, further support is being undertaken to help stimulate production. The Federation of Senegalese NGOs has recently begun collaborating with the CFC project on Potato Value Chain Development in West Africa (Guinea and Senegal).

Local production of potatoes for consumption

The majority of potato cultivation in Senegal is carried out in the Niayes area, a coastal stretch from Dakar to St. Louis that offers favourable

weather conditions and along the Senegal River delta. Water availability remains the principal limiting factor for the crop. Production occurs between the months of October and April.

In recent years, two periods have marked the evolution of potato production in Senegal. Between 1991 and 1996, production fell significantly – from 12 500 tonnes per year to around 6 000 tonnes per year – owing to poor yields and lower plantings. However, since 1997, production has been relatively stable.

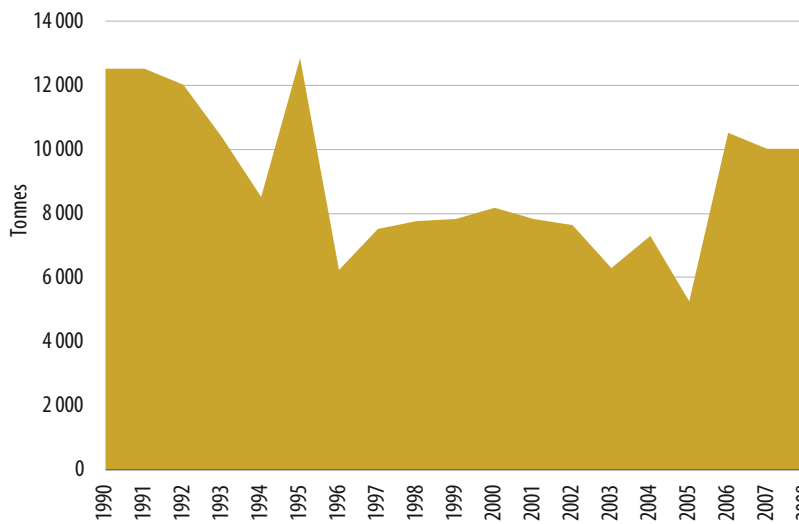
Senegal has two production cycles – early cropping from October to December, and late cropping from January to April. An average yield of 25–30 tonnes per ha can be achieved, although yield levels depend on farm size, water availability and management.

Production costs are relatively high at over 150 CFA (US$0.35) per kg. The cost of seeds represents more than 50 percent of the total production costs, so seed tubers are cut to minimize costs.

L'Association des Unions Maraîchères des Niayes (AUMN) is the umbrella organization of 18 unions of producer groups that represent the majority of potato producers in Senegal. Since 2002, AUMN has been searching for solutions to improve its supply of quality seed. The association operates at least 6–7 ventilated storage facilities.

L'Agence de Régulation des Marchés (ARM) supervises imports and the management of marketing by producers.

Evolution of potato production in Senegal



Marketing activities

In Senegal, two types of marketing networks typically exist.

- **Short marketing networks.** Small *grenaille* (new potatoes) are sold directly by the farmers in daily local markets.
- **Long marketing networks.** Farmers sell their potatoes to "collectors", often present along the road or at major intersections. This system represents between 30–40 percent of food products sold commercially, including potatoes. The collector is responsible for distributing the potatoes to wholesalers.

Traders (*banabanas*) are linked closely to producers. They supply seed and pesticides, plus they provide information on the market situation. In cases where the trader is also the producer or where the trader performs a producer-grouping or collecting function, the products are sold directly on the Dakar, Thiaroye, de Castors, de Touba, de Thies and Mauritius markets. Under this system, the trader or producer transports the potatoes to the market.

Potatoes are received at the markets by the wholesalers. Small potato wholesalers depend on the major wholesalers who have storage facilities. Certain wholesalers specialize in imported potatoes. The function of traders at these markets is organized and linked in a complex manner; wholesalers rarely sell directly to retailers.

Costs and profits

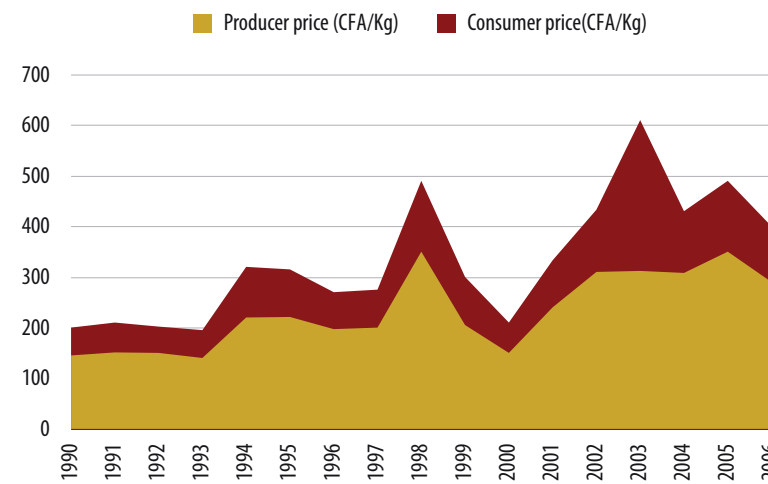
Profitability within the potato value chain varies among the different value chain actors and over time.

- **Producers:** During peak production in April, producer prices tend to be relatively low, making producer profit margins weak. To overcome this, many producers harvest their crop as late as possible in the season to benefit from prices that rise as availability diminishes. Senegalese producers have benefited from simple post-harvest measures. For instance, by using standardized 40–50 kg bags intended for onions, with pre-set prices per bag, they have received better prices for their potatoes which has hence increased profit margins.
- **Transporters:** Transportation within the value chain is managed by traders or collective organizations. Transportation costs typically represent 40 percent of total production costs.
- **Importers:** Importers generally have relatively low profit margins, although their margins usually increase as domestic potato supplies fall.
- **Wholesalers and retailers:** Profit margins vary, but are typically 4–5 percent for wholesalers and 7–10 percent for retailers. In general, their profit margins represent 26 percent of the price paid to the producer.

Prices

The average price of potatoes for consumption varies by season, ranging from 160 to 230 CFA (US$0.37– US$0.53) per kg. Price peaks occur closer to the end of the year (November–December) and before the religious holidays such as the end of and post-Ramadan festivals of *Korité* and *Tabaski* (*Eid al-Adha*) which can last from two to ten days, depending on the season, and increase demand. On average, producers receive 40 percent of the consumer price during the harvest period.

Evolution of potato production in Senegal



Source: Cabinet GRESSARD

Trade

Senegal's potato imports reached approximately 68 000 tonnes in 2007, making it the largest importer of European potatoes in the region, followed by Côte d'Ivoire, Mauritania and Cape Verde. Since the 1970s, these four countries have accounted for approximately 40 percent of the region's imports.

With Dakar as one of the ports of entry to West Africa, Senegal imports potatoes throughout the year, peaking in December and during religious holidays. These imported potatoes are of good quality principally because they have low water content which gives them a long shelf life.

Some of the imported potatoes are re-exported within the region to Mali, Mauritania and Côte d'Ivoire. This trade network is expected to increase, considering Senegalese warehouses are now present in Bamako.

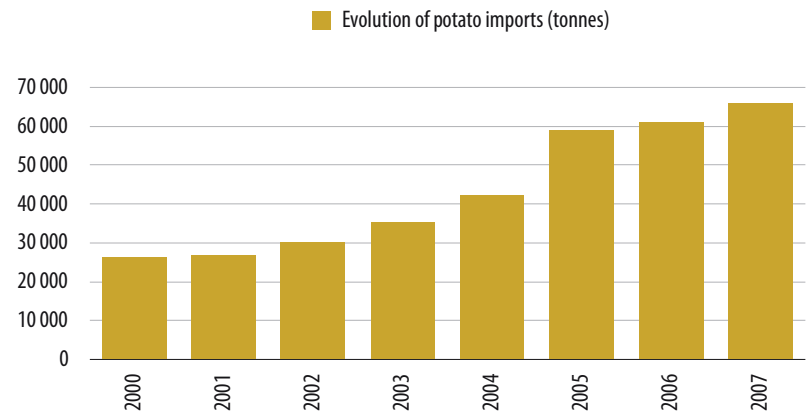
Senegalese potatoes are currently available on the market for three months. However, if quality seed potato were available in October, potatoes could be available for six months. Currently, domestic demand is mostly satisfied by imports from various origins including Holland, France, Spain, Italy and Morocco.

Crop seasons and limited areas, consumption patterns in large cities and the inability to cultivate during the winter all influence the importance of imported quantities.

The way forward

Looking at the commercialization of potatoes in both Guinea and Senegal, inter-regional potato distribution networks are still marginal. Potatoes

Evolution of potato imports, 2000-2007



Source: Cabinet GRESSARD

cultivated in West Africa are mostly sold on the local market, with a very small proportion sold for export to regional markets. Increasing inter-regional trade in potato requires overcoming two main constraints:

- the significant presence of European potatoes in most countries in the region, and
- the lack of appropriate post-harvest infrastructure for storing and conserving the tubers, which limits the possibility of marketing in urban centres.

The potato value chain in sub-Saharan Africa with case study on Eastern Africa

Berga Lemaga
Potato specialist
CIP, sub-Saharan Africa

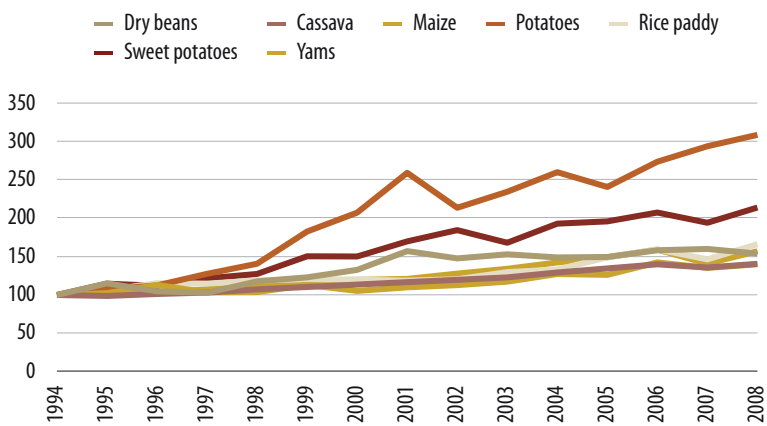
In sub-Saharan Africa (SSA), the population doubles every 25 years, meaning average land size per household is shrinking rapidly. Therefore, crops that give more food, more nutrition and more cash per unit of area and time are increasing in importance. One crop that meets these characteristics is potato.

Potato is a nutritious food security crop and a buffer to rising food prices, especially cereals. Thus, it is increasingly considered a smallholder cash crop of the future and a pathway out of poverty. In addition, its short production cycle fits well into the farming system and it has a potential for export within the region.

Potato production in SSA

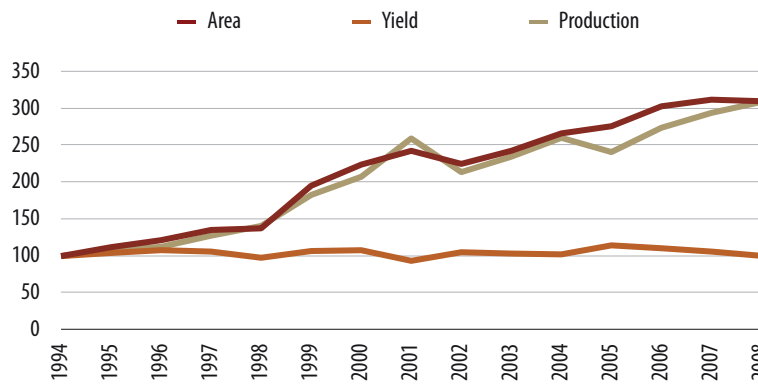
While the production of most crops in SSA (with the exception of maize) has increased steadily in recent years, the production of potato and sweet potato has shown an especially significant increase. In fact, since 1994, potato production has more than doubled.

Index of crop (including potato) production in SSA (1994=100)



Source: FAO

Index of potato production, area and yield in SSA (1994=100)



Distribution of potato production in SSA

SSA sub-region	*Share of SSA area*
Eastern Africa	71%
Southern Africa	21%
West Africa	8%

(excl. Malawi)

This production growth has been driven entirely by increases in the area used to produce potatoes. Between 1994 and 2008, the area of land used for potato production more than doubled. However, at the same time, average yields declined considerably.

In 2006, approximately 8 million tonnes of potato were produced on 1.1 million ha in SSA for an average yield of 7.5 tonnes per ha. The majority of potato production in SSA (71 percent) is produced in Eastern Africa. Southern Africa and West Africa account for 21 percent and 8 percent of production, respectively.

Drivers of growth

Urban markets and urbanization

Potato area in SSA has grown as commercially oriented farmers have responded to increased demand from growing urban markets. This demand is for both fresh and processed potatoes and is being driven by increased urbanization and changing urban food consumption patterns.

The process of urbanization is expected to continue. Currently, about 34 percent of SSA's population is urban, but it is expected to reach 47 percent by 2015. The rate of urbanization is highest in Eastern Africa at 4.5 percent per year.

Commercial farmers supplying urban markets

As food demand in urban areas has evolved, it has opened new markets for convenience and fast foods and prestige food products. These trends have been driven by many factors, including:

- busy urban lifestyles;
- increased number of fast food or takeaway restaurants;
- introduction of food products that can be consumed on the street such as potato chips, fries and crisps;
- demand for prestige food in franchised restaurants;
- demand for prestige home-prepared food;
- increased tourism.

Size of urban markets in SSA

SSA urbanization:

Today	34%
2015	47%

Rate of SSA urbanization - projections to 2015:

Western Africa	3.0% per year
Southern Africa	3.5% per year
Eastern Africa	4.5% per year

Source: IFPRI 2003; UNEP Africa Environment Outlook

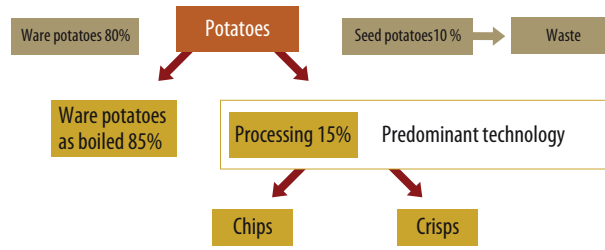
Subsistence farmers are responding to ever-shrinking farm sizes

Potato production in SSA is generally concentrated in the high potential lands, which tend to be densely populated. Inter-generational transfer of farms in these areas has resulted in reduced farm sizes, as land must be shared among many children. As farmers seek to maintain income levels on smaller areas of land, they have increasingly diversified into potato production as the revenue from potatoes can be as much as 10 times greater than the revenue from grains.

Utilization of potatoes in Eastern Africa

In Eastern Africa, approximately 80 percent of the potatoes produced are sold as ware tubers and 10 percent as seed tubers, with natural

Utilization of potatoes in the Eastern Africa



wastage accounting for the remainder. Of those potatoes used as ware, the vast majority (85 percent) are consumed fresh with the remainder used for processing, primarily for chips and, to a lesser extent, crisps.

Developments in the value chain for seed producers in Eastern Africa

Eastern Africa combines both formal and informal seed systems.

- **Formal.** National Potato Programmes produce the first three generations of formal seed (i.e. from nuclear to basic seed) under acceptable health control standards.
- **Informal.** Takes over after the third generation, with farmers and other multipliers typically using this basic seed to supply quality or improved informal seed for ware potato production.

Seed system in Ethiopia

Potato seed producers in the highlands of Ethiopia are supported by the Ethiopian Institute of Agricultural Research (EIAR), the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and CIP. These organizations have formed a monitoring and evaluation body to supervise seed production in Ethiopia, which is recognized by the Ethiopian government.

These highland seed producers receive basic seed from the EIAR national potato programme and then multiply this seed under supervision for ware potato production throughout the country. Seed is typically sold at a premium of at least US$10–20 per 100 kg to ware potatoes.

The combination of both formal and informal seed systems has improved the livelihoods of seed producers in the highlands of Ethiopia. These producers now typically have better houses, increased food security, more animals, more land and more children in school, and they have diversified their incomes away from potato.

Developments in the value chain for ware producers in Eastern Africa

Kenya

In Kenya, the Maasai people in the Olokurto Division traditionally kept animals while

growing wheat and barley. In 2001, they formed the Naramatisho Self Help Group, consisting of 97 members, to evaluate their future options. Upon deciding that one option was to produce potatoes, they received a new potato variety called Tigoni. By 2004, they were supplying 8 tonnes of ware potatoes every week to Njoro Canning Factory and Steers' Restaurants.

The livelihoods of these producers have improved significantly, with support from Kenya Agricultural Resource Institute (KARI), Ministry of Agriculture (MoA), CIP, ASARECA, GTZ and others. Potato production typically generated six times more revenue than what they had received for barley or wheat production. As a result, producers have built new houses, can pay school fees, have food security, etc.

Uganda

In Uganda, 141 farmers formed a group called Nyabyumba United Farmers and currently supply 8.5 tonnes of potatoes each month to Nando's fast food restaurants. These producers work in collaboration with the National Agricultural Research Organisation of Uganda (NARO) to identify the appropriate crop husbandry techniques, notably crop spacing, to produce the tuber size demanded by Nando's.

The livelihoods of the Nyabyumba United Farmers have improved considerably with this value chain development. In 2005, the group earned about UGS30 000 (US$36 000).

Ethiopia

In Ethiopia, many farmers traditionally faced food shortages from September until November, prior to their grain harvest. During these months, late blight prevented the production of potato. Now, the availability of late blight-resistant varieties means that producers in the highlands of Ethiopia can grow potato during the long rainy season. This not only has eliminated the September–November period of food shortage, it has provided potato producers an income from the sale of ware potatoes in September and October.

Developments in the value chain for processors in Eastern Africa

Preference for potato chips

The demand for potato chips (the main use of potatoes in the processing sector) is growing rapidly as a result of a change in eating habits as well as the increase in urbanization, fast food restaurants and tourism. According to a survey carried out between 2004 and 2006, 85 percent of respondents preferred chips to any other potato product. In Kenya, Tanzania and Rwanda, 100 percent of respondents preferred chips.

Percentage of retail outlets that preferred chips to other potato products

Country	*Sample Size*	*%*
Ethiopia	97	66
Kenya	41	100
Uganda	76	65
Burundi	59	79
Tanzania	53	100
Rwanda	102	100
Mean	71	85

Note: Respondents included 225 hotels, 317 bars and restaurants, 948 households and 6 processing firms.

Volume of potato chips processed and sold in the retail outlets

Between 1997 and 2004, Nairobi, Kenya experienced 117 percent growth in the volume of potato that restaurants processed into chips. This translated into an average annual growth rate of almost 17 percent. Chip consumption had its greatest increase in restaurants.

Nairobi's growth in demand is in line with the range estimated for Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. Demand for chips by the hotels and restaurants in these six countries is estimated to have increased by 10–17 percent per year between 1997 and 2004.

Consumption of chips in hotels and restaurants in Nairobi between 1997 and 2004

Source: Kirumba et al., 2004

Profitability

Given the availability of high-yielding varieties with good processing quality, there is a high potential for smallholder farmers to access the growing preference for chips in national and regional markets. The potato chip industry is still in its infancy with potential to continue growing. The processing of potatoes into chips adds value to the potato chain. The profitability of chip processing ranges from US$11 per 100 kg chips in Tanzania to US$126 per 100 kg chips in Rwanda.

Stakeholders' empowerment

Over the last decade, there have been a number of trade developments that favour smallholder access to national and regional chips market.

- **Common Market for Eastern and Southern Africa (COMESA).** Eastern African countries are members of COMESA. In 2000, COMESA established a full free trade area (FTA) that guaranteed the free movement of goods and services produced in the region and removed all tariff and non-tariff barriers.
- **Common External Tariff (CET).** COMESA members agreed to implement a CET, with the adoption of a single COMESA Customs Document (COMESA-CD). In addition, they agreed to facilitate transit traffic and reduce the cost of transit goods. All agreed to adopt harmonized transit charges, improve the provision of trade information and establish a regional competition policy.

Profits from processing 100kg chips

	Burundi	*Ethiopia*	*Rwanda*	*Tanzania*
Total Cost	59 727	242	20 400	56 676
Gross margins (local currency)	128 000	828	90 000	67 622
Net margins (local currency)	68 273	586	69 600	10 946
Net margins (in US$)	68.90	68.90	126.09	10.95

Challenges to strengthening the potato value chain

There are a number of challenges facing the development of the potato value chain in SSA. The chronic shortage of seed is the most important challenge that needs to be dealt with.

Opportunities for strengthening the potato value chain

Improving the seed system

To improve the seed system, FAO quality declared seed needs to be available at an economical price. This seed can then be multiplied using rapid multiplication techniques, including tissue culture aeroponics, whereby tubers are multiplied at a ratio of 1:50 instead of the conventional 1:10.

In addition, better knowledge exists and systems have been developed that capitalize on:

- improving positive on-farm selection, which helps farmers keep clean seed longer and can increase yields by some 30 percent;
- establishing good health control systems and certification, including quarantine;
- creating markets and market standards;
- establishing a harmonized disease and insect pest threshold (Kenya has a zero tolerance policy, the other SSA countries have more relaxed policies);
- strengthening linkages among partners.

Challenges facing the potato value chain in SSA

- Shortage of seed
- Biotic stresses (e.g. late blight)
- Abiotic stresses (climate change, especially drought)
- Limited infrastructure
- Poor linkages among partners
- Inefficient marketing and transportation systems
- Limited private sector involvement
- Shortage of trained personnel
- Disorganized subsector
- Unfavourable policies for tuber crops

Strengthening the ware potato system

The ware potato system can be strengthened through the use of disease resistant, high-yielding and quality varieties. Such improved varieties can generate on-station yields of up to 35 tonnes per ha, and on-farm yields of up to 25 tonnes per ha, under good management

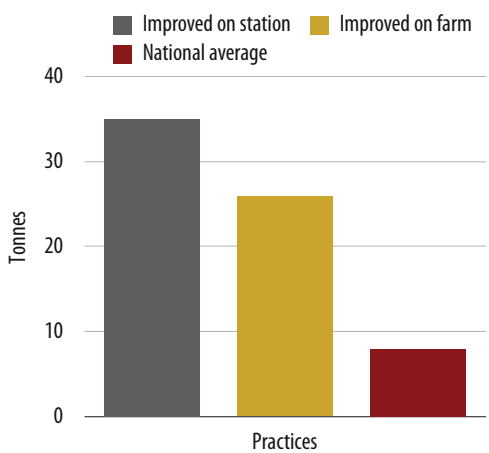
techniques. This compares with an average of 8 tonnes per ha for traditional varieties.

The use of improved varieties also provides additional marketable qualities. The good processing quality of improved varieties has resulted in import substitution, saving the region several million dollars per year. A 2004 cost-benefit analysis found that the use of improved varieties generated 14 times more benefit than would have been achieved from a local variety.

Strengthening marketing systems and linkages

A number of different approaches can be used to strengthen marketing systems and linkages. For example, the participatory market chain approach (PMCA) is a novel approach for generating technological, commercial and institutional innovations along market chains.

Impact of using improved seed varieties



Cost benefit analysis of using local and improved potato varieties (Birr/ha)

Cost item/benefit	*Local variety*	*Improved variety*
Gross benefit	4 800	40 000
Costs		
• labour	673	770
• inputs	1 668	4 639
Total cost of production	2 341	5 409
Net benefit	2 459	34 591
Net benefit US$	324	4 564

Source: Field Survey, October-December 2004

It helps increase trust, confidence and linkages among market chain actors and improves market access for smallholders. Smallholders are the principal beneficiaries of the innovations that come out of this participatory research and development (R&D) process.

The PMCA approach is structured in three phases.

- **Phase 1– Interest.** Interest is created among the different market actors (i.e. participants) to increase understanding of the activities, interests, ideas and problems that exist within the chain. The R&D organization plays a significant leadership role during this phase.
- **Phase 2 – Trust.** Trust is developed and joint market opportunities are explored. The R&D organization only plays a facilitating role during this phase.
- **Phase 3 – Collaboration.** Having developed trust, the actors collaborate during this phase to identify product,

technology and institutional innovations within the chain. The R&D organization's role is now minimal.

The PMCA was used in Uganda in 2005–2007 to strengthen the potato marketing systems and linkages. Funded by DFID, CIP and ASARECA, the PMCA generated a number of technological, commercial and institutional innovations.

For example, Tomcris Enterprise, one of the firms that applied the PMCA, had the following post-PMCA experiences:

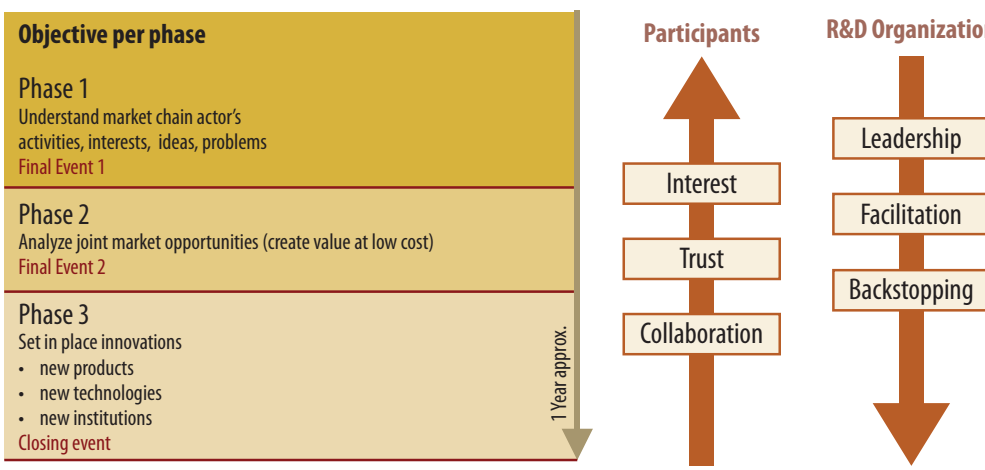
- enhanced knowledge on management of the potato chain;
- formed links with producers who could be relied upon to supply quality potatoes on a regular basis;
- established better access to markets, including supermarkets, hotels, restaurants and airlines;
- increased income significantly;
- increased recognition within the value chain;
- became a partner in the Common Fund for Commodities (CFC)-funded wealth creation potato project.

Strengthen capacity building and farmer empowering

To empower farmers, it is important to use a participatory approach which includes, for example, organizing farmers into groups. This is particularly useful for accessing credit and increasing farmers' bargaining power. It thus helps to strengthen market linkages within the value chain.

Capacity building and farmer empowerment can be improved with training through, for example, Farmer Field Schools (FFS), farmer

Basic process structure of PMCA



PMCA-generated technological, commercial and institutional innovations in Uganda

Commercial innovations	Technological innovations	Institutional innovations
• Potato and sweet potato (SP) crisps • Packaging • Orange flesh SP flour • New SP varieties in supermarkets • Marketing stall • Tomato sauce • Tomato chili appetizer • Hot pepper paste • Pickled hot pepper • Hot pepper pesticide	• Quality seed of hot pepper • Sealing machine for processed products • Improved packaging	• Sweet Potato Market Chains Club (SPOMAC) formed • Platform provided for market chain actors • Hot pepper contract farming scheme started, enabling constant supply to Europe and more negotiating power for reduced shipping rates

research groups and other available inputs. However, such training should be available to all stakeholders and not just farmers.

The way forward

Strengthening potato value chains has the potential to generate more income to all stakeholders, especially smallholder farmers and the private sector. Engaging the private sector in potato value chains ensures demand-led chains and sustainability.

There is also a need for an integrated approach across all areas of the potato value chain, including seed, ware and processing. In this respect, farmer organizations can be strengthened or established to empower farmers to benefit more from the potato value chain. A strengthened potato value chain can make a positive contribution to the Millennium Development Goals.

The potato value chain in Bhutan

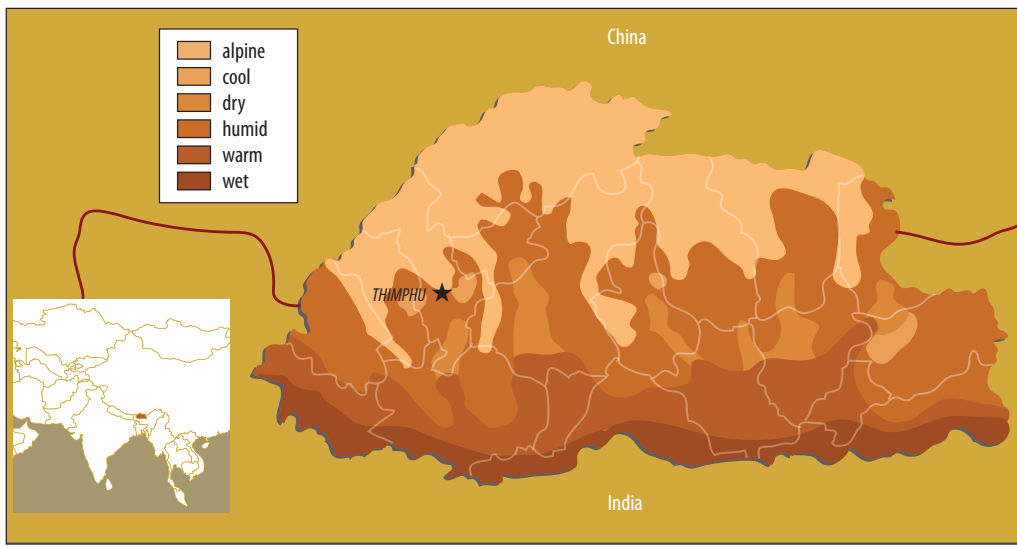
Karma Nidup
National Potato Coordinator
Bhutan Potato Development Programme, Department of Agriculture

Bhutan has a wide range of vegetation – from deciduous forest in the subtropical zones in the south to the main forest species of chir pine and blue pine in the alpine zones in the north. Annual rainfall across the country varies from 2 500 mm in the south to less than 650 mm in the north. Most potatoes are grown in the cool temperate zones at altitudes of 2 600 – 3 600 masl, with annual rainfall of 650–850 mm.

Characteristics of agro-ecological zone in Bhutan

Zone	*Altitude range (m)*	*Annual rainfall (mm)*
Alpine	3 600–4,600	<650
Cool temperate	2 600–3 600	650–850
Warm temperate	1 800–2 600	650–850
Dry subtropical	1 200–1 800	850–1 200
Humid subtropical	600–1 200	1 200–2 500
Wet subtropical	<600	2 500–5 500

Agro-ecological zones of Bhutan



Major potato areas

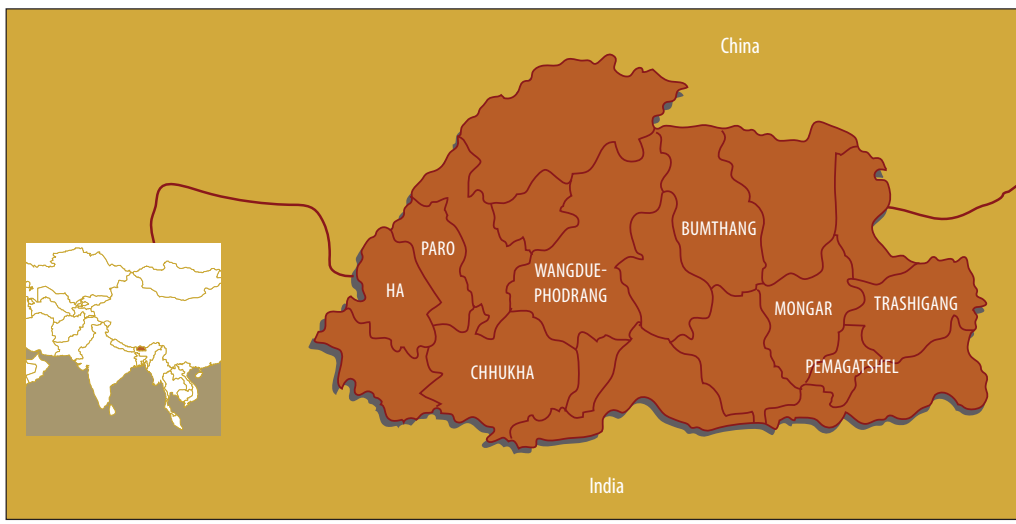
Potato is almost exclusively produced under rainfed conditions by smallholder farmers with landholdings of less than 4 ha. The eight districts in Bhutan that account for 85–95 percent of potato production – Ha, Paro, Chhukha, Wangdue-Phodrang, Bumthang, Mongar, Pemagatsbel and Trashigang – are located in the cool temperate zones.

Cropping systems

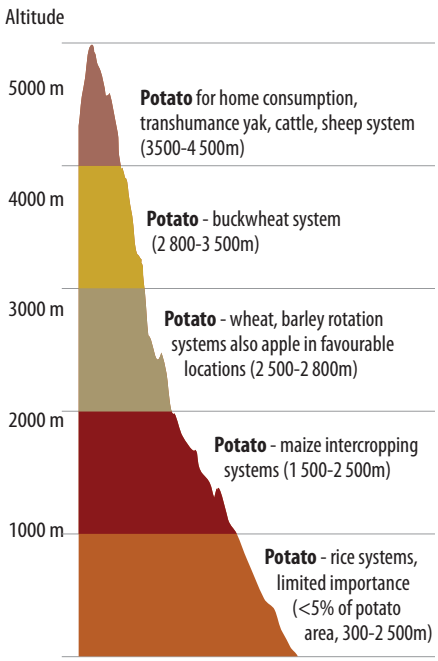
The cropping system for potato varies according to altitude. Potato can be cultivated as a winter crop in the subtropics and as a summer crop in temperate and sub-alpine environments.

- In yak-herding communities (3 500–4 500 masl), potatoes are generally only produced for home consumption.
- In wheat- and buckwheat-growing regions (2 500–3 500 masl), potatoes are grown in rotation. This is the altitude range in which the majority of Bhutanese potatoes are grown. It provides good conditions for rainfed potato production which produces seed of high quality that can be stored for use in the following season.
- In maize-growing regions (1 500–2 500 masl), potatoes are intercropped with maize, mainly in the eastern part of Bhutan. This system offers a number of advantages for smallholder potato producers, including increased productivity, improved soil conservation, reduced risk and increased food security.
- In rice-growing regions (300–1 500 masl), potatoes are grown in the crop rotation before rice. The importance of potato production at this altitude range is limited, accounting for less than 5 percent of potatoes in Bhutan.

Major potato growing districts in Bhutan



Typical potato cropping systems



Supply, demand and markets

Potato production

Potato is Bhutan's most important cash crop. It is very adaptable and can be produced from the lowest elevations of about 300 masl up to 4 500 masl. Farmers at elevations of 2 500–3 600 masl have little choice other than to grow potato as a cash crop to sustain their livelihoods. Almost 85 percent of households grow potatoes for export or their own consumption.

Production of potato in Bhutan increased fourfold between 1990 and 2006. In 2006, 63 946 tonnes of potatoes were produced by 27 745 households on 7 059 ha. Average production per household was typically 2.3 tonnes and average yields were 9.1 tonnes per ha. There are currently four recommended varieties grown in Bhutan, namely the internationally renowned commercial varieity Desiree, and the local varieties Kufri jyoti, Yusikaap and Khangma kaap. Desiree accounts for 90 percent of potatoes produced, due to its favourable storage and eating qualities as well as the premium price it tends to command.

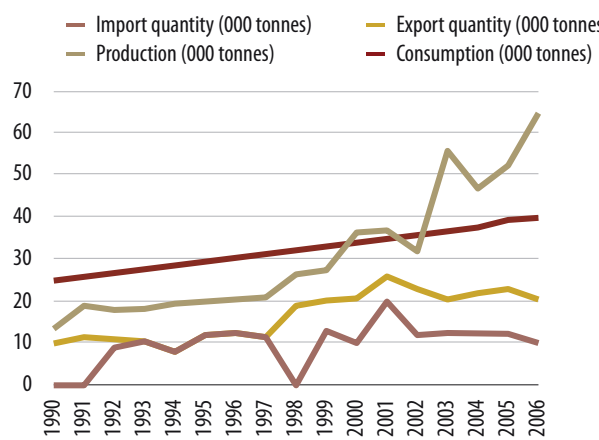
Consumption

Since 1990, domestic consumption of potato in Bhutan has almost doubled. In 2006, consumption was 26 998 tonnes, equal to some 40.15 kg per person.

Trade

Bhutan is a net exporter of potato. Exports have doubled since 1990, with the main export markets being India (West Bengal and Assam)

Potato production, consumption and trade, 1990–2006 ('000 tonnes)



and Nepal. Imports have increased slightly, mostly between December and March each year when traders seek to meet urban retail demand.

Marketing

Potato producers sell about three quarters of their production and use the remainder for their own consumption. Their main market outlets are the auction yard system and the local weekend markets.

- **Auction yard system.** The majority (56 percent) of potato production is sold in the south of the country through auction yards. This production is typically sold to Indian traders for export. The auction system provides a mechanism to optimize the interaction between potato growers and buyers, in exchange for a 6 percent commission.
- **Local weekend markets.** With fast growing urban populations, domestic demand for potatoes is rising. Local weekend markets currently account for 12 percent of potatoes sold.

Challenges and problems

The major challenge for Bhutanese potato producers is balancing socio-economic expectations of the rural population with the expectations, demands and wishes of the conservationists.

High production cost and protection from wildlife damage

Potato production in Bhutan incurs high labour costs, mainly because some 40 percent of production costs are associated with protecting the crop from wildlife, mainly wild pigs. The small size of land holdings and difficult topography limits the potential gains from mechanization, which increases labour costs further. This high cost of production will continue to put Bhutanese farmers at a disadvantage compared to their counterparts in the region. They will only be able to realize the full benefits from the opportunities of potato cultivation when the labour cost involved in guarding the crop from wild pigs can be minimized.

Soil conservation and fertility management

Most of the potato production in Bhutan takes place in mountainous areas on steep terrain under rainfed conditions. Production involves mass disturbance of the soil. Meeting the challenge of maintaining or improving soil fertility with minimal environmental impacts warrants the development of innovative, pragmatic and unconventional soil conservation and fertility management strategies.

Currently there is minimal use of synthetic fertilizer. Farmyard manure (FYM) is most commonly used. This requires careful management, because FYM is slow to decompose and release its nutrients at higher altitudes in temperate climates.

Price fluctuation in the market

Potato prices in Bhutan are directly dependent on the price of potatoes in India. This is because

Benefits of the auction yard system

Benefits to sellers	Benefits to buyers
• Assured payments • Weighing system • Transparency • Pool of traders	• Handling facilities for packing and weighing • Quality check opportunity • Loan facilities for registered traders

most of the potatoes sold through the auction system are used in the neighbouring Indian states of Siliguri, Kolkatta, Guwahati and Cooch Behar, and more recently in Nepal. These are mainly for use as seed.

Breakdown of seed multiplication system

Bhutan's wide range of production environments necessitates the choice of many different varieties. Yet, as a relatively small country with a small potato area and limited resources, Bhutan does not have its own potato breeding programme. Instead, it selects varieties that are best adapted to the Bhutanese environment from CIP and regional institutes such as India's Central Potato Research Institute (CPRI).

Post-harvest losses

Post-harvest losses generally occur due to minimal curing and sorting of tubers, and improper use of packaging. Storage losses due to pests such as rodents and the potato tuber moth are most common.

In low altitudes, the potato tuber moth prevents seed from being saved and used in subsequent production seasons. The solution is a downward flow of seed, with seed produced in the high altitudes used in the mid-altitudes and, similarly, seed produced in the mid-altitudes used in the low altitudes.

There also is a lack of small- and medium-sized processing enterprises to cushion price fluctuations in the post-harvest period.

Opportunities and key future steps

Market opportunities

Potato production areas in Bhutan at elevations above 2 800 masl have excellent environmental advantages for seed production for export:

- absence of vectors for virus transmission in the high altitude areas;
- absence of important seed-born disease, especially bacterial wilt;
- excellent storage conditions in the high altitude areas.

Key future steps

Capitalizing on marketing opportunities requires overcoming the challenges to potato production. The most important challenges are the limited land holdings, sloping topography, high labour cost and wildlife damage problems. Most of these challenges are linked. Small plots and sloping topography limit the options for mechanization and result in high labour costs. The high labour requirement is further amplified by the requirement to guard fields against wildlife damage.

Overcoming these challenges to potato production in Bhutan requires following a series of steps that:

- promote farm mechanization suitable for mountainous regions as a substitute for costly labour;
- improve post-harvest management such as seed stores, packaging and transport;
- reduce wildlife crop damage, especially wild pigs;
- improve support services such as input delivery services;
- develop and promote small-scale potato processing industries;
- introduce crop insurance schemes;
- improve potato marketing by promoting market information systems, and educating and raising farmers' awareness of effective marketing.

Constraints of potato seed production in developing countries

Prem Gaur
Agricultural scientist (retired)
India

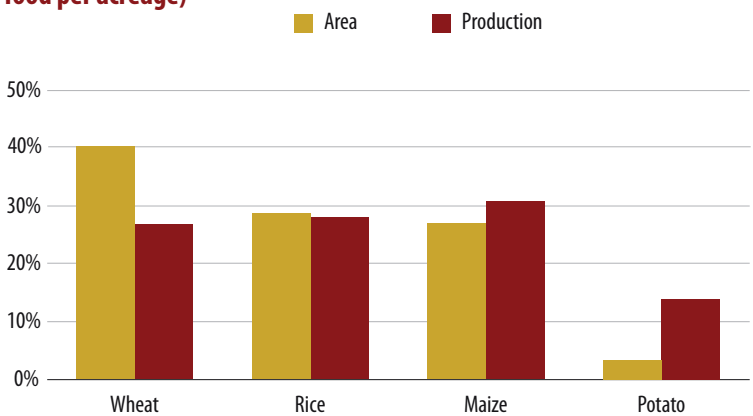
Potato is one of the world's four major food crops, along with rice, wheat and maize. It is a versatile crop that can be grown in a variety of altitudes, ranging from sea level to the snow line. It has wide flexibility in terms of the time of planting and harvesting, and can be harvested and consumed before the crop is fully mature. In addition, potato can be planted in various multiple cropping systems.

In addition to these favourable qualities, potato produces more food per unit area than any of the other major food crops. Potato accounts for approximately 3.5 percent of the area devoted to the world's four main food crops, but contributes some 14 percent of the share of food production.

The production of dry matter and protein from potato is significantly higher than other food crops such as wheat, rice and maize. Furthermore, the biological quality of the potato protein is high, with a well balanced amino acid content that is comparable to that of milk and eggs. In fact, the protein from the combination of egg and potato has a much better biological value than egg or milk protein alone.

Potato also generates more employment in the farm economy than other major crops.

Production and area of the world's main food crops (potato produces more food per acreage)



With all these favourable qualities, potato is an important crop to ensure food nutrition and social security in developing countries.

Productivity in developing countries

Production and productivity trends

Given the favourable qualities of potato, the area of potato production in developing countries increased by 50 percent between 1990 and 2005, to a total of 9.5 million ha, and production itself almost doubled, to 151.2 million tonnes. In contrast, production fell in developed countries.

Despite the increased production of potatoes in developing countries over the period, productivity remained low, at 14.4 tonnes per ha. This is barely a third of yields in some of the world's main potato producing countries. For example, yields in France, Netherlands, USA and UK are consistently above 40 tonnes per ha.

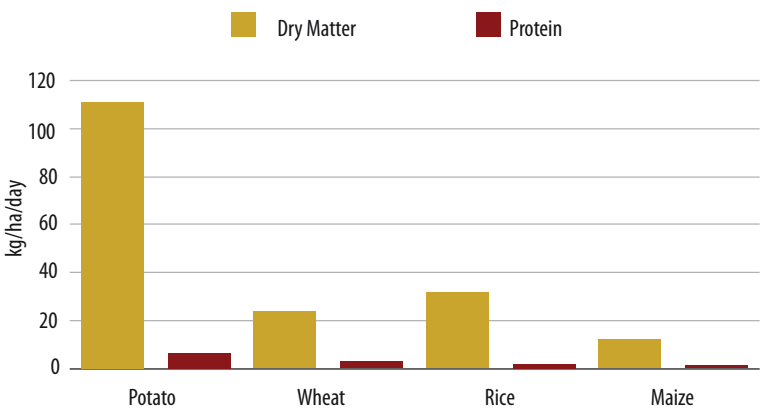
Causes of low productivity

There are a number of factors that can account for the potato's low productivity in developing countries. These include:

- lack of high-yielding varieties;
- non-availability and high cost of good seed;
- low use of inputs;
- suboptimal cultivation conditions;
- short cropping season in subtropics, which has a season of some 90 days compared to 150–160 days in Europe;
- diseases and pest outbreaks;
- inadequate storage facilities.

Of all these factors, quality seed is probably the most important factor, as it accounts for 40–50 percent of the total cost of production. Furthermore, if poor quality seed is used, then no other input will be able to compensate to achieve higher yields.

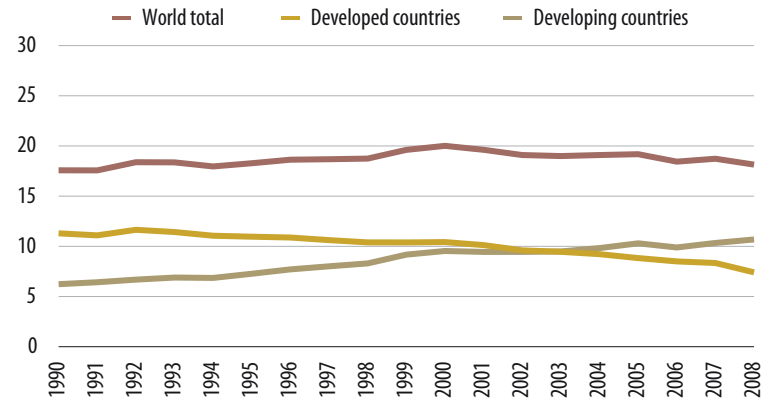
Dry matter and protein content of the world's main food crops (potato produces more dry matter and protein)



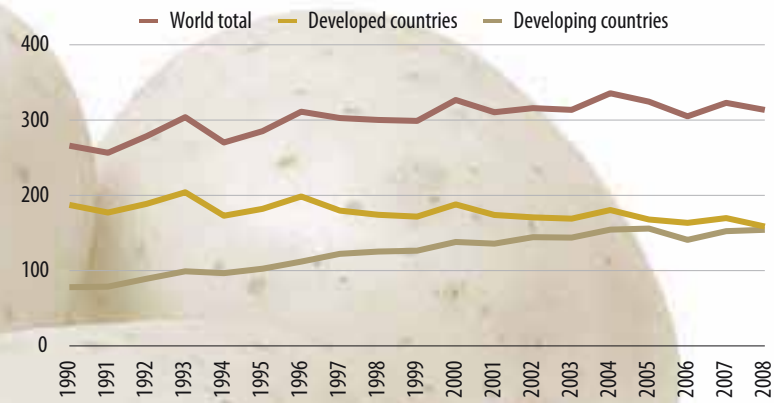
Biological value of selected foods

Food	*Biological value*
Egg	100
Potatoes	98
Milk	94
Rice	81
Maize	76
Wheat	57
Egg + potato (35:36)	130

World potato production area, 1990-2005 (million ha)



World potato production, 1990-2005 (million tonnes)



Potato productivity, 2006 (tonnes per ha)

Seed availability and production in developing countries

Sources of seed

Most of the seed available in developing countries is from informal sources, which means the quality of the seed is not guaranteed. Typically, potato producers in developing countries retain their own seed. Larger tubers are usually sold as ware potatoes while the smaller tubers (which often contain viruses) are kept for seed. In some cases, producers replace some of their seed with tubers from other local producers or from producers in higher altitudes.

Local traders often provide seed on credit to producers, on the condition that they will sell all of their ware potato tubers back to the trader at harvest. When they pay for the tubers at harvest, the traders deduct the cost of the seed that they provided on credit.

In some developing countries, seed (typically uncertified) is imported regularly through either public sector or private sector involvement. This seed is used for the production of ware potatoes or multiplied, with or without certification, for use in subsequent years. Such multiplication usually takes place in areas free of soil-borne diseases, although typically little attention is paid to the virus status of the areas.

A number of developing countries have certified seed production programmes in place. However, in most of these countries, production can be ineffective or they may not produce enough seed to meet domestic requirements.

Systems of potato seed production

Developing countries follow two systems for potato seed production, one conventional and one modern.

Conventional potato seed production

	Single plant selection and greenhouse tuber indexing	ELISA testing (ET) Electron microscopy
Year 1	Clonal multiplication of healthy tubers (1m x 1m)	ELISA test 3 Field inspections
Year 2	Clonal multiplication: Single rows 100 x 30 cm	ELISA test all plants composite sample
Year 3	Clonal multiplication (60 x 30 cm)	10% ELISA test 2 Field inspections
Year 4	Basic seed production (60 x 30 cm)	400 Plants/ha ET2 Field inspections
Year 5	Foundation -1	200 Plants/ha ET
Year 6	Foundation -2	3 Field inspections
Year 7	Certified seed	2 Field inspections

- **Conventional.** Under the conventional potato seed production system, disease-free seed is multiplied over a period of 6–7 years under field conditions, after which it is sold as certified seed to producers.
- **Modern.** Under the modern potato seed production system, most of the seed multiplication is achieved in tissue culture laboratories, through aero-hydroponic systems. Exposure to field conditions is limited to 3–4 years.

The modern potato seed production system provides good quality seed and can be used in countries where it is not possible to keep the seed free of diseases for long periods during multiplication in field conditions. But the seed produced by this method is more expensive than seed produced under the conventional production system.

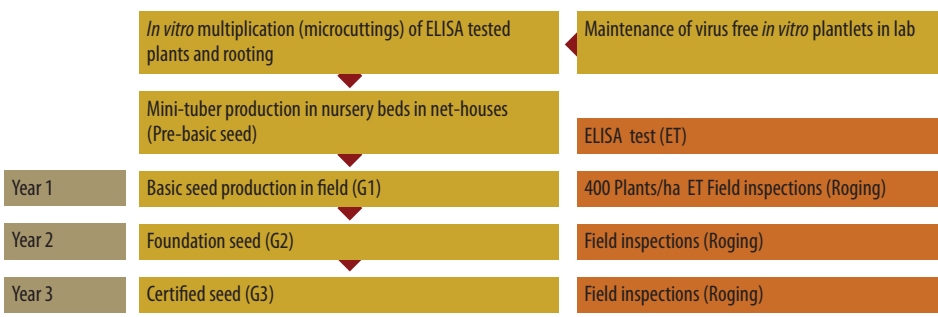
Constraints of disease-free seed production

Regardless of the seed production system used to produce seed tubers, five factors are important for the production of disease-free seed:

- availability of virus-free material of adapted varieties;
- low seasons when the disease-free material can be multiplied;
- good virus detection techniques;
- timely roguing of seed crops;
- trained labour and infrastructure.

Often, in developing countries, these factors are lacking. When this is the case, it causes a variety of constraints to their ability to produce disease-free material. The following identifies some of the main constraints.

Modern potato seed production system



Variety. Developing countries typically grow old varieties. Even in countries where a large number of varieties are grown, they often are not properly evaluated.

Disease. High incidence of soil-borne diseases, such as bacterial wilt and cyst nematodes, can be dangerous for seed production programmes.

Virus vectors. While information on the incidence of soil-borne diseases exists in some countries, virtually no developing countries have up-to-date information available on virus vectors in potato crops. This creates a considerable constraint to seed production in developing countries if they cannot guarantee that they raised their crops under vector-free or minimized conditions and, thus, have produced good quality virus-free seed.

Lab facilities. Tissue culture laboratories and other virus testing facilities in developing countries are ill equipped. In some developing countries, good facilities have been created with support of international funding. However, once funding ends, the effectiveness of these facilities generally decreases.

Net houses. Availability of net houses in developing countries is low. Even where available, they are often poorly maintained which renders them ineffective. If disease build-up occurs in net houses, the quality of seed production is poor. In many countries, virus freedom is not maintained during multiplication.

Seed multiplication. Formal seed production agencies in various countries often do not have sufficient space to carry out the seed multiplication stage. Therefore, part of the pre-basic seed that has been produced in net houses is sold directly to potato producers rather than effectively utilized for further multiplication.

Field multiplication. In some developing countries, pre-basic seed (either imported or domestically produced in net houses) is given to selected potato producers for further multiplication in the field. When selecting these producers, often little attention is paid to assessing the plots in which the seed is to be grown. In addition, little attention is paid to educating potato producers in seed crop management, such as the need for roguing diseased plants and the importance of crop rotation.

Seed potato storage. Although ware potatoes can be sold at harvest, seed potatoes have to be stored from harvest to planting. At planting, the seed tubers in subtropical countries are often over-sprouted with some loss due to rotting, which leads to lower yields. In temperate countries, there are often a large number of rotten tubers due to high humidity during storage. In addition, seed tubers in temperate countries often remain dormant at planting, leading to delayed germination and crop growth.

Infrastructure. In some developing countries, such as the high regions in Nepal and Bhutan, the conditions for potato production are optimal. However, such areas have not been fully exploited due to poor infrastructure such as lack of road networks and transport.

Human resources. Lack of trained workers is perhaps the weakest link in all developing countries. While potato producers in such

countries often have the ability and technology to produce ware potato tubers effectively, they do not necessarily have the expertise and infrastructure needed to grow good quality seed tubers.

Certification. Some developing countries have a seed potato production programme in place. However, they often do not have a seed certification agency to monitor the quality of seed production in the field.

Strategies for gearing up quality seed production in developing countries

Various strategies can be undertaken to overcome existing constraints and improve the status of seed production in developing countries.

Evaluation systems. Since most developing countries grow exotic potato varieties, it is in their best interest to have a good evaluation system in place for evaluating those varieties. This evaluation system should involve stakeholders representing all parts of the value chain, to ensure that appropriate varieties are selected collectively.

Pest surveys. Regular surveys of aphids need to be carried out over the long term to make information on virus vectors in potato crops as readily available as information on soil-borne diseases. This will allow identification of areas that are free of both soil-borne diseases and virus vectors for the production of good quality seed.

Producer networks. A network of certified seed potato producers needs to be developed. Producers will need to be trained in seed potato production management and provided with good quality potato seed year after year. As certified seed producers, their seed crop needs to be monitored regularly by the certification agency to ensure quality. Additional support should be provided to help these producers market their seed.

Multiplication proximity. Final seed multiplication should be done near the main ware potato production areas to ensure that the quality seed is available in the right place at the right time. If such quality seed is not available at the right time in the right quantities, producers will likely substitute with local "dirty" seed.

Rotation cropping. Potato producers in both hills and plains need to identify alternative economic crops suitable for crop rotation and multiple cropping systems, respectively.

Standards and certification. In those developing countries that adopt a seed production programme, seed standards need to be set, a certification system needs to be introduced and seed producers need to be registered.

Storage and distribution. Appropriate potato storage needs to be provided in both the seed production areas and seed consumption areas. This will strengthen the potato value chain by developing linkages between the producers and consumers of quality seed. Furthermore, there needs to be a cooperative movement involving farmer groups and both the public and private sector, to link seed production with storage and distribution.

Seed production partnerships. In those developing countries that have a formal seed production programme but do not produce seed in sufficient quantity to meet demand, seed producers can augment the basic seed production by involving other agencies, such as state agricultural universities, private entrepreneurs and NGOs.

Training. All value chain participants need to be trained in proper seed production management. These include professionals, seed growers, inspectors of seed certification agencies and extension workers.

Global view of potato seed production

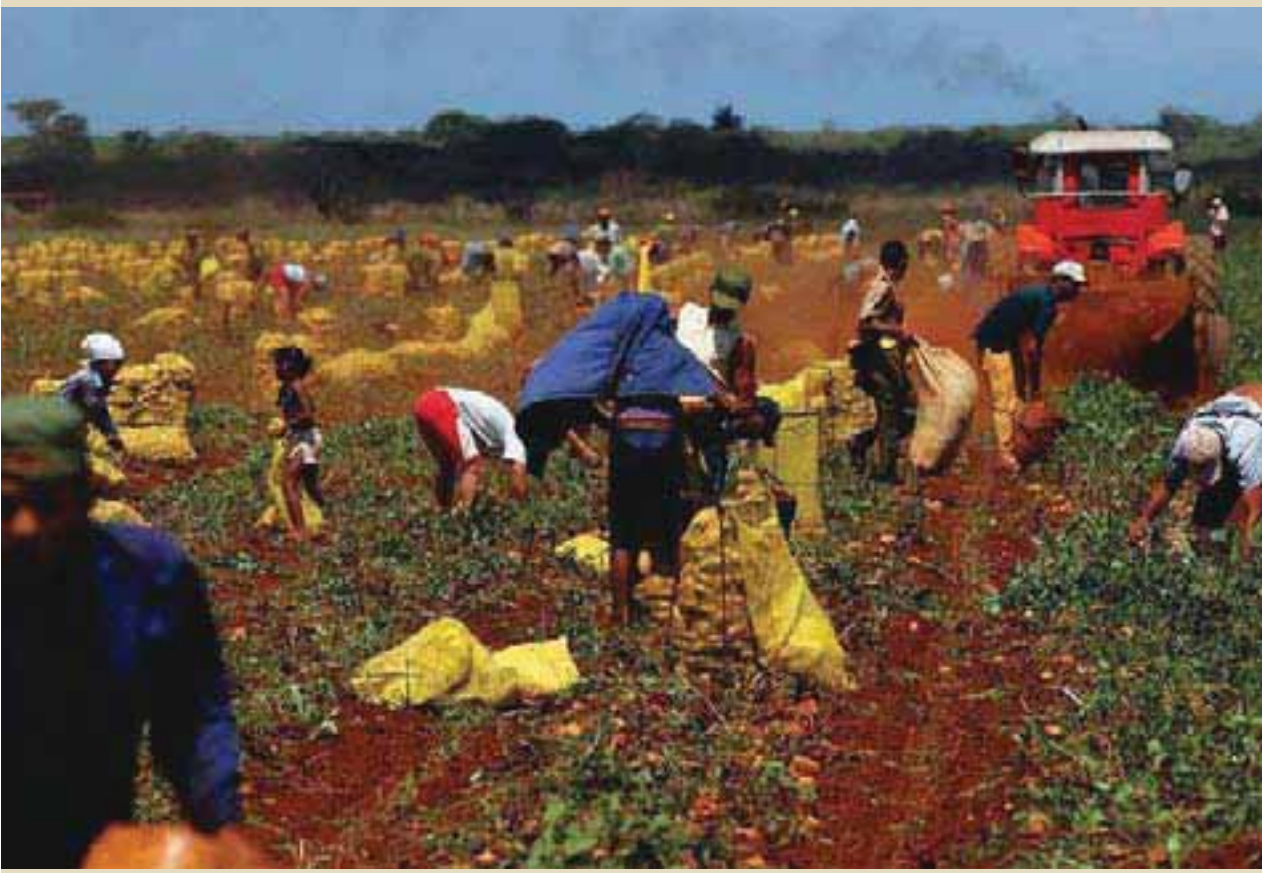
While countries that are located above 40° latitude generally have low aphid populations because of cold climates, they still can have considerable soil-borne diseases. However, the overall likelihood of having a good seed multiplication system is very good at high altitudes in such localities.

The higher altitudes of countries located between 30° and 40° latitude will have similar climatic conditions to those areas generally above 40° latitude and, thus, low aphid populations. In the lower lying areas, at altitudes nearer 30°, aphid populations need to be controlled during the summer months when temperatures exceed 35°C. Thus, the production of seed can take place in the winter production season rather than the summer season.

In countries located below 30° latitude, quality seed production will be difficult as the crop will be exposed to high aphid populations. As this means it will not be possible to keep the seed free of diseases for long periods, the modern potato seed production system may be a more appropriate system for seed production under these conditions.

Classification of seed potato production potential for developing countries based on latitude

Latitude	*Characteristics*
> 40°	Low aphid population, but need to monitor soil-borne diseases (e.g. Mongolia, Armenia and Georgia)
30–40°	In high altitude areas, ideal winter crop in plains (e.g. Turkey, Syria, Afghanistan, Pakistan, India, China, N & S Korea)
< 30°	Lower grade seed production



Terminal markets as the fundamental driver for seed potato

Fengyi Wang
Scientist
CIP, ESEAP

As demand for food throughout the world has grown, potato production as a major food crop has increased in importance in many countries. As with the development of any agricultural sector, this has meant the use of good quality seed also has increased in importance.

However, the development of the potato seed sector in many countries typically lags behind the production sector, even though the technology for seed production exists. Nevertheless, in those countries where the potato seed sector has shown signs of development, the challenge has been to identify producers to sell into terminal markets that require such high quality seed. Thus, the fundamental driver for the development of the seed potato sector is arguably the terminal market within the potato value chain.

Factors effecting yields

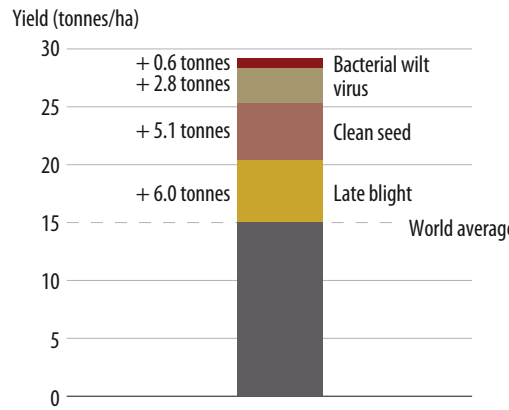
Many parts of the world have significant potential to increase the yield of the potato crop. Research has demonstrated that yields can be improved significantly by producing potatoes where natural conditions are favourable or using adapted varieties that suit the prevailing natural conditions. At the same time, proper crop management – the appropriate and efficient use of inputs and equipment, including the use of good quality seed – is necessary to realize yield potential.

Potato yield gap analysis suggests that with efficient control of some of the most common potato diseases and the use of good quality clean seed, average producers have the potential to double yields.

Realizing the benefits of seed

Using good quality seed does not guarantee that a producer will achieve maximum yields. Farmers also need to understand how to benefit from its use.

Potato yield gap analysis



Research priority assessment for the CIP 2002-2015 Strategic Plan: Project impacts on poverty, employment, health and environment. Source: Fuglie (2007).

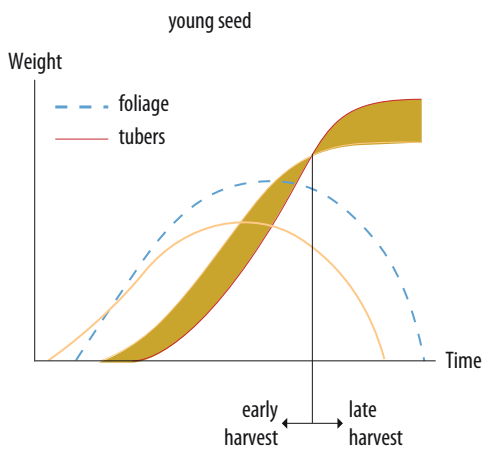
Publicizing the concept of seed

Producers cannot realize the benefits of using good quality seed unless they understand the differences between using clean quality tubers for seed and using ware potatoes. Such education can be carried out practically, using demonstration fields as a tool where the procedure for seed potato production and storage of quality seed tubers for later use in ware potato production can be explained.

Guaranteeing seed quality

The benefits of clean seed can only be realized if its quality is guaranteed. This means regulations need to be in place and overseen by an appropriate authoritative body, usually governmental, with responsibility for authorizing producers and certifying their seed. A seed tuber quality control and monitoring system needs to be set up and overseen, usually by a government agency staffed with specialists who regularly visit certified producers, monitor the quality of the seed being produced, and then certify the seed and issue a certificate. Certified seed offers producers better access to higher value seed markets for their tubers.

Yield potential of young seed tubers



Reducing cost of seed potato

For farmers to have the benefits of good quality seed, the seed material must be available at an affordable price. There are a number of ways to reduce the cost of seed production that the public sector can support:

- increase the scale of seed production;
- improve rapid multiplication techniques;
- develop new technologies;
- utilize government subsidies, where available.

Having seed supply available at the right time

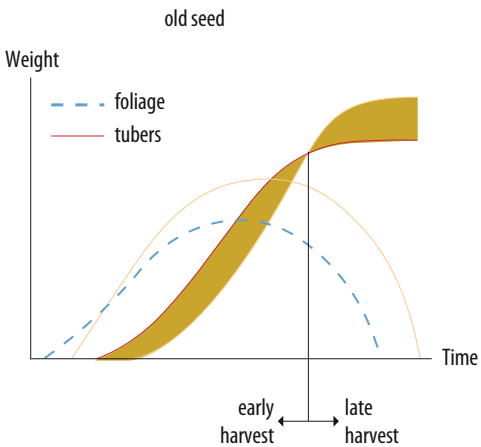
Once the quality of the certified seed has been recognized by producers, clean seed not only has to be available at the right price, it has to be available in sufficient quantities at the right time of the year. This requires adequate storage facilities and infrastructure for transportation.

Choosing appropriate tubers

To realize the full potential of quality seed, an understanding of the physiological status of the tuber at planting and its impact on yield is paramount. The use of younger (physiologically less mature) tubers at planting means a higher yield potential if they are harvested late in the production season.

However, when harvesting is to take place earlier in the production season, then the use of older seed tubers (physiologically more mature) is likely to have a higher yield potential.

Yield potential of older seed tubers



Physiological status of seed tubers and its impact on the production process

Crop development	*Young seed*	*Old seed*
Emergence	Late	Early
Tuberization	Late	Early
Foliage growth	High	Low
Tuber number	High	Low
Maturity	Late	Early
Yield	High	Low

Comparative benefits

Seed costs and production benefits

Producers will more likely use quality seed when the cost of the seed is relatively low or the market price of the potatoes produced from the seed is high enough to justify the additional investment in the seed. If the additional yield, as shown in the following table, from using quality seed does not outweigh the cost of the seed, and its use results in lower profitability, then there is little financial incentive to use quality seed.

Comparative benefit of seed use Chinese example of farmer seed over quality seed

(1 Chinese CNY = 0.1467 U.S. dollars)

	Producer using own seed	*Producer using quality seed*
Yield:	15 tonnes	20 tonnes
Production value:	6 000 CNY (US$879)	8 000 CNY (US$1 172)
Seed cost:		2 880 CNY (US$422)
Gross value:	6 000 CNY (US$879)	5 120 CNY (US$750)

Potato and other crops

In addition to comparing the financial incentive to purchase quality seed rather than using the producer's own seed, the economic decision to grow potatoes should be seen within the wider cropping decision-making process. Cropping decisions are mainly determined by the net profitability of competing crops.

In China, for example, the major potato production is in the cooler and short growing season when potato competes with spring crops such as spring wheat, spring oilseed rape, early soybean and early maize. On average, the profitability of potato production seems very competitive with these crops.

Typical production values of spring crops in China

(1 Chinese CNY = 0.1467 U.S. dollars)

	Spring wheat	*Oilseed rape*	*Early soybean*	*Early maize*
Yield (tonnes/ha)	2.5	2	2	4.5
Market price (US$)	293	366	293	146
Production value (US$)	732	732	586	659

Maximizing the value in the chain

Importance of storage facilities

Additional value can be created for potato producers by selling the tubers in seasonal periods when the price is relatively high. This requires storing the potatoes in appropriate conditions that preserve the physiological status of the tuber.

Balanced market supply

For the fresh potato market, an even, year-round supply of quality tubers will help maintain a constant potato price throughout the year. In addition to the use of good storage facilities, the distribution of potato production among regions with different growing seasons will help to create an even supply of potato in the market.

Processing industry development

Relatively favourable prices paid by the processing industry during seasons of supply shortages have encouraged potato producers to invest in good storage facilities to meet seasonal demand shortfalls. Both the starch and food processing industries offer potato producers the opportunity to add value to their tubers through storage.

Case examples of seed use in China

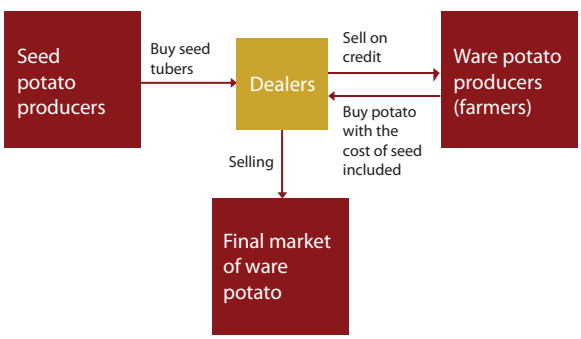
Role of traders in promoting seed potato use

In Shandong and Guangdong Provinces of China, professional dealers have appeared within the potato value chain in recent years, linking small family farmers with markets. The traders purchase tubers from seed potato producers and sell them to ware potato producers on credit. At harvest, the traders buy the harvested ware potatoes from the producers, deduct the cost of seed provided on credit and sell them to the best terminal market on which a profit can be made for all supply chain participants, including the seed potato producers, ware potato producers, the traders and the terminal market.

This model has a number of benefits.

- **Seed potato producers** are confident of the traders' ability to identify ware potato producers who use the quality seed and also identify the appropriate terminal markets that are prepared to purchase the quality ware production at a good price.
- **Ware potato producers** are confident of the traders' ability to secure quality seed and identify the appropriate terminal markets that are prepared to purchase the quality ware production at a good price.
- **Buyers of ware potatoes** in the terminal markets are confident of the traders' ability

Function of professional traders for seed potato in Shandong and Guangdong Provinces



to secure sufficient quantities of quality ware potatoes, reducing the need to source directly from many small-scale producers.
- **Traders** themselves make good profits along with the other value chain actors.
- **Risk** is shared among all the actors within the value chain.

Chinese starch industry

In China, there are 50–60 starch production factories, each with an annual production capacity of over 10 000 tonnes. In total, the annual starch production capacity in China is approximately 900 000 tonnes, but actual production is currently nearer 32–35 tonnes.

Potato producers selling tubers to the starch industry receive an average price of 600–700 CNY (US$88–103) per tonne. With average production yields of 23–30 tonnes per ha, the gross income of potato producers is around 16 250 CNY (US$2 381) per ha.

Chinese food processing industry

In recent years, the number of multinationals making foreign direct investments in China has increased. This includes food processing companies as well as fast food restaurants. Consequently, there is growing demand for ware tubers from potato processing companies, such as McCain, Simplot or Frito-Lay, to supply fast food chains such as McDonald's, KFC, Pizza Hut, Wendy's or other retail outlets with fries, chips and crisps. In addition, the potato flake flour industry is under fast development, creating a further demand for Chinese ware potatoes.

Looking forward

The development of certified seed production requires an understanding of terminal markets and their products. Thus, the fundamental driver for the development of the seed potato sector is arguably the terminal market within the potato value chain. However, developing relationships along the value chain and with terminal markets is likely to evolve over time, rather than being instantaneous.

For the value chain to realize the benefits of good quality seed, it must be available at an economic and affordable price. Seed technologies can be improved in a relatively short time to realize these benefits although the development of new technologies will likely take longer. In addition, the cost of seed production can be reduced through efficiencies gained by increasing the scale of seed production.

For ware potato, producer associations need to be organized to reduce producers' exposure to market risk.

Post-harvest research to respond to constraints in the potato value chain: the experience of Papa Andina, Peru

Kurt Manrique Klinge
Technical Coordinator
International Potato Center, Peru

The Andean region is a vast mosaic of ecosystems ranging from 800 to 4 500 masl, with distinctive agro-ecological conditions, rainfall and geology. This is one of the most diverse areas in the world, and the centre of origin of many species of animals and plants, including food crops such as potato, maize, legumes and tomato.

A wide range of potato varieties can be grown even at the highest altitudes, where harsh climatic conditions are a limiting factor to growing other crops. Peru holds the widest collection of potato varieties, estimated at more than 2 800 native landraces.

Since pre-Inca times, the potato crop has been important to livelihood strategies of the population living in the Peruvian Andean highlands. For these populations, characterized by small land holdings of less than 5 ha per family and high illiteracy rates, the potato crop is key for food security, both in terms of household diet and as a cash crop for escaping poverty and famine.

Small farmers generally live in remote areas and have little or no access to technical assistance. This results in limited and non-homogeneous production surpluses for marketing. Additionally, they have a community-oriented, rather than market-oriented, organizational structure. All this increases costs of marketing and transaction, and the per-unit costs of assembly, handling and transportation.

Consequently, profitability of small-scale farmers is low. An innovation strategy that focuses only on improving potato production will not help them out of poverty. Potato production has to be associated with market-oriented strategies in order to improve living standards.[1]

Basic principles in post-harvest management and physiology

Post-harvest physiology[2]

Post-harvest physiology is the division of plant physiology that deals with functional processes in plant material after it has been harvested. This includes the period from harvest or removal of the plant from its normal growing environment until the time of ultimate utilization.

[1] Antezana, I., Fabian, A., Freund, S., Gehrke, E., Glimann, G. and Seher, S. 2005. *Poverty in potato producing communities in the Central Highlands of Peru.* Centre for Advanced Training in Rural Development (SLE). Humboldt Universitat zu Berlin. Hessische Str. 1-2, Unter den Linden 6 D-10099 Berlin, Germany. 248p.

[2] Kays, S.J. 1991. Postharvest physiology of perishable plant products. AVI Book, New York (USA), Van Nostrand Reinhold (Publisher). 532 p.

Once the potato tuber is detached from the plant, it becomes totally dependent on its accumulated reserves. At the same time, it faces chemical changes and the losses of its water, solids and vitamin content. Perishable plant products are alive and continue to function metabolically once detached. Respiration is one of these metabolic processes that continues to function and has a direct impact on the shelf life of any perishable product. A high respiration rate can be caused by environmental factors such as high temperature, low relative humidity or exposure to light, or by mishandling and bruising. This results in the release of energy as heat and water loss, which initiates the deterioration and decay process. The control of post-harvest respiration is therefore a key factor in maintaining the quality traits of perishable plant products.

Post-harvest management

The potato tuber is a natural reservoir structure that accumulates photosynthates (starch) and water. This condition allows the potato tuber to have a longer perishability period compared to horticultural crops – such as lettuce, asparagus and broccoli – which are more exposed to water loss and rapid decay.

However, the high water content of the potato tuber (80 percent) makes it vulnerable to sprouting and deterioration (rotting). Appropriate low temperature storage conditions of 7°C to 10°C are thus necessary to avoid bacterial and fungal development, and proper handling is necessary to avoid skin injuries that facilitate bacterial infection and increased respiration rate. A complicating factor is that temperatures below 7°C cause some of the potato starch to be converted to reducing sugars. These sugars are undesirable for potato tubers intended for the snack industry, because the affected tubers result in dark potato chips.

Potatoes should be stored in an environment with high relative humidity to minimize the risk of tuber shrinkage which causes dehydration and the lost of quality traits. Shrinkage occurs when, for example, water flows from inside the tuber to the external environment as a result of a negative gradient. This is why modern potato storage facilities have humidifiers and temperature controls.

The Incas already had a clear understanding of the basic principles of post-harvest technologies in the tenth century. Scientists have found, from studying their potato storage facilities, that the Incas manipulated the storage environment to control storage temperature through ventilation, insulation and the selection of warehouse locations.

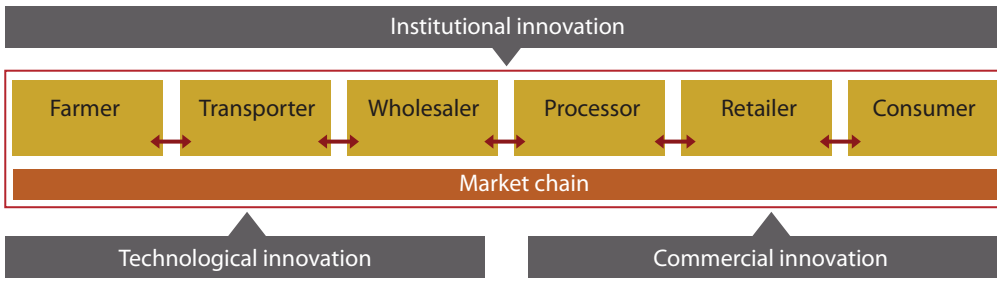
The ancient structures were built with massive walls and thatched roofs to protect them during warm days as well as from the excessive cold. Windows placed on both sides provided cross drafts, and many storehouses had open stone floors connected to the outside by ducts or vents.[3]

Participatory market chain approach: a tool for innovation and guide to post-harvest research

Papa Andina and the Innovation and Competitiveness of Peru's Potato Sector Project (INCOPA), funded by the Swiss Agency for Development Cooperation (SDC)

[3] Morris, C. E. and Thompson, D. 1985. *Huanuco Pampa: an Inca city and its hinterland.* Thames and Hudson, London. 181p.

PMCA approach



and implemented by CIP, have developed and conceptualized the PMCA.[4] The PMCA approach is a structured, three-phase participatory methodology to identify and exploit new business opportunities that can benefit the poor. Its premise is that commercial innovations constitute a driving force that can promote the other types of innovations required along the market chain to sustain and strengthen the development of new products, namely technological and institutional innovations.

Technological innovations for potato would include research for new product development or culinary uses as well as for development of quality norms, variety selection for processing, and for improvement of production processes, storage and post-harvest techniques, and commercial information systems.

[4] Bernet, T. Thiele, G. and Zschocke, T. 2006. *Participatory Market Chain Approach (PMCA) User Guide.* Lima. International Potato Center (CIP) – Papa Andina.

Application of PMCA in Peru

PMCA has been applied to the potato sector in Peru twice: first to promote innovation throughout the whole potato marketing system and, second, to add value to native potato

Adding value to native potato varieties– Innovations in colored potato chips

Potato diversity shows an amazing assortment of colors, shapes, textures and flavours.

Commercial innovations generated by PMCA

Mashed potatoes

Fresh potatoes

Colored potato chips

varieties.[5] In each case, post-harvest research issues were identified and tackled.

The commercial innovations fostered by the application of PMCA in Peru include promoting the development of new products (fresh or processed) that add value to Andean native potatoes and modern potato varieties. The PMCA has allowed the development of segmented potato chains for each new product, namely: colored potato chips, selected potatoes for fresh consumption, and processed or boiled mashed potatoes.

Technical topics for post-harvest research addressed for innovation

The development of innovative new products has generated additional post-harvest research demands to ensure quality raw material for both the fresh consumption and processed snacks industries. The processing and snack industries have more specific quality standards related to sugar and solids content, whereas for the fresh consumption industry, quality standards mainly concern grading, external defects and sprouting.

Storage innovation

Once potato growers join a potato supply chain, they need to start managing stocks of stored potatoes. Therefore, the traditional on-field native potato storage has to be improved.

Traditionally, small-scale Andean farmers stored harvested potato varieties under straw in fields, unsorted and ungraded. Consequently, potatoes were exposed to insects and to damaged tubers during storage. Now farmers have adopted new methods of sorting harvested potatoes by variety and bagging them prior to storage to protect them against insects and rodents.

[5] Manrique, K., Fonseca, C. and Bernet, T 2006. Promoting the use of native potatoes in Peru. *In: Participatory Market Chain Approach (PMCA) User Guide.* International Potato Center (CIP) – Papa Andina. Lima. pp. 117-128.

Demand-driven post-harvest research for innovation	
Topics for post-harvest research agenda	**Problems to solve**
Storage innovation	Avoid seasonal lack of continuous supply to potato chain
Sprout inhibitor method – applying CIPC and natural oils	Avoid decay, regulating supply, low sale prices
Quality standards – grading and packing for wholesale marketing	Have homogeneous quality for fresh consumption, processing
Quality control –keeping sugars low, monitoring chemical changes	Avoid chips darkening in frying process

Other types of storage improvements in Peru have included the introduction of wooden boxes and eucalyptus leaves that deter insects, and the use chlorpropham (CIPC), a commonly used sprout inhibitor in developed country potato industries. Results indicate a reduction in storage losses from 30 percent (primarily due to weevil and shrinkage) to less than 10 percent.

Sprouting control

CIPC is not currently available in Peru where potato storage is rare in the local potato market. That said, Peruvian potato growers realize the potential of using CIPC to reduce supply seasonality and losses, help storage management and facilitate better potato supply planning. Such benefits would help growers achieve greater bargaining power when negotiating with potato dealers and processors.

Natural oils, such as muña oil (an extract from a wild Andean herb) offer a natural alternative for sprouting control in storage. A storage trial and comparative study carried out by CIP and the University of Idaho, USA, found no significant statistical difference between using muña oil and CIPC, when muña oil was applied to tubers and stored in cold rooms.

Quality standards

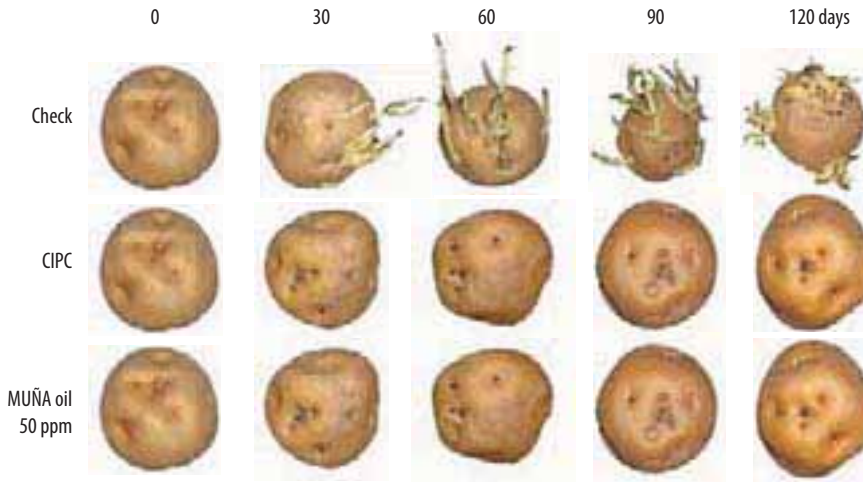
Establishment of quality standards and sizes of potato tubers is a primary step in ensuring quality and homogeneous raw material, either for fresh consumption or processing. As a result of the first PMCA, *Cadenas Productivas Agrícolas de Calidad en el Perú* (CAPAC-Peru), a potato market chain association was created and quality standards were developed for potato marketing at the wholesale market level by the local potato brand, *Mi Papa*.

Mi Papa has a defined grading and size system that consists of five quality categories or grades for three different potato varieties: *perricholi, canchan* and *tumbay*. Each of the five quality categories is intended to serve five different marketing chains. National authorities have recently established a technical committee to define official potato standards for Peru, using the *Mi Papa* scheme and standards as an input in the process.

Reducing sugars accumulation

"Cold sweetening" is a physiological problem that affects potato tubers when they are exposed to temperatures below 7°C. At this point, starch is degraded and hydrolyzed into reducing sugars. This process is undesirable for the snack

Muña oil, a natural alternative to control sprouting



Muña oil is an effective sprout inhibitor when treated tubers are kept in cold storage (8°C) and sprayed every 15 days

Mi Papa wholesale quality standards

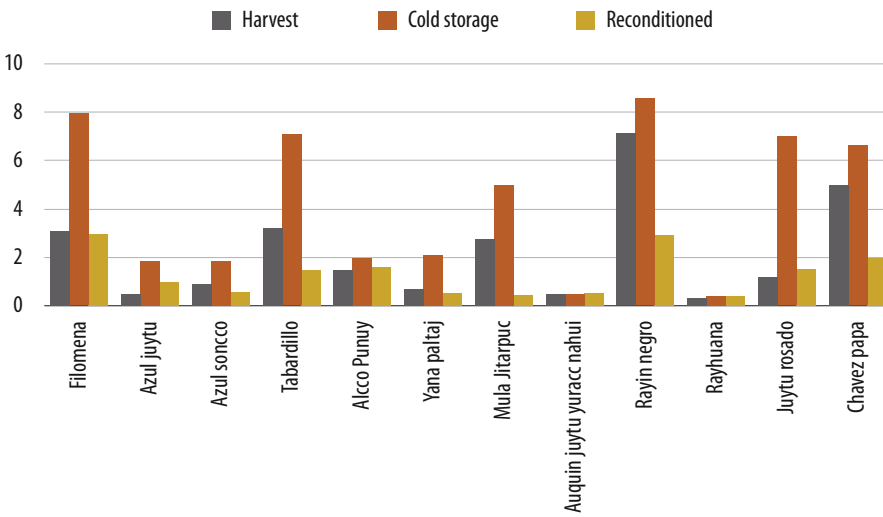
Name/ Grade	 Perricholi	 Canchan	 Tumbay
Extra	>8 cm		>6.8 cm
Selecta	7.0 - 8.0 cm		6.0 - 6.8 cm
Commercial	5.5 - 6.9 cm		5.0 - 5.9 cm
Domestica	3.0 - 5.4 cm		3.1 - 4.9 cm
Baby	2.0 - 3.0 cm		2.0 - 3.0 cm

industry due to the dark colored chips that result from affected tubers. This is the main reason why the snack industry reduces the grade of potato tubers from sensitive potato varieties grown in the Andean highlands.

Unfortunately, most potato breeding programmes in Peru do not test for cold sweetening. Consequently, sensitive new potato varieties have been developed that are not suited for the highlands where low temperatures prevail. Cold storage trials, held on 12 native cultivars to test the extent to which tubers are sensitive to cold sweetening in Peru, found that almost all responded to reconditioning treatment that restored their processing qualities.

Potato growers can monitor the quality of their tubers through various on-farm quality

Glucose content (mg/g) in native potato tubers after harvest and after cold storage (4°C, 85% HR, x 45 days) and reconditioned (25°C x 72 days)



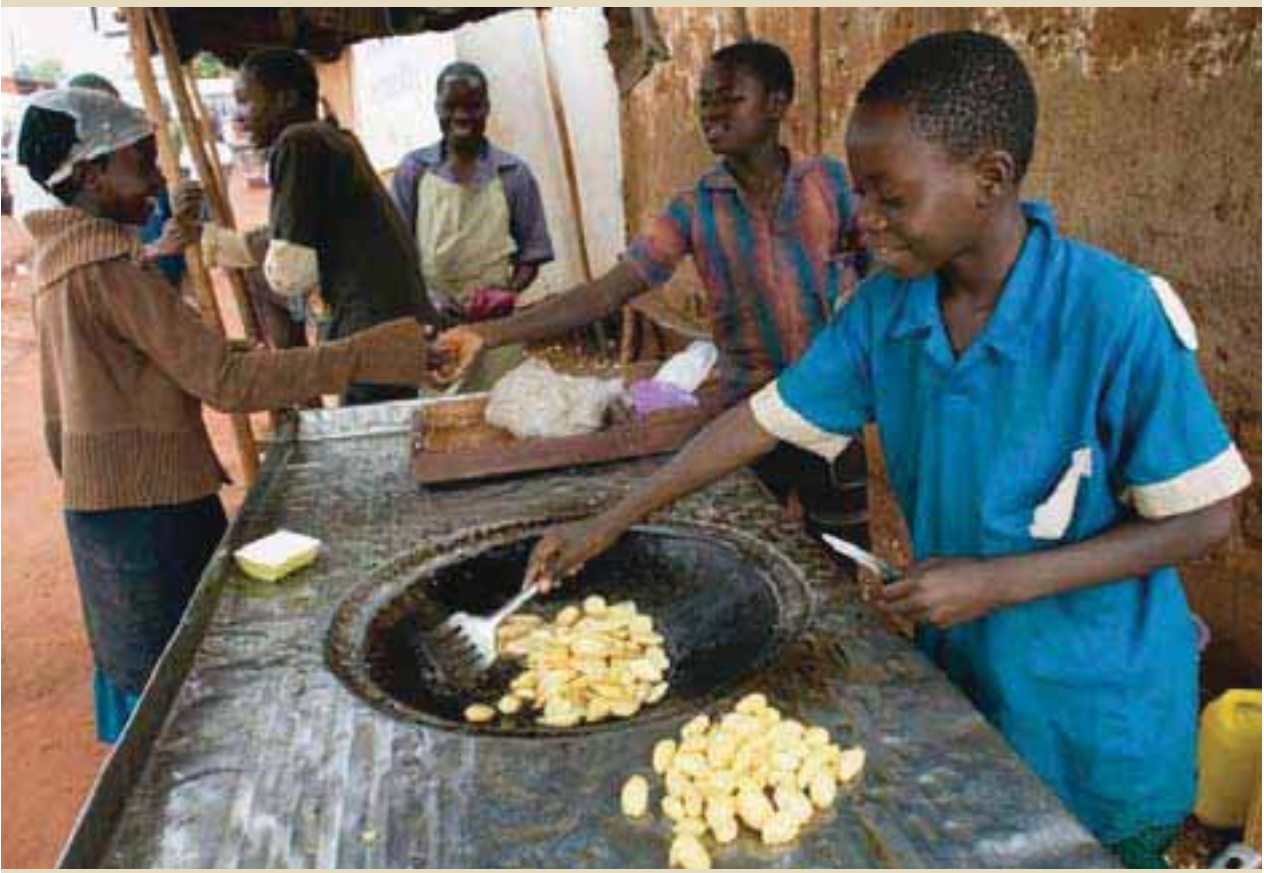
control procedures. These procedures are intended to help growers who participate in the potato value chain to implement a basic quality control programme that:

- measures reduction in sugar content using a glucometer, which is commonly used by diabetes patients;
- determines the specific gravity of potatoes to control sprouting, using the easy and accurate weight in water/weight in air method;
- performs frying tests with frying kits to assess the problem of cold sweetening.

Key messages

Based on the experiences of post-harvest research and application in Papa Andina, Peru, a number of suggestions on how to overcome constraints in the potato value chain can be made.

- **Post-harvest research** is essential for improving the competitiveness of the potato value chain and market orientation.
- **Good understanding of potato post-harvest physiology** is necessary to capitalize on technological innovation.
- **Commercial innovation** promoted by the PMCA has led demand-driven technological and post-harvest innovations.
- **Biodiversity** can become an important source of revenue for small-scale farmers.
- **Stakeholder platforms** are a necessary complement for sustainability and continuity of the innovation process.



Potato system diagnosis in East Africa: An innovation system analysis

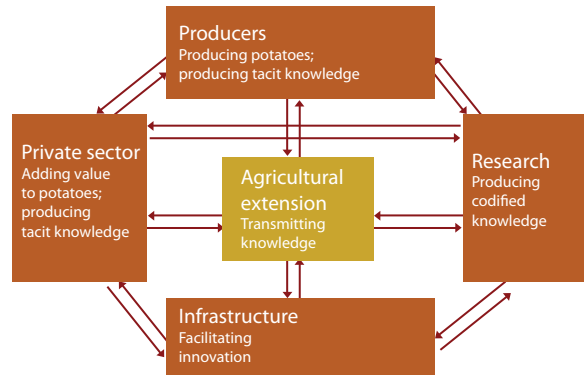
Peter Gildemacher
Sustainable Economic Development Advisor
Royal Tropical Institute, The Netherlands

What is an innovation system?

An innovation system (IS) is the complex of actors and their interrelations that contribute to the process of generating and applying knowledge. This includes the application of research-generated knowledge but also the existing knowledge of all actors within the system.

Looking specifically at the innovation system for potato in East Africa (specifically Kenya, Uganda and Ethiopia), a number of actors can be identified, namely: producers, research extensionists, representatives of the private and public sectors, and policy-makers.

Innovation system for potato



Innovation system analysis - data collection

To analyze the potato systems in Kenya, Uganda and Ethiopia, data was collected using a number of data collection methods:

- multi-stakeholder meetings
- knowledge and information system surveys
- surveys of farmer practices
- disease surveys.

The role of the multi-stakeholder meetings

Multi-stakeholder meetings were held in the three East African countries. Each meeting was attended by a number of actors within the potato system to assess what they thought of their relationships with each other. These views were collated in a two-dimensional matrix which helped identify the most important constraints to improved interaction among potato system actors. This led to a discussion of opportunities for change.

Economic situation

Production

Productivity within the three countries varies from 5.8 tonnes per ha in Uganda to

Average potato productivity per farmer in Kenya, Uganda and Ethiopia (tonnes/ha)

	Kenya	*Uganda*	*Ethiopia*
Average production	9.1	5.8	7.9
Median	7.7	4.2	6.0
Standard Error of Mean	0.35	0.43	0.44
N	249	128	177

Source: potato practices and technology survey

9.1 tonnes per ha in Kenya. In Kenya, for example, 35 percent of the agricultural area is under potatoes and demand continues to grow. However, demand is primarily being met by area increases rather than productivity gains, with large areas of forest being cleared each year. This is unsustainable from an environmental perspective (deforestation) as well as a production management perspective, given that a third of the crop rotation is already in potato.

Potato: food security and cash crop

The production of potato in the three countries has the dual objective of being both a food security and a cash crop, although in all three countries the majority of potatoes are sold off-farm. The proportion of the potato crop that is kept for home consumption varies from 39 percent in Ethiopia to 18 percent in Kenya.

Profitability

The profitability of potato production in East Africa is relatively low, particularly compared to production in West African countries. In 2005/06, gross margins in the major potato producing areas of Kenya, Uganda and Ethiopia typically ranged between US$415/ha and US$492/ha, with the exception of production in Meru Central in Kenya which totaled US$708/ha.

When expressed on a net margin basis, factoring in opportunity costs, profitability in Meru Central was nearer that earned in other major potato producing areas. The major exception was in Nyandarua, Kenya, where net margins were negative because of the allocation of opportunity costs to family labour. However, returns to family labour were positive in all the major potato producing areas in the three countries, ranging from US$1.0/day in Nyandarua to US$4.1/day in Meru Central.

Marketed potato yield versus home consumption in Kenya, Uganda and Ethiopia

	Kenya (N=96)		*Uganda (N=154)*		*Ethiopia (N=419)*	
	Weight (kg) household season	*Percent*	*Weight (kg) household season*	*Percent*	*Weight (kg) household season*	*Percent*
Ware sold	2 899	77	753	61	528	48
Seed sold	165	4	112	9	146	13
Ware home	327	9	191	16	300	27
Seed home	352	9	170	14	126	11
Total	3 743		1 226		1 107	
Total market	3 065	82	865	71	673	61
Total home	679	18	361	29	434	39

Source: potato practices and technology survey

Average production costs and revenues of potato production in the major potato producing areas of Kenya, Uganda and Ethiopia, 2005-2006[a]

	Kenya (N=251)		*Uganda (N=144)*		*Ethiopia (N=220)*	
	Meru Central	*Nyandarua*	*Kabale*	*Kisoro*	*West Shewa*	*Awi*
Investments	256	199	73	84	180	91
Cash investments	154	79	97	74	69	146
In kind investments	198	408	336	297	233	305
Fa vestments	8.8	9.2	5.3	6.8	7.7	5.1
Revenues	80	45	88	72	62	91
Yield (t/ha)	708	415	462	492	480	469
Price ($/t)	80	45	88	72	62	91
Gross margin ($/ha)	708	415	462	492	480	469
Net margin (opp. cost; $/ha)	197	-59.52	184	248	115	75
Return on family labour ($/day)[e]	4.13	0.97	2.08	2.99	1.97	1.55
Return on cash investment ($/$)[e]	1.8	1.1	5.4	4.8	1.7	4.1

[a] *Figures presented are calculated from the average of all valid farmer estimates. Farmers have estimated costs and revenues per plot per season, which was then withered for area over seasons, varieties and plots*
[b] *Cost of seed is put at the verage price of ware potato because of widespread use of farm -saved seed.*
[c] *Opportunity cost of labour is assumed equal to the average estimated cost of hired labour*
[d] *No opportunity costs are calculated for family labour*
[e] *Net margin divided by days of family labour*
[f] *(Gross margin minus cash investments)/cash investiments; only fertilizer, fungicides and hired labout are considered cash*

Given that smallholder producers in East Africa are generally cash constrained, the return on cash investment is an important financial indicator. Returns on cash invested were generally healthy in all the major potato producing areas, with the highest returns achieved in Uganda at US$4.8–US$5.4 per US$1 invested. However, returns were particularly low in Nyandarua, Kenya, where smallholders received on average US$1.1 per US$1.0 invested.

Overall economic situation

In general, the profitability of potato production in the major potato producing areas of Kenya, Uganda and Ethiopia is healthy. However, the return on cash investment is a serious constraint. This is particularly a concern, given that market insecurity is high as a result of relatively volatile market prices, dependence on rainfed systems and limited chain integration.

Technical constraints

Disease control

Farmers consider late blight and bacterial wilt the main disease problems affecting potato production. However, analyses of samples of uncertified seed potatoes sold at rural markets in the major potato producing areas in Kenya found that potato disease problems were not limited to late blight and bacterial wilt. Only 3 percent of the potatoes analyzed were virus free. In contrast, 82 percent of the potatoes analyzed contained more than one virus.

Soil fertility management

The use of manure and fertilizer in potato production in East Africa was found to vary considerably among countries. Use was highest in Kenya where the proportion of farmers using manure and fertilizer was 45 percent

Potato disease problems prioritized by farmers in Kenya and Uganda, 2005

	Kenya (N=99)	*Uganda (N=155)*
Late blight (*Phytoph ora infestans*)	49	119
Bacterial wilt (*Ralstonia solanacearum*)	71	132
Other	1	2

Source: knowledge and information survey

and 88 percent, respectively. In contrast, use was lowest in Uganda where only 18 percent of farmers used manure and 5 percent used fertilizer.

Conclusions on technical constraints

In general, seed potato quality is the main technical constraint faced by producers in the major potato producing areas of Kenya, Uganda and Ethiopia, although farmers do not explicitly relate seed quality to disease problems due to their limited knowledge of potato diseases. Farmers do not always perceive viruses to be a major disease problem affecting production. In fact, bacterial wilt and late blight may be considered the main disease problems simply because their symptoms or effects are easier for farmers to distinguish. Soil fertility management is also an issue in some countries.

Knowledge and information

Based on a survey, Kenyan farmers rely on neighbours and family members as their major source of information for enhancing knowledge on production practices. Outside of immediate family and communities, most information is provided by intermediaries. Public extension services and NGOs are indispensable for the dissemination of "outside" information.

In contrast, direct contact between research institutions and farmers is limited, and

Incidence of PLRV, PVY, PVX and PVA in seed potatoes sold at rural markets in Kenya (2006)

		Virus incidence levels (%)					
Market	*District*	*PLRV*	*PVY*	*PVX*	*PVA*	*Virus free*	*Multiple infections*
Murang'a	Muranga	95	100	64	64	0	100
Kagio	Kirinyaga	68	91	83	56	0	96
Karatina	Nyeri	91	78	83	28	1	93
Meru	Meru Central	91	58	70	40	1	84
Nanyuki	Meru Central	96	100	55	65	0	98
Naru Moru	Nyeri	63	29	46	65	6	75
Elburgon	Nakuru	29	83	39	10	8	50
Molo	Nakuru	49	70	64	14	6	66
Mau Narok	Nakuru	61	83	30	15	9	68
Kihingo	Laikipia	71	48	100	9	0	79
South Kinangop	Nyandarua	74	94	23	65	3	83
North Kinangop	Nyandarua	99	98	34	78	0	98
Grand mean		***74***	***77***	***57***	***42***	***3***	***82***

Source: Gildemacher

Manure and fertilizer use in potato production in Kenya, Uganda and Ethiopia

	Farm Yard Manure (FYM)			*Fertilizer*				
	Farmers using FYM (%)	*FYM applied (kg/ha)*	*s.e*	*Farmers using fertilizer (%)*	*N applied (kg/ha)*	*s.e*	*P applied (kg/ha)*	*s.e*
Kenya	45.0	4327	512	87.8	43.3	2.0	101.4	4.67
Uganda	17.7	2207	606	4.7	37.6	18.9	46.9	45.11
Ethiopia	26.1	3006	317	57.2	30.6	2.5 3	3.4	2.31

Outliers in farmer estimates of applied amounts were removed by skimming the top 5% estimates.
Source: potato practices and technology survey

Knowledge and information system in Kenya

	Source of information (%)							
Farming practice	*Own experience*	*Family member*	*Farmer own community*	*Extension / NGO*	*Research*	*Publication / media*	*Private sector*	*Others*
Potato varieties	12.6	5.0	73.4	6.0	1.5	1.0	0.0	0.5
Seed potato selection	48.5	6.8	22.0	21.1	0.0	1.7	0.0	0.0
Soil fertility management	58.9	6.9	13.1	18.3	0.0	1.7	0.6	.6
General crop husbandry	54.9	11.7	3.1	19.4	0.2	0.2	0.4	0.2
Post-harvest handling	48.7	14.8	19.6	16.9	0.0	0.0	0.0	0.0
Marketing	41.4	15.2	23.2	11.1	0.0	7.1	2.0	0.0
Crop protection	29.0	7.0	27.0	20.0	2.0	2.0	13.0	0.0

Source: knowledge and information survey

intermediaries are needed for the dissemination of research information. Similarly, the role of both the private sector and the media is limited, although the private sector's input suppliers are considered relatively important for information on crop protection.

Linkages between actors

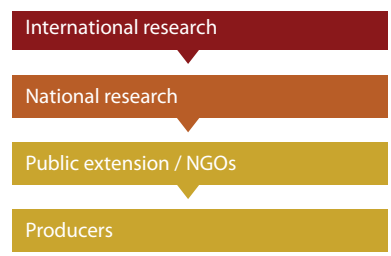
In general, the "linear" model of thinking on the relationships among the different actors within the system still dominates. For potatoes, CIP provides information to the national programmes, which is translated to the local situation and disseminated to local producers through public extension services and NGOs.

Even though many do not regard the linear model as the theoretically optimum model for information dissemination and innovation, in practice that is the way the actors in the potato chain still work.

More generally, the following problems within the potato chain have been identified.

- **Private sector.** The private sector is entirely absent from any innovation system activities.

Linear model of actor linkages



It has no linkages with actors involved in research or extension services.

- **Capacity building.** There is a very limited focus on building the capacity of partners at either the national or international research levels.
- **Information dissemination.** There are limited skills in, and priority for, the synthesis and communication of research results by the national and international research organizations or the public extension services.
- **Communication.** There is generally very poor communication among actors in the potato sector.
- **Representative organizations.** Virtually no bodies that have overarching goals represent farmers or the private sector.
- **Extension and research focus.** Most extension and research activities are biased toward medium-scale producers, as they are generally considered "easier" to work with because they have more knowledge, opportunities and different economic possibilities than do the poor, small-scale producers.
- **Research goals.** Research tends to have a high-tech bias, which is not always the solution from a practical implementable perspective.

Improving actor linkages

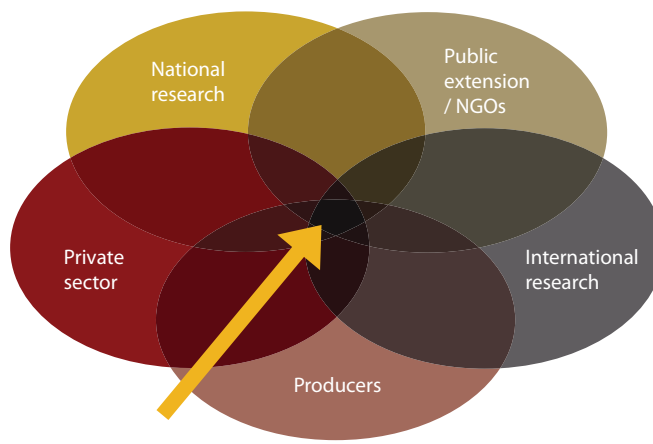
Based on the identified economic, technical and information system constraints, a number of solutions to improve linkages among actors within the potato system have been identified. These include the improvement of:

- interaction of stakeholders;
- collaboration among public sector, private sector and producers to solve technical problems;
- communication of research results.

Improved stakeholder interaction

Improved stakeholder interaction requires the formation of producer and private sector organizations that can facilitate information flows. This would ideally lead to the formation of a multi-stakeholder platform that would further improve stakeholder interaction. With such a platform, the potato system could move from a linear model in which information is exchanged

Improved stakeholder interaction



among a limited number of actors at a single stage in the chain to a mutual learning model that promotes information dissemination among many actors, including the private sector, at the same time.

Improved collaboration

Improved public sector, private sector and producer collaboration can help solve a number of technical problems.

- **Joint innovation projects** would enable development of more relevant production technologies because farmers would be involved in the process. With private sector involvement, technical innovation activities can be combined with market innovation activities.
- **Vertical market integration** would lead to better communication throughout the supply chain. This could lead to the development of price incentives for a specified quality of production as well as opportunities for specialization in seed or particular ware markets.
- **Improved stakeholder influence on the research agenda** would help reduce medium-scale farmer bias, reduce focus on high-tech solutions and improve the market focus of research activities.

Improve communication of research results

Improved communication of research results can be achieved though more collaboration with the media as well as with input suppliers and among NGOs, public extension services and research organizations.

At the same time, skills need to be developed for effective communication of research results. Communication needs to be given a higher priority to promote innovation throughout the potato system.

Examples of possible partnerships

Positive Seed Potato Selection Programme, Kenya

The Positive Seed Potato Selection Programme carried out in Kenya is a low-tech programme that involves no cash payments and uses zero-cost technology, thereby addressing some of the economic and technical priorities of concern to the potato systems in East Africa. The programme also has a focus on the effective communication of research results.

Seed Potato Producers Association, Ethiopia

The formation of this producer association in Yeldu and Galessa in Ethiopia has improved incomes. It has promoted innovation in the storage of potatoes through low-tech ware potato and diffused light stores. In addition, improved varieties have been identified through research-NGO-producer collaboration.

Integrated Potato Sector Development Project, East Africa

This CFC project in East Africa was implemented in 2008 and continues to 2012. It focuses on an integrated approach for developing the potato sector as a whole. Specifically, it comprises platform building, vertical market integration (seed-ware-processing-marketing), technical innovation and communication (farmer capacity building).

Linking potato farmers with markets in Indonesia through participatory market chain approach

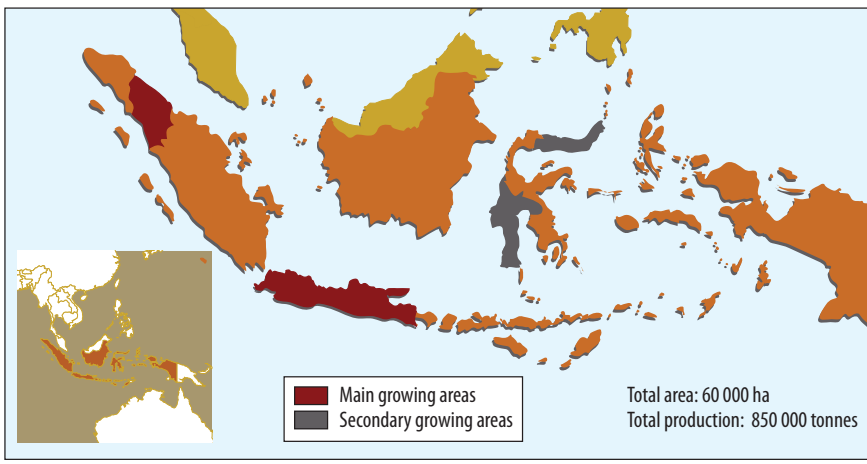
Mieke Ameriana
Researcher
Indonesian Vegetables Research Institute, Indonesia

Indonesia comprises 17 508 islands. Its main potato producing regions are located in Sumatra and Java and secondary potato producing regions are in Sulawesi. In total, approximately 850 000 tonnes of potatoes are produced on 60 000 ha with an average yield of 14.2 tonnes per ha.

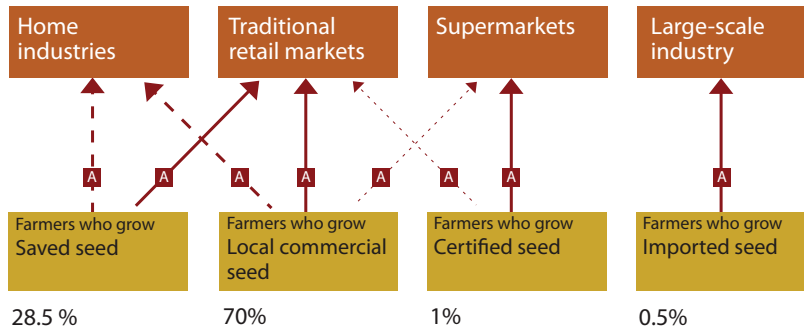
In general, potato production in Indonesia is small scale, with individual producers typically growing less than 0.5 ha of potatoes. Potato producers tend to have low capital capability and seek a quick cash return. They prefer a lower but "certain" return instead of higher profit that could come with higher risk.

Consequently, Indonesian potato producers' lack of capital severely limits their ability to purchase the necessary agricultural inputs, such as good quality seed, fertilizer and pesticides, the costs of which have been rising in recent years. The main potato disease problem in Indonesia is late blight. Potato yields and profitability are constrained by the lack of good quality seed on the market as well as an inability to control pest and disease outbreaks effectively.

Potato production regions in Indonesia



Existing potato market chain



Potato marketing in Indonesia

A number of marketing problems also affect potato production in Indonesia. High competition among the different actors within the potato value chain, including the farmers and traders, has resulted in a lack of trust and limited the chain's effectiveness.

In addition, there has been a significant increase in the number of supermarkets, meaning a growth in demand that has outpaced the supply response. As a result, there is a lack of good quality product available on a continuous basis. This is partly because Indonesian farmers' knowledge of the markets remains relatively low, their market share is low and market institutions are still weak.

Almost all Indonesian potato producers (98.5 percent) use non-certified seed, mostly to produce potatoes for home industries and traditional retail markets. Only 1 percent of potato producers use certified seed to produce quality tubers for sale to the supermarkets.

The participatory market chain approach

PMCA is a systematic R&D process that promotes innovation and competitiveness in market value chains. Innovation can take numerous forms, including:

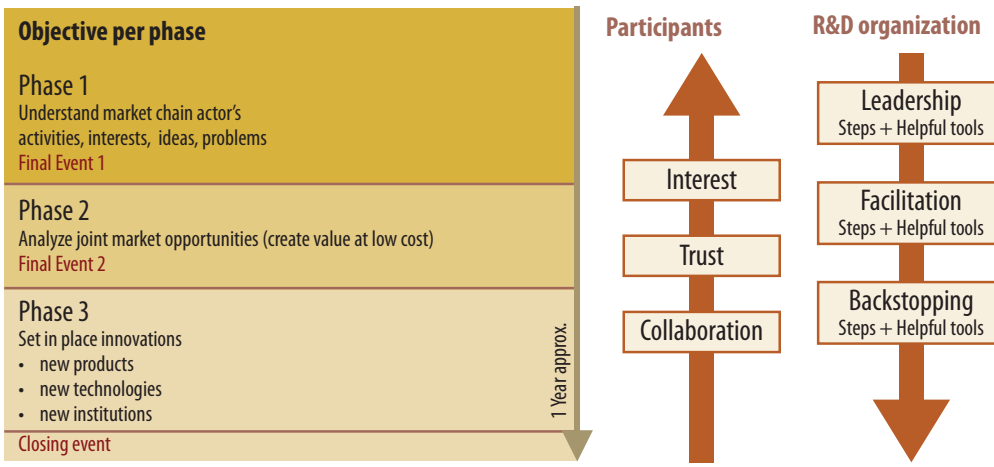
- product innovation
- technological innovation
- institutional innovation.

The PMCA focuses on market demand with an emphasis on building trust among the value chain actors. This is achieved through the promotion of mutual learning and collective action, as well as the empowerment of key actors and farmers within the value chain.

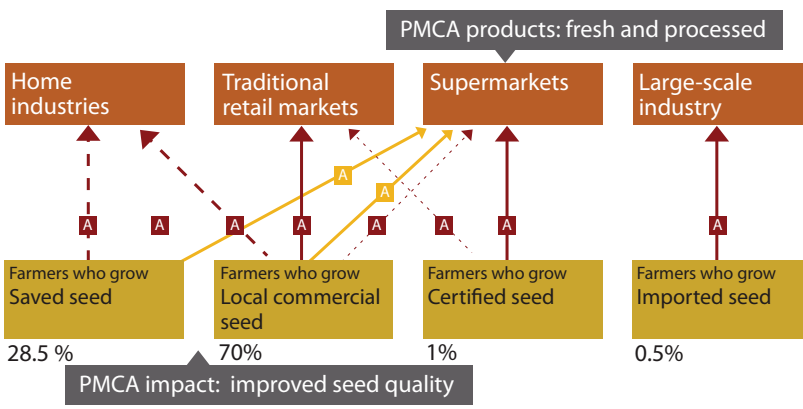
By promoting innovation, PMCA provides a systematic process for overcoming the marketing problems within the Indonesian potato value chain.

- **Trust.** Competition within the Indonesian potato value chain has resulted in a lack of trust among the different actors. PMCA works to overcome this through its emphasis on building trust among the value chain actors and promotion of mutual learning and collective action.
- **Product availability.** Lack of good quality product that is available on a continuous basis within the value chain has resulted in Indonesian potato producers being unable to capitalize on evolving market opportunities, such as supermarkets and food courts. PMCA works to overcome this

Basic process structure of PMCA



Post-PMCA potato market chain



through its focus on market demand and the promotion of innovation.

- **Low market share.** Indonesian potato producers' low market share has inhibited their ability to respond to evolving demand. PMCA works to overcome this through the empowerment of key actors and farmers within the value chain.

At the same time, technological innovation in improving seed quality will promote product innovation through the increased and continuous availability of good quality fresh and processed product for the supermarkets. Institutional innovation in support of collective action will facilitate the marketing of the product to the supermarkets.

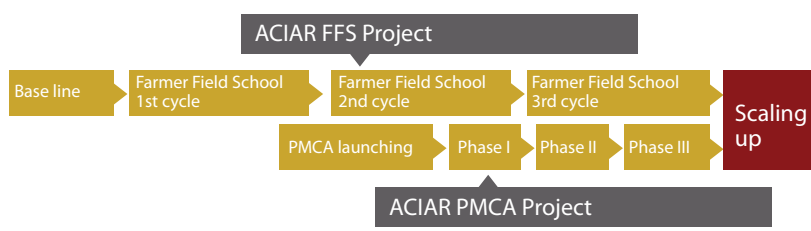
Implementation of the PMCA in Indonesia

PMCA is being used in the Indonesian potato value chain through an Australian Centre for International Agricultural Research (ACIAR)-funded project that links farmers with their markets. Launched in February 2008, the PMCA project has incorporated PMCA for fresh and processed potato, specifically for home industries. It involves a number of project partners, including CIP, Adelaide University, Indonesian Vegetables Research Institute and the West Java Province Agricultural Government.

The PMCA project was implemented in association with another ACIAR-funded project – the Farmer Field School (FFS) on Potato Brassicas. Launched in 2006, the FFS project initially conducted a baseline survey, followed by a number of cycles of the FFS. The PMCA project was launched during the first FFS cycle, and both projects continue to be linked and run in parallel, working with some of the same farmers who are part of the value chain.

This has allowed synergies to build between the two projects. The FFS project seeks to introduce marketing in its curriculum, with the aim of scaling up beyond the pilot farmers' groups while, at the same time, the PMCA project seeks to exploit market opportunities for potential on-farm innovations and thereby enhance farmers' capacities to participate in the PMCA.

Link between the PMCA and FFS projects



Phase I of the PMCA project – potato market chain assessment

In assessing the existing potato market chain, CIP initially carried out training of the project facilitators, designed to provide them with an understanding of the actors within the market chains, to explain the PMCA and how it is implemented, and to discuss how to carry out market chain assessments.

The market chain assessment was based on information collected from various actors within the value chain, including farmers, collector traders, large traders, wholesale traders, suppliers, retailers and actors within the home industries. The project assessed the activities, interests, ideas and problems of these actors while, at the same time, it encouraged them to participate in the PMCA.

The results of the market chain assessments were presented to a wide range of value chain actors and the findings confirmed. These included those actors who provided the information used for the market chain assessments as well as other actors who were specifically involved in the marketing of potatoes within the value chain.

Phase II of the PMCA project – thematic group meetings

In thematic group meetings, project facilitators received additional training to improve their facilitation skills and learned about the marketing concept and the tools available for use in the PMCA.

A number of the thematic group meetings focused on seeking joint market opportunities. For example, they included discussion on the relevance of the marketing concepts of "product, place, promotion, packaging and price"as shown below.

- **Fresh potato thematic group meetings.** Three thematic group meetings included farmers, local traders (*Bengkoang*), wholesaler traders (*Kramat Jati-Jakarta*), suppliers (*Bimandiri*), supermarkets,

Identifying market opportunities: Fresh Potato Thematic Group meeting

	1st MEETING	2nd MEETING	3rd MEETING
PARTICIPANTS	14	16	11
DISCUSSION	• Forming Sub TG • Potential innovations	Marketing concept "5 P"	- Packaging expert - More focus on packaging
MARKET OPPORTUNITIES (SUB THEMATIC GROUP)	SUB TG 1 : Promoting grade C (Ø 30 - 45 mm) and how to produce more grade AL (Ø 90 mm) SUB TG 2 : • Organic/less pesticide SUB TG 3 : • Product image	Promoting grade C and product image • Canceling prod AL • Postponing less pesticide	Promoting grade C

organic vegetable retailers, the mashed potato industry (*Asaad*) and government officials.

The objectives were to identify a market opportunity for fresh potato and to design an innovative marketing concept for that opportunity. After evaluating a number of options, a decision was taken to promote grade-C fresh potatoes, which are small tubers with a diameter of 30–45 mm.

After their work on innovation and the product, place, promotion, packaging and price marketing concept, a decision was taken to market the small grade C potatoes to supermarket outlets in three different types of packaging under the brand name "Cumelli". It also was decided to promote this product at trade fairs and malls, although no decision was taken on price.

- **Processed potato thematic group meeting.** Three thematic group meetings were held, consisting of farmers (Sauyunan Farmers' Group), home industries (Rasa Mandiri, Erlis), large traders (Hikmah Farm), the Indonesian Chef Association and government officials.

  The objective was to identify a market opportunity for processed potato and to design an innovative marketing concept for that market opportunity. After evaluating a number of options, a decision was taken to promote chips and *mustofa*, a local potato product.

  After their discussions of innovation and the marketing concept, a decision was taken to produce the chips and *mustofa* using smaller potatoes. These would both be marketed to supermarket outlets and

Designing an innovative marketing concept: Fresh Potato Thematic Group meeting

"5 P"	INNOVATIONS		
	1st MEETING	2nd MEETING	3rd MEETING
PRODUCT	• On-farm practices • Super market • Good promotion • Healthy food image	Promoting baby potato: small size (Ø 30 - 45 mm)	Baby potato with brand name "Cumelli"
PLACE		Try to access Supermarkets	Supermarket
PACKAGING		a. To use materials grass - paper with net at front and rear, 1 kg/bag. Label printed. b. Plastic net, 1 kg/net, label	a. Bag/grass - paper b. Transparent plastic c. Plastic net
PRICE		Rp 8,000 / kg ~ U$ 0.80	Will be recalculated
PROMOTION		- Content: usage of baby potato - Place: mall, trade fair	- Content: usage of baby potato - Place: mall, trade fair

PMCA designed fresh potato product: Baby potatoes - Cumelli

Existing product

"Baby potato"
PMCA product

Identifying market opportunities: Processed Potato Thematic Group meeting

	1st MEETING	2nd MEETING	3rd MEETING
PARTICIPANTS	17	21	13
SUBJECT/ DISCUSSION	• Novelty product by chef • Forming Sub TG • Potential innovations	• Demo by chefs • Marketing concept	• Packaging expert • More focus on packaging
MARKET OPPORTUNITIES (SUB THEMATIC GROUP)	Product development of existing Chips and *Mustofa* (Sub TG 1) • Novelty products (Sub TG 2)	STG1 : Chips STG2 : Mustofa STG3 : Potato bread STG4 : Potato skin STG5 : Potato wedges STG6 : Potato strudel	• Focus on chips and Mustofa • Novelty products postponed

Designing an innovative marketing concept: Processed Potato Thematic Group meeting

"5 P"	INNOVATIONS		
	1st MEETING	2nd MEETING	3rd MEETING
PRODUCT	DISCUSSION : • Kitchen practices • Product development • Packaging improvement • Market expanding by promotion	• Chips with smaller size • *Mustofa* with different slices. • Novelty products	• Chips with smaller size • *Mustofa* with round slices "Cumelli" brand name for all of the product
PLACE		• Supermarkets, kiosks • Supermarkets, restaurants, hotels	Supermarket, kiosks
PACKAGING		• Transparent plastic • Transparent tube	Healthy transparent plastic
PRICE		Not discussed	Not calculated yet
PROMOTION		• Mall • Trade fair	• Mall • Trade fair

kiosks in transparent packaging under the brand name "Cumelli". It was also decided to promote these products at trade fairs and malls, although no decision was taken on price.

Key points

During implmenetation of the PMCA project, a number of preliminary steps were taken in order to apply the PMCA and link potato farmers to markets.

Application of PMCA

- The level of participation at each meeting depended on the actor's perception of the likely benefits that would be accrued.
- Building trust is a process that takes place over time. Trust among the various actors increased successively in each meeting.
- The thematic group meetings ideally should take place every 2–3 weeks in rotating venues. Field trips should be interspersed with the meetings to enhance the process of building trust.
- In subsequent meetings, the level of progress should increase significantly as actors capitalize on their knowledge and create synergies. The presence of an expert consultant at the meetings is important.

Implementation of the PMCA to link potato farmers with markets in Indonesia

- New markets for innovative quality products will be developed for both the fresh and processed potato markets.

- Markets and the need to supply them with quality products will increasingly boost farmers' demand for good quality seed.
- Increasing demand for good quality seed will facilitate the development of the seed production sector.

The role of the Common Fund for Commodities in supporting potato in developing countries

Nicolaus Cromme
Project Manager
Common Fund for Commodities

Common Fund for Commodities

Organization and membership

The CFC, established in 1989, is an intergovernmental financial institution founded within the framework of the UN. The CFC has 107 member countries as well as a number of regional economic communities and is steadily growing. Although the CFC is not a full-fledged UN agency, it has observer status and works closely with UN agencies such as FAO, the UN Conference on Trade and Development (UNCTAD) and the UN Industrial Development Organization (UNIDO).

Goal and mandates

The overarching goal of the CFC is to enhance socio-economic development of commodity producers. Specifically, this means development to alleviate poverty by focusing on commodities such as potato in commodity-dependent countries. To achieve this, CFC provides financial assistance with focus on specific commodity problems or opportunities that cut across national boundaries. It gives priority to poorer commodity-dependent producers and small- and medium-sized enterprises.. CFC also takes an advocacy role for commodity issues, through activities such as organizing workshops.

The CFC has a commodity focus rather than a country focus. It provides financial assistance to projects that address generic commodity problems and opportunities rather than those addressing commodity issues of specific countries. The geographical location of CFC-financed projects is thus a secondary issue. Of greater importance is identifying the country in which the project can be implemented best, so that the results can be disseminated effectively to its specific target groups – smallholder farmers and small- and medium-sized enterprises (SMEs).

Rationale for commodity focus as a means to alleviate poverty

Commodity production in developing countries is heavily concentrated at the base of the social pyramid. An estimated 4 billion people live on less than US$1 500 per year. Therefore, the development of commodity-based value chains primarily targets the incomes of the world's poorest people, who are effectively CFC's target groups.

Role of the CFC

Since the approval of its first project in 1991, CFC has approved some 250 projects totaling US$460 million, of which CFC financed

US$230 million. However, CFC's role is not limited to just financing projects. It is active in project identification and screening, and assists in formulation at every stage of project development and in the final project appraisal. The CFC also provides assistance through identifying co-sponsors for the projects.

Project interests of the CFC

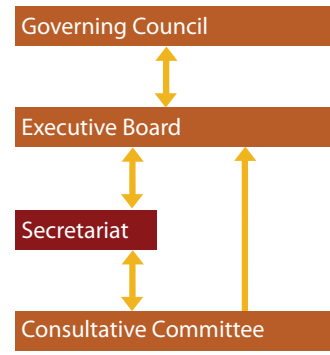
When approving projects, the CFC seeks projects that focus on a number of key areas.

- **Diversification** into non-traditional commodities as well as value-added products from the same commodity, for example transforming potatoes into chips, to broaden a country's commodity base.
- **Strengthening commodity value chains** and supporting effective participation of farmers and SMEs in those value chains, with the ultimate aim of improving market access and increasing farmers' and SMEs' shares of the value added.
- **Development of market mechanisms** through supporting, for example, the development of commodity exchanges, warehouse receipt systems and the use of financial products to mitigate price risk.

Organizational structure and decision making

The CFC is a relatively small organization with 29 permanent staff. At the top of the organizational structure is a Governing Council that meets annually for strategic decisions. A secretariat carries out all the day-to-day work. This includes presenting all proposals deemed supportable to the Consultative Committee, an independent technical panel of experts from CFC member countries that meets twice a year for discussion. This Consultative Committee can reject a project proposal, or make recommendations for amendments or for approval. Project proposals supported by the Consultative Committee are presented for formal approval to the Executive Board, which meets twice a year.

Common Fund for Commodities Organizational structure



Types of projects financed

The types of projects financed by the CFC can be categorized under a number of broad themes.

- **Post-harvest processing, marketing and quality improvement**
- **Pre-harvest and productivity improvement, including research**
- **Price risk management**
- **Expansion of market demand**

CFC operating sites

The main beneficiaries of CFC funding are countries in which poor commodity producers live, particularly African countries.

Sources of finance

CFC provides financing for up to 50 percent of the total project cost. The remainder is covered by other funds in either cash or in-kind contributions.

Basic criteria for projects to be considered by the CFC

Basic considerations

CFC financial contributions to a project range from US$30 000 to US$4 million, but the average is around US$2 million in the form of a grant, loan or a combination of the two. Projects on this scale are considered manageable and can be implemented over a three- to five-year period.

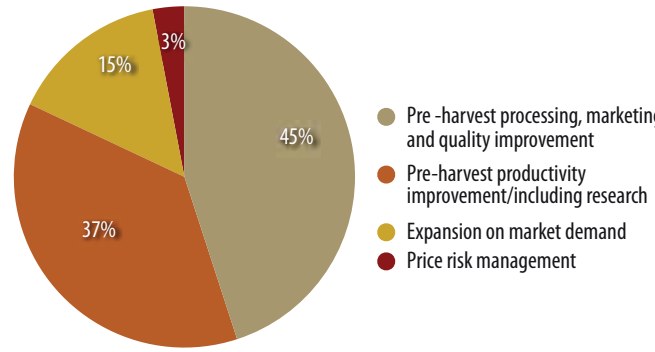
All CFC-financed projects must be endorsed by the designated International Commodity Body (ICB). An ICB qualifies as a partner for the CFC when it has a sufficient number of consumer and producer countries as members. Having formal endorsement of an ICB for each project ensures the project has broad agreement on both the producer and consumer sides. In the case of potato, this is the FAO Intergovernmental Group (IGG) on Grains.

Technical criteria

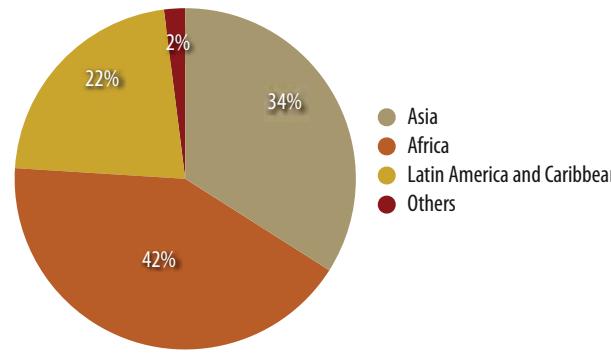
The CFC has a number of technical criteria that have to be satisfied when considering a project for financing. These criteria apply for both grants and loans.

For example, the criteria for technical quality of project design considers whether

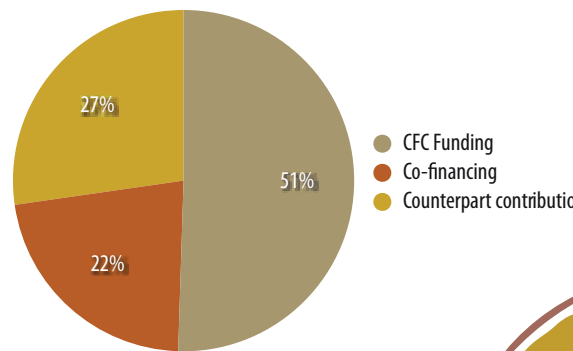
Types of projects financed by the CFC



Operating sites of CFC projects



Sources of CFC project finance



Technical criteria for CFC funding

- Technical quality of project design
- Expected impact on CFC target group
- Beneficiary focus (poor farmers and SMEs)
- Replicability of results
- Sustainability
- Cost effectiveness
- Manageability

the set-up is arranged, the activities and goals are set out in a logical sequence, and whether all players are ready and action is geared and directed towards a clear goal. The criteria for replicability assure that more countries can benefit from the outcome of individual projects. This is an important criterion in the CFC which implements projects that address generic commodity issues, such as constraints or opportunities, rather than working with a country focus.

Consideration of the global value chain

The global value chain is a guiding paradigm of the CFC and hence a key criterion that is considered when assessing project proposals.

The commodity's production is only one element of the value chain. Creating value for the commodity producer is dependent on the product. Value only can be generated by the product if it meets market demand and is competitive in its target market.

Thus, in principle, any project proposal must start with a clear view of the end market. If there is no concept for, or understanding of, a market, then there is little chance of receiving CFC funding.

The overall economic impact of a value chain-driven project is, therefore, generated by the market rather than by the donor financing itself. The CFC finances production activities only for the sake of better performance of the product at the market, usually in terms of price and quality.

Elements of competitiveness

- Meets clear demand
- Meets quality standards
- Availability in terms of time
- Location and supply of regular quantity
- Predictability and consistency of supply

Scope for donor involvement

Project proposals that are seeking funding from the CFC usually must have a clear target market and product. Concrete obstacles or opportunities in the value chain must be identified, such as:

- quality and certification;
- technical capacity and consistency;
- production efficiency and cost; and
- supporting structures, including financial and social institutes.

In addition, project proposals need to have a clear strategy with links to private and civil society organization partners to increase the sustainability of the value chain on project termination.

CFC Action Plan 2008–2012

The current five-year CFC Action Plan differs slightly from previous action plans as it was formulated in discussion with each ICB to improve identification of the priority areas for intervention.

Together with the FAO IGG on Grains, the following priority areas have been identified for 2008–2012:

- measures to improve the structure of markets, including trade financing, risk management, warehouse inventory and receipt systems;
- development of new markets for industrial use;
- improvement of small-scale processing and supply chain management;
- development of grain- and cassava-based biofuel production systems.

Terms and conditions for CFC loans

CFC loan financing

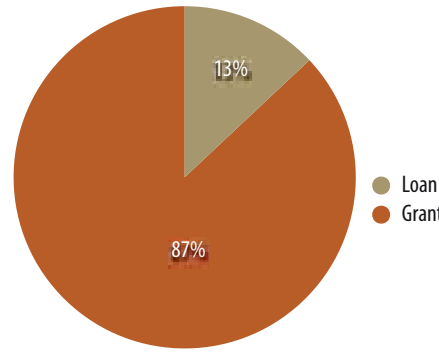
Any part of the CFC financial commitment can be given as a concessional loan. In general, the CFC offers loan financing where project activities are expected to generate a financial return and where the provision of a grant is not justified.

Providing loans rather than grants for project financing can increase the efficient use of CFC funds by enabling funds to be recycled. The CFC loan portfolio continues to account for a small proportion of its overall project commitments. Thus, the CFC is reviewing its loan portfolio in an attempt to increase the proportion of loans in its overall project commitments.

General terms and conditions for CFC loans

Loan-financed projects are assessed under the same general criteria as grant-financed projects. That said, in contrast to grant finance, CFC welcomes single-country project proposals seeking loan-based finance. In most cases, the use of loans for multi-country pilot

CFC project commitments



projects becomes less manageable. In addition, loan-based project proposals need to contain supplementary information on the:

- borrower
- guarantor
- project cash flow – including internal rate of return (IRR) and net present value (NPV) calculations.

No guarantor is needed if the borrower is a government ministry, a national bank or an international financial institution. In addition, a guarantor is not normally required if it is a regional government or a state-owned bank involved in development.

Current loan portfolio

The loan portfolio of the CFC's third five-year action plan totals approximately US$22 million, consisting of eight active loans (three in Africa, four in Latin America and one in Asia). Interest rates on these loans range from 0 percent + service charge to the London Inter-Bank Offered Rate (LIBOR) +1 percent. As of 2008, CFC had eight loans approved, although not yet ready for disbursement.

The role of FAO in supporting potato in developing countries

NeBambi Lutaladio
Senior Officer and Secretary of the International Year of the Potato
Plant Production and Protection Division, FAO

Overview of FAO Plant Production and Protection Division operations

FAO's Plant Production and Protection Division (AGP) works to foster global food security by insuring the sustainability of food production, even as agricultural intensification progresses. AGP also supports crop diversification for nutritional health and income generation, and supports the global food economy through the implementation of international treaties.

Core themes and activities

To achieve its aims of fostering global food security, AGP centres its activities on seven core themes.

- **Sustainable production intensification** – includes conservation agriculture, integrated pest management (IPM), farmer field schools, and fertilizer and plant nutrition.
- **Pest and pesticide management** – includes IPM, migratory pests, pesticide management, Rotterdam Convention and International Plant Protection Convention (IPPC).
- **Seeds and plant genetic resources** – includes seed systems, intergovernmental instruments, knowledge resources, and global partnership initiative for plant breeding capacity building.
- **Biodiversity and ecosystem services** – includes weeds, ecosystem-based production practices, crop and crop-associated biodiversity, pollination, soil, pest regulation, grasslands and rangelands.
- **Plant production and climate change** – includes events, publications and conservation agriculture.
- **Horticulture and industrial crops** – includes FAO-WHO Fruit and Vegetable Initiative for Health, Global Cassava Development Initiative, International Year of the Potato, urban and peri-urban horticulture, and networks.
- **International treaties, conventions, advisory bodies** – includes International Plant Protection Convention, Rotterdam Convention, Joint Meeting on Pesticide Residues, Commission on Genetic Resources for Food and Agriculture, FAO Regional Commissions for Locust Control, International Rice Commission, and International Treaty on Plant Genetic Resources for Food and Agriculture.

Most of AGP's activities related to supporting potato in developing countries come under the "horticulture and industrial crops" theme. That said, there are active linkages among AGP programme entities that allow interdisciplinary activities to take place among themes. AGP

also collaborates with other FAO divisions on interdisciplinary activities as required, such as post-harvest, policy, nutrition and economics.

In the context of FAO's new strategic framework illustrated in the figure below, AGP technical operations are integrated into the Strategic Objective A, which is composed of four Organizational Results (ORs) as follows:

A1 – Policies and strategies on sustainable crop production intensification and diversification at national and regional levels;

A2 – Risks from outbreaks of transboundary plant pests and diseases sustainably reduced at national, regional and global levels;

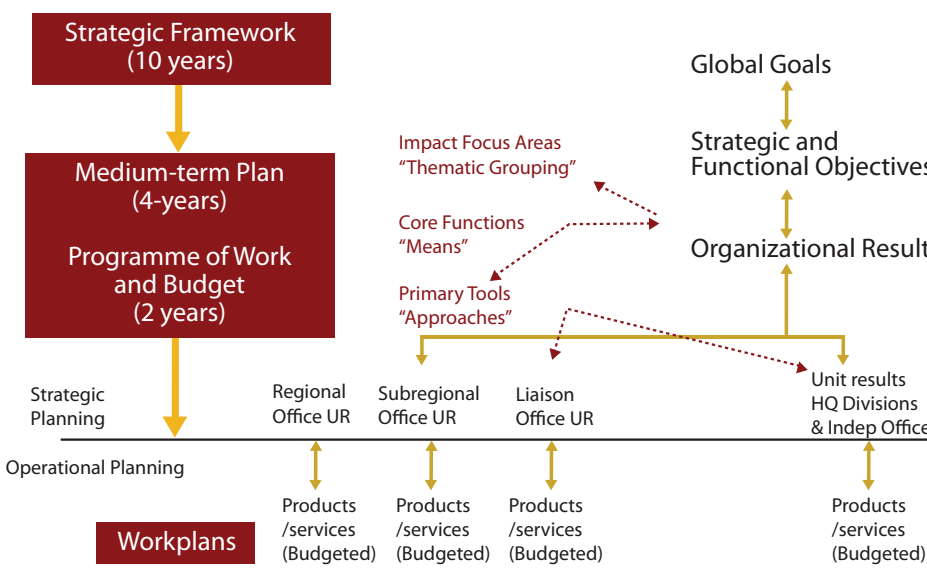
A3 – Risks from pesticides sustainably reduced at national, regional and global revels;

A4 – Effective policies and enabled capacities for better management of plant genetic resources for food and agriculture including seed systems at national and regional levels.

In the new framework, AGP's work on potato is included in OR-A1 under two Unit Results (URs), namely:

- **UR A0101** – Tools and guidance for decision makers on sustainable crop production intensification and

Strategic Framework



FAO's new Strategic Framework context
1 Internal Vision – 3 Global goals – 11 Strategic objectives – 56 Organizational results)
8 Core function – 2 Functional objectives

diversification, through an ecosystem approach;

- **UR A0102** – Capacity of member countries enhanced to implement sustainable crop intensification and diversification strategies, through the use of decision support tools, partnerships and facilitated knowledge exchange.

AGP activities relating to potato

The strategic objective of AGP's thematic activities relating to potato is to increase food production and availability, in order to support food security and increase the income of producers.

Technical capacity building

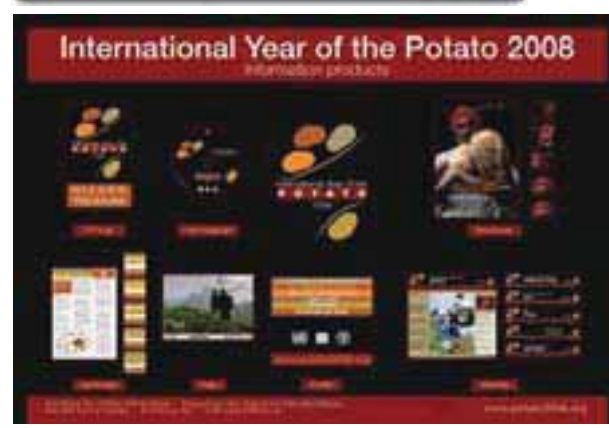
AGP has a particular interest in improving crop seed management, which is one of the bottlenecks in increasing food production in developing countries. AGP uses Farmer Field Schools (FFS), a participatory approach, to educate farmers in the production of better quality seed. The FFS is a form of adult education, which evolved from the concept that farmers learn optimally from field observation and experimentation. AGP is developing FFS guidelines that set out the modules for training trainers and the communities. These guidelines can be adapted easily for specific training.

Information systems and platform

FAO is a knowledge organization. To maximize the value of this knowledge, it develops information systems and platforms so that decision tools can be used effectively to promote potato production systems and strengthen the activities on the ground.

FAO's International Year of the Potato Web site continues to provide a range of information on potato for different target users. This includes information on:

- the crop itself, including varieties, cultivation, nutrition, etc.;
- a cross-section of personal perspectives on potato;
- world potato statistics and country profiles;
- child-focused facts about potato, recipes, potato events, etc.



Sharing practical information and knowledge

AGP links with partners in the field to promote the sharing of practical information and knowledge on good agricultural practices. Such information and knowledge is disseminated via technical documents for use by, for example, extension services.

Support to policy and technology transfer

AGP supports the development of policy and the transfer of technology to improve the potato sector in developing countries. Such policy development and technology transfer takes place in collaboration with stakeholders through organized activities such as workshops and seminars.

Potato production indicators and good practices

AGP draws up guidelines to assist decision-makers in developing countries in developing their potato sector. The main goal is to encourage farmers to move from subsistence farming to income-generating production through the adoption of good agricultural practices and value addition schemes.

Promote diversification options

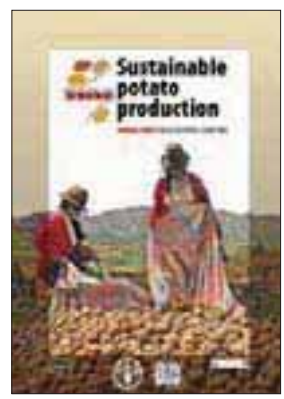
AGP carries out activities to promote diversification options and to make use of available germplasm. In particular, support is provided to developing countries to make better use of available germplasm. Catalogues of available potato varieties have been put together to facilitate this process.

Workshops, conferences, and networking

AGP has been active in supporting national, regional and international workshops, conferences and networking on potato.

Field project activities

AGP supports numerous projects aimed at transferring technologies to the field. In particular, the FAO Technical Cooperation Programme (TCP) supports developing countries through small pilot projects which address specific problems in agriculture, such as seed multiplication. The aim of a TCP project is to produce tangible and immediate results which will facilitate securing additional funding to take the project to the regional or national level.



The way forward

AGP and the International Year of the Potato highlighted the positive attributes of potato, namely its high nutritional value and its potential to improve the income of both farmers and the agrifood sector in developing countries. AGP also has promoted the role that potato can

play as a significant vehicle for fighting poverty and hunger. However, potato is still relatively neglected in agricultural development policies for food crops in the developing world.

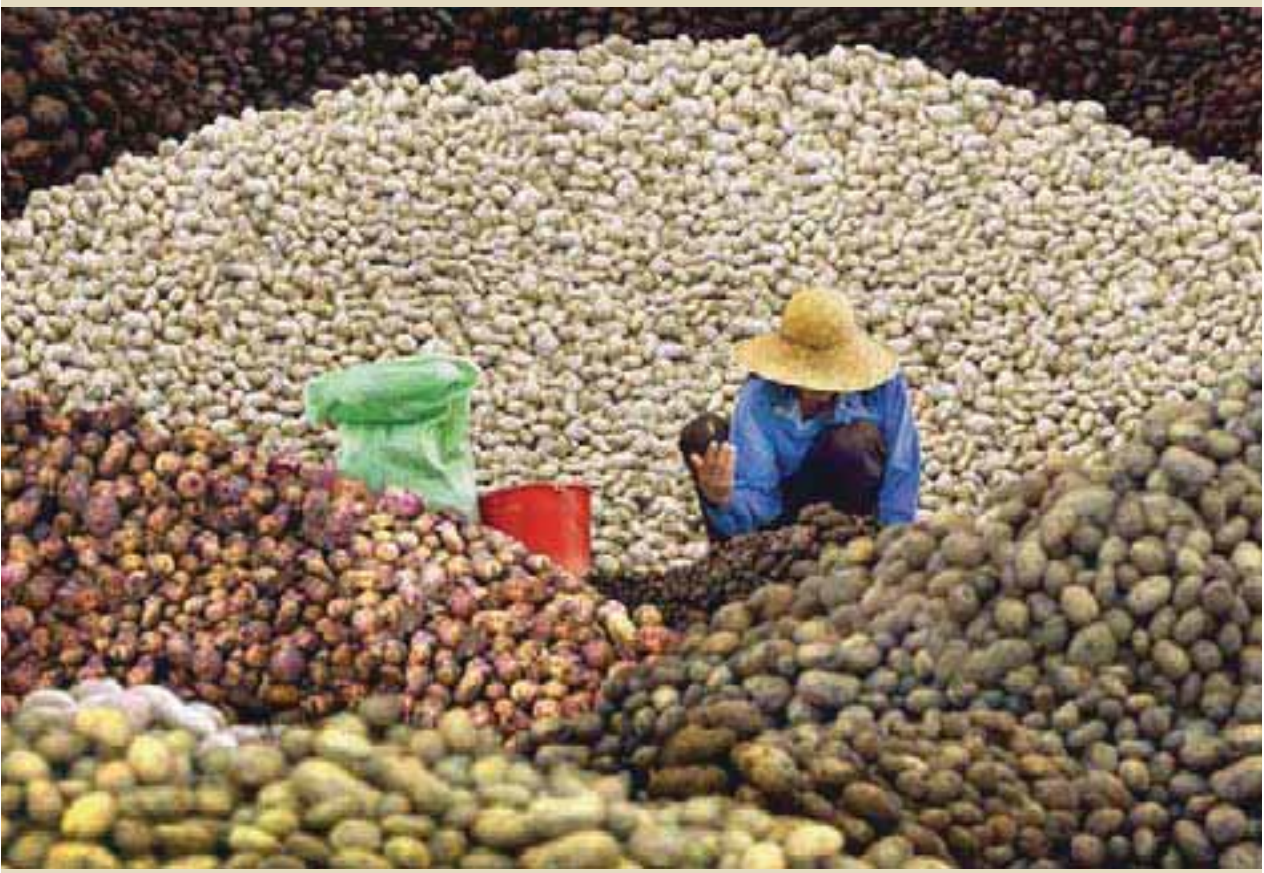
In many developing countries, the potential of the potato is constrained due to factors such as the lack of marketing channels, lack of a reliable seed delivery system, inadequate international support and infrastructure, and restrictive trade practices that are slow to be reformed. AGP believes that national and international stakeholders need to give potato a much higher place on the development agenda in the developing world.

Above all, developing countries need to increase their level of productivity using good farming practices that make efficient use of the natural resources base, coupled with an enabling policy and institutional framework. Sustainable livelihood, food safety and value chain approaches need to underpin the increase in productivity and profitability. This will require research into how to overcome some of the most important production and policy constraints such as the lack of clean seed, diseases such as late blight and viruses, and storage problems.

It also will require providing conditions and a conducive environment for access to good agricultural practices and knowledge, post-harvest and processing technologies, food safety systems, markets and credits. This framework should also include international instruments, treaties, conventions and codes for enhancing and sustainably using natural resources and for reducing risks from transboundary pests and diseases, and pesticides, through ecosystem approaches and services.

In summary, there is a need to further the development agenda to benefit small- and medium-scale farmers in developing countries.

AGP believes that through the development of productive and efficient potato-based systems as well as more stable yields, potato can realize its true potential in the fight against hunger and poverty.



What policy-makers can do to strengthen the potato value chain: Sharing Bhutanese experiences

Ganesh Chettri
Agriculture specialist/Joint Director
Ministry of Agriculture, Royal Government of Bhutan

The role of potato in Bhutan

Bhutan has favourable conditions for the production of high quality potato for both domestic and export markets. As such, potato has played a very important role in the transformation of the Bhutanese subsistence agricultural system to a market-oriented system and in cushioning the fast decline in the contribution of agricultural production to GDP.

The Royal Government of Bhutan (RGoB) is strongly committed to improving the nutrition and increasing the incomes of the rural population, while at the same time maintaining or improving the country's natural resources. It is believed that potato will continue to play an important role in the socio-economic development of the country, making a major contribution towards achieving the national objectives of reducing poverty, generating employment and rural income, and reducing the rate of migration.

Challenges and problems

Socio-economics and conservation

One of the most important challenges for Bhutan is balancing socio-economic expectations of the rural population with the conservation objective of the government. In some respects, the development of potato production in Bhutan is in conflict with the government's conservation objectives of promoting biodiversity and protecting fauna and flora, given that a proportion of the potato crop faces damage from wildlife, particularly wild pigs.

Cost of production

The combined effects of high labour costs, small land holdings and difficult topography, which limits opportunities for mechanization, will always put Bhutanese farmers at a disadvantage compared to producers in other areas of the Indian subcontinent.

Soil fertility management

Agriculture in mountainous environments must pay careful attention to soil fertility management and soil conservation. The challenge is to maintain or improve soil fertility and production while at the same time minimizing environmental impacts. Therefore, innovative, pragmatic and unconventional soil fertility management and soil conservation strategies need to be developed. Some of the most promising strategies include:

- irrigation management
- strip cropping

- minimum tillage
- rotation with legumes
- mulching
- low-input technologies
- organic agriculture.

Farmer-wildlife conflicts

Bhutanese farmers will only be in a position to realize the full benefits from the opportunities in potato cultivation if the wildlife cost to production can be minimized. The labour requirement for guarding fields against wild pigs is currently the most important constraint to potato production in most of the potato growing areas.

Policy issues

Present policies of the Bhutanese Ministry of Agriculture (MoA) related to natural resource management, trade and export are well adapted to the needs of Bhutan, its agricultural population and its consumers. Most existing policies may remain in place without need for major changes.

For the development of the potato value chain, it will be important to create favourable conditions for production, processing and marketing while at the same time avoiding potential negative environmental and nutritional impacts.

Policy areas that need to be addressed

- Research and development
- Land use and environmental issues
- Informal seed system
- Subsidies
- Equity/pro poor policies
- Employment
- Value addition/marketing

Research and development

The MoA will be the most important institution for directing research and development, so it will be critical that the MoA receives adequate funding and other necessary resources as well as sufficient room to optimize efficiency and output from resources, both human and financial. Current conflicts on objectives and priorities will need to be reconciled, such as wildlife preservation and agricultural production, and equitable market-oriented agriculture and food self-sufficiency.

Other government bodies important for potato research and development include the Ministry of Trade and the Royal University System. The role of the private sector in research and development in Bhutan is limited.

Potato may be an ideal commodity to test new concepts of research and development, through which producers and other stakeholders can gradually take over some of the responsibilities as the sector becomes more market oriented. Clear policies will be required to promote and enhance stakeholder participation in planning and implementation of government-sponsored research and development. At the same time, adequate funding and other resources will need to be provided. Clear policies also will be required to allow and foster research and development initiatives outside the government system, particularly managed by producer groups, NGOs, etc.

Land use

There is a need to revise land-use policies to optimize soil and nature conservation and

production. For optimal potato development the following are required:

- regulations limiting the cultivation of fields with a slope of above 25 percent, to minimize soil erosion;
- regulations requiring soil conservation measures for fields with a slope of above 10 percent;
- clarification of the status of *pangshing* (rotating) land to allow such fields to be used for potato cultivation if they have a slope of less than 25 percent; and
- allowing the conversion of *tsamdo* (pasture) land for potato cultivation under specific conditions.

Informal seed system

There is a need for policy to recognize the role and importance of the informal seed system in an effort to increase seed availability. In Bhutan, policy recognizes and formalizes the production and supply of informal seeds, which are mainly produced by farmer groups.

Subsidies

Subsidies can provide opportunities to initiate certain processes. However, clear policies are required to allow flexible but focused use of subsidies to influence development processes. For the development of potato value chain activities, subsidies and other support systems may be required for:

- initiating new models for marketing;
- reducing the impact of market price fluctuations;
- optimizing seed quality for export;
- promoting mechanization;
- optimizing employment opportunities.

Equity/pro-poor policies

There always will be differences among potato producers in terms of landholding, production environment, access to markets, etc. Thus opportunities and benefits from market-oriented production, especially for a commodity such as potato, will vary greatly from one community to another.

In order to generate sufficient income from potato production, a household should have at least 1–2 ha of good arable land. For many families, especially in eastern Bhutan, landholding may not be sufficient. Thus, continuous efforts need to be made towards equity within rural populations as well as between rural and urban populations.

Employment

Unemployment and income disparity are fast emerging as major challenges for the Bhutanese society. Potato has the potential to contribute substantially towards providing employment and equitable income to a large segment of the rural population. This unique opportunity needs to be recognized when planning policies that focus on employment, equitable development and opportunities for rural families. Potato also can become a resource for the processing industry, providing opportunities for Bhutanese industrialists as well as employment.

Value addition and marketing

The extent of potato development and the benefits derived for potato producers will depend directly on the conditions of the export and in-country markets. Policies and mechanisms need to be developed to optimize a market environment that favors the interests of producers and to enhance the development of Bhutanese entrepreneurs in the export and local markets.

The international value chain: Exporting potato seed to developing countries

Peter Joyce
International Representative
United States Potato Board

United States potato industry

The United States produces hundreds of different varieties of potatoes, in an array of shapes, colors, sizes, yields, disease resistances, etc. Potato growing in the US is capital intensive and highly mechanized. Its environment for growing potatoes is close to ideal, with long warm days and cool nights. In areas where rain is limiting, water requirements are supplemented by irrigation systems. Most potato areas in the US are now irrigated.

US Potato Board and seed export programme

US Potato Board

The US Potato Board (USPB) is essentially a legal association of US potato producers. Any producer who plants over 2 ha of potatoes is required to be a member of the USPB. This equates to approximately 5 000 producer members who are obligated to pay a levy to the USPB of US$0.44 per tonne of potatoes sold each year. This provides annual funds to the USPB of approximately US$8 million, which are used mostly to improve domestic consumption of potatoes in the US. However, a small percentage of this budget funds the US seed export programme.

US seed export programme

The USPB does not represent potato producers directly. It supports variety trials in third country markets, identifying appropriate varieties for each individual market and for production zones within those markets. USPB supports a producer-to-producer model and also facilitates sales and services, mostly for the initial year of sales, with the ultimate goal of moving as quickly as possible to connect seed buyers with seed sellers.

Key statistics on the US potato sector, 2007	
Harvested area	457 368 ha
Average yield	44.5 tonnes/ha
Quantity harvested	20.3 million tonnes
Average fresh tuber price	US$238/tonne
Average processing tuber price	US$134/tonne
Estimated crop value	US$3.3 billion

The USPB has worked in a number of different countries, including Brazil, Venezuela, Honduras, Dominican Republic, Panama, Uruguay and Sri Lanka. In such countries, US seed potato producers work with ware potato producers of all sizes and degrees of commercialization.

Developing countries using US seed

Developing countries using US seed have a number of advantages.

Physical environment, low disease prevalence

Potatoes are grown in all 50 states, but seed is grown only in the northern states or states with high elevation.

The US can produce high quality seed in these regions because they have favourable cold climates, typically falling to -30ºC, and the ground can freeze from 10 to 30 cm deep. The cold never kills all insects, but it kills most of them which gives producers a fresh start each year. Specifically, seed production in the US benefits from a very low prevalence of late blight and no bacterial wilt, which are two of the most common diseases found in tropical countries.

Limited generation system

All seed produced in the US comes from a limited generation system, which means that seed is constantly renewed via tissue culture. The

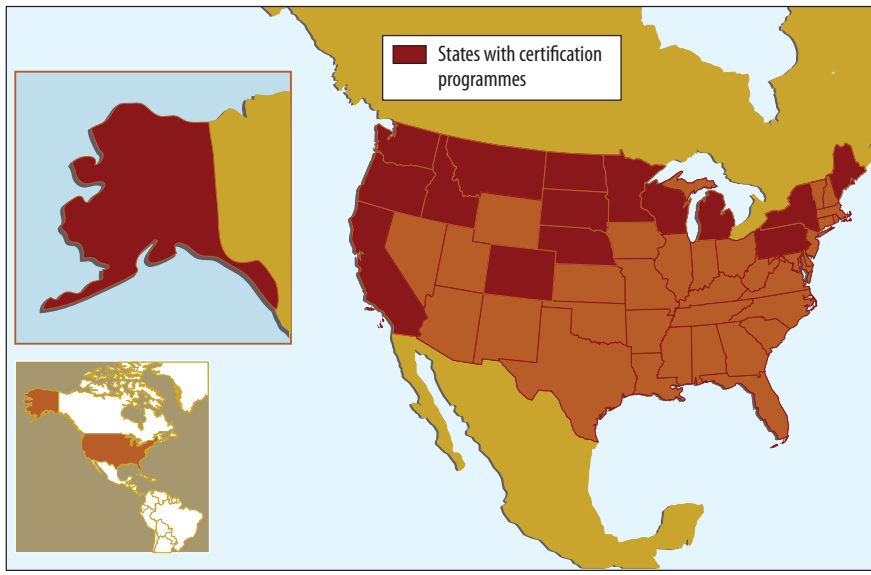
US seed in Uruguay: case example

Carlos Couto, a Uruguayan potato producer with 400 ha of potatoes, is achieving yields of over 40 tonnes per ha using US seed. He has achieved a farmgate price of over US$1 000 per tonne. Production costs totaled around US$6 000 per ha, which included 1 200 tonnes of US seed.

US seed in Sri Lanka: case example

In Sri Lanka, US seed potato producers work with small cash growers and subsistence farmers. In 2008, 50 tonnes of seed were distributed among 124 farming families, with seed sales ranging from 30 kg to 5 tonnes per farm.

US states with seed certification programmes



limited generation system is regulated by the number of generations in the field and disease tolerance. For export, the number of generations grown in the field is limited to no more than five. Since the limited generation system began in the early 1980s, there has been a significant reduction in bacterial and viral diseases.

World class varieties, breeding programmes

The US has 12 public breeding programmes and one private programme. In total, over 1 million seedlings are planted each year to identify new improved varieties. In general, five to ten new high-yielding and high-disease-

Example of a limited generation system

Production Location	Serological testing	Seed Class	Field Generation
Wisconsin Limited Generation System	*	Foundation – Generation 1	3
		Foundation – Generation 2	4
Wisconsin Certified Seed Potato Growers	*	Foundation – Generation 3	5
		Foundation – Generation 4	6
*Depending on need		Certified	7
Table and Process Potato Growers		Commercial Use	

resistant varieties are released each year for the processing, chip and fresh potato markets.

Strict oversight by APHIS

The seed potato certification system is overseen by the US Department of Agriculture Animal Plant and Health Inspection Service (USDA APHIS), which is in charge of US phytosanitary measures including the issuing of phytosanitary certificates. This body is responsible for setting the federal standards for certification. At the state level, certification of the seed is the responsibility of either the individual state's department of agriculture or a local university.

Relationships and communication

US producers focus on establishing good communication with their buyers. Seed buyers purchase directly from US seed producers, usually with visits between the buyers and sellers of the seed. Sales are transparent and based on trust.

In summary, potato producers in developing countries purchasing US seed potatoes benefit from:

- better access to proven varieties of diverse qualities that are of optimal phytosanitary and physiological quality, and available throughout the year;
- competition between the US and other seed exporters, which helps ensure that US seed producers continue to increase quality, lower prices and offer better service.

Tropical growers using US seed

Potato growers in tropical countries need more seed options that will allow them to lower cost and increase quality

Typical production cost and revenue data for potato production in the Dominican Republic using US seed

	US$ per tonne	US$ per ha
Cost of seed	1 000	3 000
Total production costs		6 000
Market value of harvested crop	440	13 200
Gross margin		7 200

Seed value

The cost of US seed potatoes varies considerably depending on variety and market destination, but typically ranges from US$440 to US$880 per tonne in port. Transport and transaction costs (including inspection fees) from the port to the potato producer's farm can add a further US$100–US$320 per tonne, meaning the total cost to the potato producer will range from US$540 to US$1 200 per tonne.

To contextualize this, seed can account for 50 percent of a grower's production costs. However, with yields of between 30–50 tonnes per ha achievable, the use of US seed is a cost-effective option with potentially high margins.

Reduce costs, improve value

To improve value further, there are many ways in which producers in developing countries can reduce costs without reducing quality, including:

- minimizing nationalization fees associated with inspections and time in the port –

potential saving of US$40–US$200 per tonne;

- purchasing larger seed (75 mm) allows producers to cut seed – potential saving of US$80 per tonne;
- reducing unnecessary packaging – potential saving of US$20 per tonne;
- entering into long-term contracts with seed producers to offer security of demand for better prices – potential saving of US$60 per tonne;
- capitalizing on transport economies, with price savings for higher volume purchases – potential saving of US$100 per tonne.


2.50
3.5
AHOY

Potato developments: The Dutch experience

Hans Peeten
Agronomist
Netherlands Potato Consultative Foundation (NIVAP)

The Netherlands Potato Consultative Foundation (NIVAP) was founded in 1949 as a farmer initiative for the collective promotion of Dutch seed potatoes in export markets. NIVAP is governed and financed by farmers and exporters of seed potatoes.

Dutch potato production

Development in production

Looking at the history of potato production in the Netherlands, significant productivity gains have been achieved. Over the last 50 years, productivity has doubled to an average of 50 tonnes per ha. However, there is significant variation (±25 percent) around this average despite a relatively uniform climate and soil type within the Netherlands, which indicates that yield variation among farms is mainly a function of management.

Annual production of potatoes in the Netherlands is typically 3.5 million tonnes, of which 1 million tonnes are for seed.

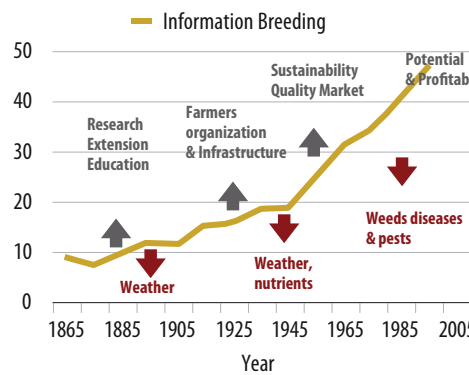
In addition to favourable climate and soil type for potato production, high yields have been achieved in the Netherlands as a result of a long history of support for research, extension and education in agriculture as well as a belief that farmers should be collectively organized and efficient infrastructure should be in place.

Significant productivity gains have been achieved despite a growing focus on sustainability

Annual potato production, utilization and trade in the Netherlands (in million tonnes)

Domestic production		
Starch potato		2.5
Seed potato		1.0
of which exports	0.6–0.7	
Total production		**3.5**
Imports		1,0
Total domestic supply		**4.5**
Domestic utilization		
Processing industry		3.0
Fresh consumption		0.5
Export		1.0

Potato evolution in the Netherlands, 1865-2005

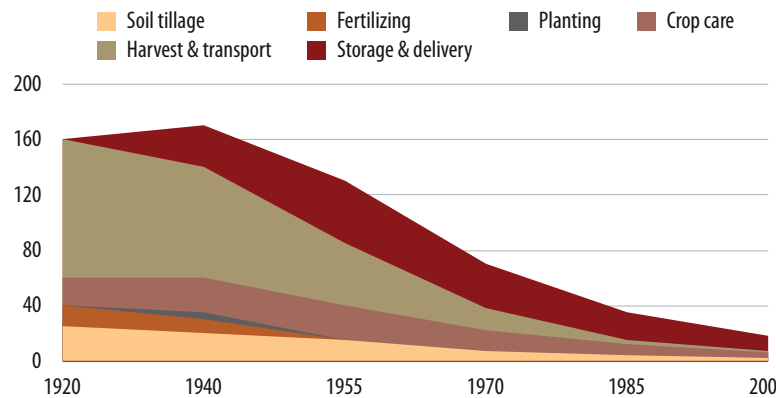


and environmental concerns as well as market development and quality issues. Breeding activities have led to the development of a broad range of varieties to meet the demand of the specific markets. Close coordination in the Dutch potato chain has facilitated this entire process.

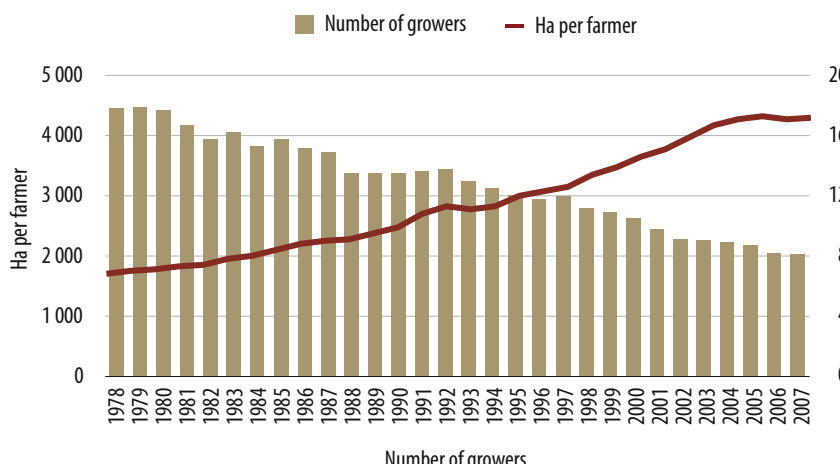
Cost of production

Mechanization has steadily been substituted for labour, due to the relatively high cost of labour in the Netherlands. The process of mechanization and the substitution for labour was particularly marked between 1940 and

Labour demand in work hours per ha, 1920–2000



Economies of scale of seed potato farmers, 1978–2006



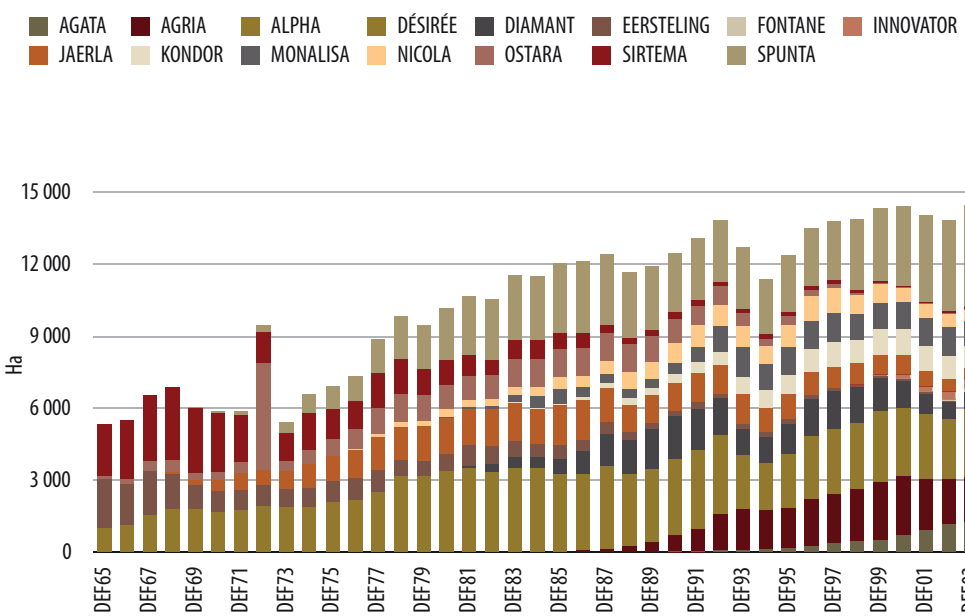
1970, but more recently has slowed down considerably.

Over the last 30 years, significant cost savings have been achieved through capitalizing on economies of scale. At the same time, the number of seed producers has fallen 1–3 percent a year, to approximately 2 000 producers, with a respective increase in the average farm size to around 18 ha per producer.

Variety innovation and introduction

Potato breeding in the Netherlands is an entirely private affair and its success has been made possible by an effective Plant Breeder's Rights (PBR) system – the 1991 Act of the International Union for the Protection of New Varieties of Plants (UPOV) Convention – which provides seed breeders a 30-year protection period on their seed variety.

Area of seed potato production in the Netherlands (million tonnes)



There are about 250 potato varieties on the official national list. Each year, some 25 would-be varieties undergo tests for inclusion on the list, of which only 2–5 are likely to become available after 10-15 years of extensive research. Success depends in part on the agronomic and commercial value of the would-be variety.

Healthy seed

In the Netherlands, there are some 2 000 seed potato producers, with an average production of 18 ha. In contrast, there are some 7 000 ware potato producers, with an average production of 10 ha. These producers are organized as cooperatives or as private companies and only can grow seeds certified in the Netherlands.

The Netherlands General Inspection Service for Agricultural Seeds and Seed Potatoes (NAK) is responsible for inspecting seed potatoes in the Netherlands. It is an independent organization, managed by representatives of breeders, traders, growers and users of seed potatoes.

Cropping techniques

Worldwide, cropping techniques are being developed and adapted to local conditions. The most important cropping techniques that potentially can have a significant impact on productivity, if applied correctly, are water management, soil fertility management, crop rotation and soil conservation through, for example, using crop residues and reduced tillage. Effective management of water, fertility and crop rotation has the potential to enhance yields significantly, to levels in excess of those already achieved in the Netherlands.

Export markets

The Dutch potato sector is highly dependent on its export markets. It exports 250 seed varieties to more than 80 countries. Most of the growth in Dutch seed exports took place between 1950 and 1990. Since 1990, export volumes have remained relatively constant at 600 000–700 000 tonnes per year.

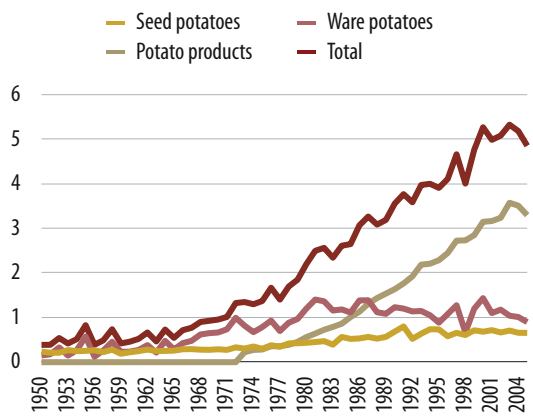
Worldwide, the Netherlands is the leading exporter of seed potato. It has a 72 percent share of the exports from the main exporting countries. Other significant exporters include Canada, France, UK, Denmark and Germany.

The main market for Dutch seed potato is the EU, which imports around 65 percent of the Netherlands' seed exports. The remainder is exported to markets in Africa (21 percent), Asia (11 percent) and Latin America (3 percent).

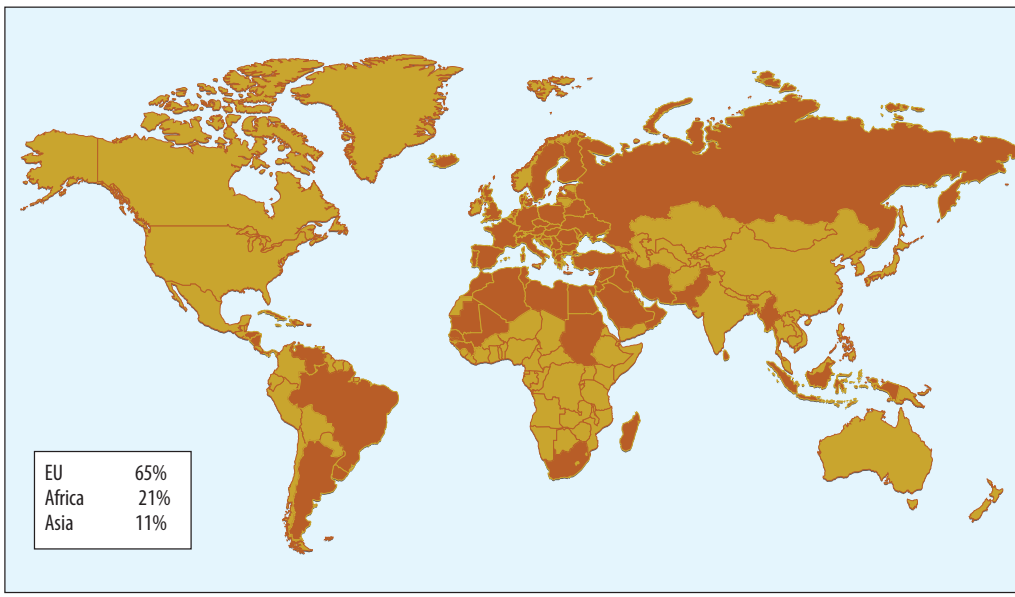
Export promotional activities

NIVAP was founded in 1949 for the collective promotion of Dutch seed potatoes in export

Dutch potato exports



World importers of Dutch seed potato

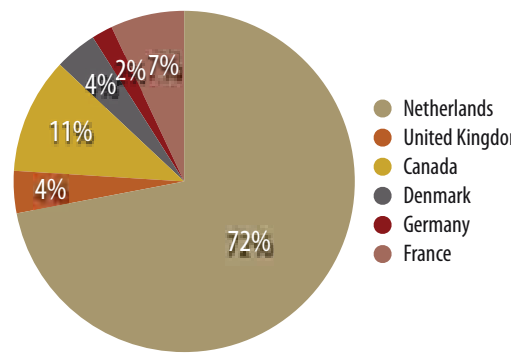


markets. Its initial activities focused primarily on the general promotion of potatoes through:

- identifying markets
- introducing varieties
- organizing extension in the field
- setting up projects
- providing training
- developing and distributing technical brochures
- undertaking public relations activities.

Over time, individual companies and exporters of seed increasingly developed their own capability for general promotional activities of the potato. Thus, although NIVAP continues its general promotional activities, its focus has

Seed potato exports from main exporting countries (000,000 tonnes)



expanded to other areas such as technology transfer and trade-related mediation on areas such as phytosanitary issues, EU accession and plant variety protection.

Example activity I: Exchange programme on seed certification

NIVAP organized an exchange between Dutch and Chinese seed certification agencies to provide field training in the establishment of seed certification programmes.

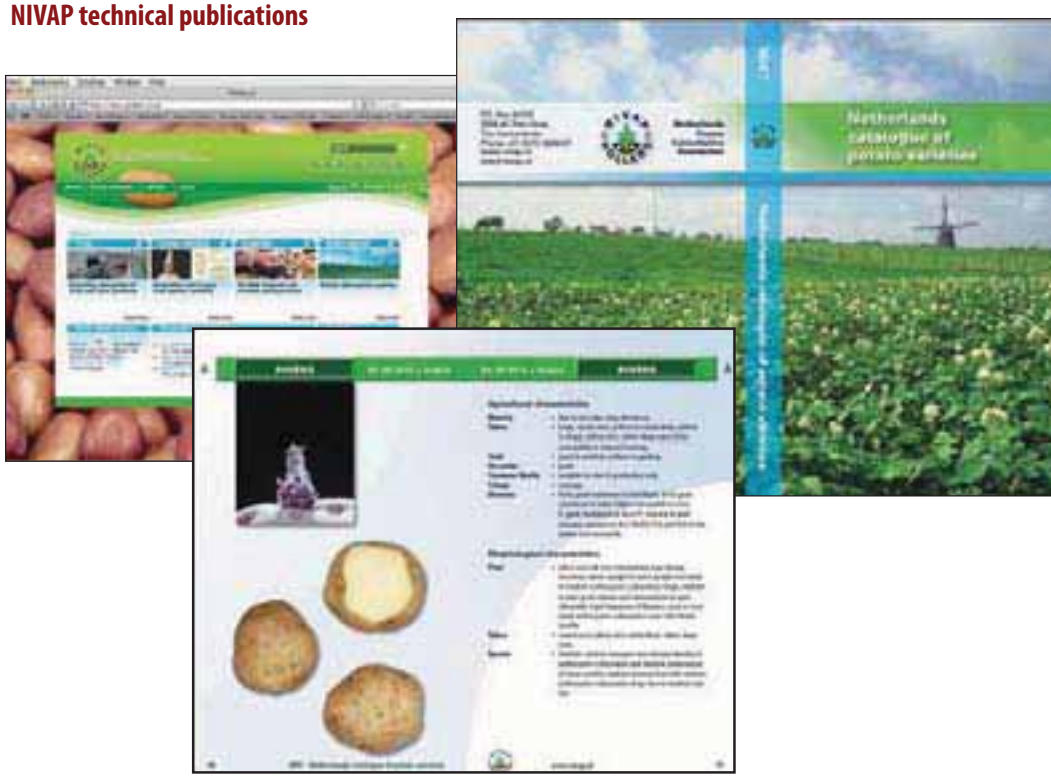
Example activity II: Training courses

Training courses for both the Dutch seed export sector and potential overseas users of seed have been an extremely important activity for the development of the Dutch seed potato market.

Milestones in NIVAP training activities	
1969	First local training course established (in Bangladesh).
1971	International Potato Course launched in Wageningen, the Netherlands, where it is presented annually.
1979	*Stage sur les Plants de Pommes de Terre* launched and continued annually until 2001.

In addition to annual training courses offered by NIVAP, *ad hoc* training courses take place on a worldwide basis in cooperation with local authorities. The subject matter of these training courses is developed in line with the

NIVAP technical publications



interests and wishes of the Dutch seed export sector.

Example activity III: Technical publications

NIVAP makes various technical publications available free on the Internet in various languages.

Challenges

Increasing yields further

There is still considerable scope to increase potato yields further in temperate and subtropical regions. Current potato yields vary enormously throughout the world depending on country and season of production. Actual yields typically range from 10 to 65 tonnes per ha. The challenge is to realize the potential, which is likely to range from 40 to 140 tonnes per ha.

Market orientated potato production

Since the 1990s, there has been a market shift from production-orientated potato production to market-orientated potato production. Increasingly, the market is demanding products that are easy, healthy, tasty, low cost, trendy, sustainable and diverse. The challenge for potato producers worldwide is to keep up to date with evolving market demand and at the same time translate this demand into the production process.

Yield potential in temperate and subtropical regions

	Season	Actual tonnes/ha	Potential tonnes /ha	Actual/ Potential %
Washington, USA	12/3-15/10	65	140	46
The Netherlands	1/4-1/10	45	100	45
Egypt	1/1-1/5 1/9-1/1	20 15	60 45	33 33
Tunisia	15/2-1/6	15	70	21
Pakistan	15/1-1/5	15	50	30
Saudi Arabia	1/1-1/5 1/10-1/1	15 12	45 40	33 30

Key messages

Based on the experiences of NIVAP and the Dutch seed sector, a number of lessons on potato developments for developing countries can be drawn.

- Appropriate cropping technology, in combination with the modernization of potato infrastructure (including storage), strongly enhances the profitability of potato production.
- Practical training, in combination with professional farm management, market transparency and the organization of farmers, improve the profitability and sustainability of potato production.
- Modern integrated technologies, including the use of improved quality seed of the right variety, provide potato producers with better returns while saving on land, water, fertilizers, pesticides, labour and risks.

SECTION 2

The way forward:
Mechanisms and recommendations for producers and policy-makers

By drawing together the current state of knowledge and experience related to potato value chains around the world, the previous section provided the foundations for guiding policy-makers towards formulating development strategies involving the potato value chain.

In this context, the following section presents a forward-looking view of the need to support the potato value chain as a mechanism for increasing income for potato producers while at the same time maintaining the potato's role as an emergency food security crop. It also synthesizes the key issues that emerged from two workshops held during the International Year of the Potato as well as the key policy recommendations of the workshop participants.

Potato in the national and global economy

Supporting the value chain to increase potato producers' income while maintaining potato's role as an emergency food security crop

Adam Prakash
Economist
Trade and Markets Division, FAO

The crisis that followed the 2007–2008 global escalation of food prices revealed the fragile state of food security and the vulnerability of countries in many parts of the world to external shocks. In many cases, high commodity prices did not spur farmers in developing countries to invest and increase production. Looking back, this was because high price signals did not transmit to them and their access to affordable inputs was limited. They also faced capacity and supply-side constraints. In fact, inappropriate policy measures plus a lack of technology, insufficient infrastructure and institutions, and price controls and tariff reductions actually reduced incentives for producers to respond.

There is a need to strike a balance between protecting consumers from higher food prices and maintaining incentives for investing in increased production and improving supply responses. When prices are low, the importance of incentives to sustain food production becomes all the more important. Policy measures need to be targeted, non-distortionary (in the market price sense) and positive towards agricultural investment. But what can be done? The issue might be better addressed by first examining what should be avoided.

Avoid short-term solutions

At the height of the crisis of escalating food prices and in its aftermath, policies were proposed to subsidize seeds and fertilizers. However, input subsidies do not necessarily target the poorest and the strategy depends on continued donor support, thereby raising questions of affordability in the event of rising fertilizer prices. Since the scheme is subject to state patronage, it breeds farmers' dependence on the state. Such short-term alleviation is, in reality, a form of food aid.

Governments in many countries also resorted to a host of other measures under the umbrella of "price stabilization policies". These included measures such as price controls through administrative orders, antihoarding measures and sales of public food stocks (where they existed) with a view to lowering market prices. Experience has shown that these measures check food prices in the short run, but maintaining stocks is a high cost operation. In addition, the longer term strategy of releasing public stocks to hold down prices can be a disincentive for producers and traders, discouraging production expansion and investment. In countries with porous borders, there is a risk that the benefits of interventions –

particularly those designed to support domestic producer prices or to subsidize consumer prices – will be eroded by cross-border trade.

Moreover, market intervention strategies assume that the commodity price shock is temporary and will reverse itself in the short run. While booms and busts occur regularly in world commodity markets, shocks to the prices of many primary commodities are typically long lasting and, thus, likely to depress prices for a long time. In such circumstances, government-supported price-stabilization activities are likely to be ineffective, and external borrowing for smoothing consumption is likely to be unsustainable.

Trade policy measures also tend to feature heavily in response to volatile international prices. When prices are on the rise, reducing import tariffs may increase the volume of imported food thereby easing the strain on domestic prices. However, there needs to be an initial scope to reduce tariffs enough to offset price increases. Yet the tariffs of many developing countries are not high enough to start with – so their reduction would not be sufficient to stabilize domestic prices.

Where scope does exist, a prolonged cut to import tariffs could expose domestic sectors to competition. While genuine and fair competition should not be deterred on the grounds that it can spur efficiency gains, the arrival of subsidized imports into domestic markets could significantly undermine productive sectors.

Similarly, by diverting food volumes that would otherwise have been exported, the pressure on domestic prices is reduced. However, the export restrictions may reduce incentives to producers, eventually resulting in a decline in productivity and production and, in effect, reverse the decline in prices that the policy initially intended to achieve. In an even larger picture, the main criticism of export restrictions is that they make the international market smaller and can exacerbate price instability in world markets, thus hurting consumers in other countries. This is especially true if the country imposing the export restrictions is a significant exporter of the product in question or if internationally traded volumes are small.

The longer-term solution to this problem is to promote measures to nurture various elements that will ensure that food markets function well and are competitive. To ensure that food systems thrive, it is important to provide market-based incentives and channel them through to economic agents and to ensure that risks are shared and risk-taking is rewarded. By concentrating efforts around the value chain, the twin objectives of food security and a sustainable market-orientated food system can be realized.

Identify sustainable, longer-term solutions

Diversifying a country's food base is an important challenge facing countries exposed to international food price shocks. Promoting supply chain development for a wider set of crops can lead to more stable farm revenue and consumption patterns. This will typically necessitate coordinated systems of input delivery, finance, and commodity marketing for a range of crops that offer higher returns to farming in the changing environment of rural economies.

Such investments would represent a shift from the strategy of price stabilization and price support for a dominant staple foodstuff to a portfolio approach. This puts greater emphasis on value chain development for a range of promising commodities and minimizes the impact of

domestic food price instability by lowering exposure to international market volatility.

Value chain coordination

An array of institutional arrangements typically governs the coordination of major supply chains of agricultural commodities in developing countries. Since transactions at the producer stage have a significant economic impact on smallholders, various efforts have been made to ensure that an equitable distribution of income accrues to farmers. Generally, the greater the participation of farmers, the greater their potential for economic benefit. Value addition typically occurs at any given stage of the supply chain, making it very important for policy-makers to create a suitable economic and institutional environment that will facilitate farmers' participation..

Recently, the Fourth Session of the Intergovernmental Group on Banana and Tropical Fruits discussed models of value chain coordination at the producer-processor stage. The models under review were of particular relevance to potato value chains, since both types of commodities share characteristics such as perishability, high transportation costs and high potential for value addition.

It is difficult to recommend a particular model, since much will depend on the institutional, social, cultural and economic backdrop in which potatoes will be produced, marketed and consumed. Generally, however, those value chain models that mitigate risks to participants, promote mutually beneficial gains from exchange and attract investment in the particular sector should be encouraged by policy-makers and alike. The list below discusses some of the more prominent or promising models of farmer-processor coordination.

- **Contract farming** establishes conditions for the production and marketing of a commodity. Typically, the farmer agrees to provide established quantities of a specific agricultural product, meeting the quality standards and delivery schedule negotiated with the buyer. In turn, the buyer commits to purchase the product, often at a pre-determined price. In some cases, the buyer also commits to support production through, for example, providing farm inputs and technical advice or arranging transport of produce to the buyer's premises.

  If the contract is fully respected by both parties, farmers can have better access to product and input markets at a lower risk and buyers will have assured quality and timeliness in the delivery of farmers' products. The practice of "side selling" – farmers also sell to competing buyers – can be a problem of contract farming. However, the major concern is the potential for buyers to take advantage of farmers over the contracted price, since their bargaining power is invariably greater than the farmers'.

- **Unrestricted contracts** adopt most elements of contract farming except that the buyer allows the farmers to side sell if the market price is higher than the contract price. To ensure the timely supply of potatoes and to avoid large transaction costs in implementing contracts with a large number of small growers, the buyer (firm) may employ a "factory-supply basis and smallholder model". Under this model, the firm establishes its own supply standards by providing technologies, production inputs and extension services to a small number of

large-scale growers, agrees to procure all products and guarantees growers a fixed revenue per ha. The firm has an obligation to procure the quantity of output specified in the contract from farmers at a negotiated price based on prevailing market conditions. Farmers have the freedom to sell to other buyers if they can obtain a higher price.

In this way, contractual disputes are generally avoided and farmers receive an equitable price. However, there is no guarantee that farmers will be able to obtain their fair share of income over the supply chain because of potential price distortions at the local market. In particular, farmers do not receive the value-added from processing or market expansion because they are restricted to supplying the chain with just potatoes.

- **Contract farming with multi-step payments** is one of the most difficult problems is to design a contract structure that deters side selling. If the predetermined transaction price is too low compared with the market price after harvesting, farmers may sell their product to competitive buyers or, if the contract price is pre-set too high, the processor risks losing its competitive edge because of higher raw material costs. A"two-step payment scheme" has been developed to address such risks and has been adopted in various supply chains throughout developing countries.

  All the major parameters of the two-step payment scheme are the same as a regular farming contract except that farmers receive two or more payments for their output. The first payment, which is often lower than the prevailing market price, is made when farmers deliver their product to the next stage of the chain. The second payment comes, for example, after the manufacturer completes the sale of its processed product sales. Depending on the contract design, this payment can be the balance of the contract price, the difference between the pre-estimated price and the prevailing market price, or a bonus as part of a profit-sharing scheme.

  Since prices can be updated throughout the season to reflect current market incentives, the main advantage of a multi-step payment is that risks are shared and potential contractual disputes between farmers and manufacturers are avoided.

- **Joint ownership** under this model, value chain participants retain a share of the ownership and management of a processing factory based on the size of the initial investment they made towards its establishment. In the case of farmers, their provision of contracted land to supply produce to the factory would make them stakeholders in the enterprise.

Value chain stakeholders form the board of directors which oversees business development of the enterprise, including strategy and decision-making. Accordingly, farmers – whose interests are usually represented by a cooperative – assume a seat at the board. All stakeholders are allocated certain responsibilities, based on their roles in the value chain. Farmers, for instance, are required to ensure that both the necessary quantity and quality of potatoes are delivered on time. With assistance from the local government, the farmers' cooperative provides technical support and training to

members as well as agricultural inputs such as seeds and fertilizers. Contracts govern farmer-processor coordination in the value chain, stipulating the quantity, quality, time, and terms of payment term plus the measures necessary for enforcement. Allowing farmers to part own and manage the processing factory, the potential for profit sharing provides additional incentive for them to deliver on contracts and to invest in their own farming enterprises.

Ensuring food security

The enormous challenge in terms of food security comes when markets are not in equilibrium. Crisis in international markets, domestic food shortages and gluts can strain value chains to the extent that they no longer function efficiently or, in the extreme, become redundant. In times of food surpluses, the very design of the value chain should ensure that incomes are sustained, since potato can be transformed into a host of high-valued products.

However, in times of basic food shortages, farmers could be compelled to break contractual arrangements by side selling, or their raw material – ware potato tubers – may become the target of government intervention to bolster food security. However, there are market-based interventions to value chains that could strengthen food security in such times of crisis.

One such instrument is the use of options. An option is a contract between a buyer and a seller that gives the buyer the right – but not the obligation – to buy or to sell a particular quantity of a commodity, such as potato tubers, at a later day at an agreed price. In the context of food crisis management, the buyer would be the state while the seller would be the producer in the value chain. The basic idea is that when food shortages are declared, the state would exercise the options contract to divert predetermined quantities of tubers for basic food supply at affordable prices, while paying farmers the prevailing contract price agreed with the processor. The decision to declare the shortage should rest on an independent authority, such as FAO or the UN World Food Programme (WFP).

An insurance plan could be sought by the state that would compensate processors for the loss of revenue, or those processors who are sufficiently diversified in raw material use (i.e. they are involved in other agricultural commodity value addition) would be permitted to enter the scheme. The state also could hedge against the cost of the scheme by taking out options on an international or regional commodity exchange, such as CBOT of Chicago or SAFEX of South Africa.

It is assumed that organized, sophisticated exchanges do not exist in the country undergoing the food crisis. The volumes purchased should be made transparent to the public, so that private food traders can factor possible market impacts of such state interventions into their commercial calculations.

Of course, the scheme could be subject to modification and fine-tuning, but the basic premise stands: value chains and their proper coordination can provide incentives for productivity-raising investments, can foster higher incomes to participants and, during times of crisis, market-based interventions to the value chain can produce non-distortionary impacts that enhance food security and bring long-term stability and sustainability to food systems.

Synthesizing key issues and recommendations for producers and policy-makers

Hendrik Knipscheer
Managing Director
European Cooperative for Rural Development (EUCORD)

The International Year of the Potato helped raise global awareness of the critical role the potato plays in the food security strategies of poor farmers as well as its newly expanded role in meeting the needs of an increasingly urban world that depends more and more on processed foods. In addition, the International Year contributed to the understanding of the potential to add value to the potato by supporting and improving the coordination of the potato value chain.

The current state of potato value chains in developing countries was reviewed during "Potato Science for the Poor", a conference sponsored by CIP and FAO in Cuzco, Peru, in March 2008, as part of the International Year of the Potato. Papers presented by representatives of the public and private sectors covered the entire value chain:

- identifying key constraints to a better functioning value chain, especially the problems of ensuring quality seed that can provide the chain with a consistent, quality product;
- understanding how value chains can be re-engineered to enhance food security and rural development, and counter cereal price inflation; and
- identifying how development agencies, national authorities and the private sector can support value chain activities.

A follow-up session, co-sponsored by FAO and CFC at FAO headquarters in Rome in November 2008, provided the opportunity for participants to build on the synthesis of key issues that had emerged during the workshop. They worked together to develop the kinds of policy recommnendations that could contribute to strengthening the potato value chain in developing countries.

This section synthesizes the key issues that were discussed at the meetings as well as the key recommendations. Further, it presents the recommendations according to the seven value chain drivers identified in the workshop paper "Value chain theory and application", namely: enabling environments, technologies, market structure, chain coordination, firm management, inputs and product demand. Specific policy recommendations developed by the workshop participants are presented for each driver.

Policy recommendations

Enabling environment

Despite the fact that global food production has doubled in some parts of the world in the past half century, many individuals and communities in developing countries still lack access to sufficient food supplies throughout the year. The potato is a highly recommended, nutrient-rich food security crop that can shield low income countries from the risks posed by rising international food prices, while at the same time providing a valuable source of income for farm households.

Increasing production and consumption of such crops can reduce food insecurity. However, to do so first requires creating a favourable environment within which agrifood chains can operate efficiently. This means finding solutions that reduce constraints, create opportunities, improve productivity and reduce risks in the farming systems on which the most vulnerable depend.

Potato has generally been neglected in agricultural development policies for food crops despite its importance as a staple food and its potential contribution to combating hunger and poverty. There is a need for policy-makers to realize the importance of potato, *vis-à-vis* other crops, for food security and poverty alleviation. Policy needs to consider mechanisms that protect the unique role that smallholders play in the potato value chain. This is particularly so in the context of achieving the Millennium Development Goals, in that potato can make a significant contribution, *inter alia*, to eradicating extreme poverty and hunger, and reducing child mortality.

RECOMMENDATION 1: Emphasize to policy-makers the income equity and food security aspects of potato farming and its potential in achieving the Millennium Development Goals.

If the Millennium Development Goals are to be realized, policy-makers need a thorough understanding of the nature and functioning of individual potato value chains. This requires that policy-makers be kept up to date on ongoing developments in the value chain and on the implementable research that can enhance chain performance. It also requires that those responsible for both policy formulation and implementation work together in developing effective potato development plans and policies.

RECOMMENDATION 2: Engage policy-makers at regional, national and local levels in preparing potato development plans and policies that encourage potato production and consumption.

There is significant scope to create a more enabling environment for potato production in developing countries through the further uptake of affordable technology. Potato production in developed countries has proven that technology exists to achieve yields in excess of 40 tonnes per ha. The challenge for developing countries is to embrace this technology and close the yield gap with developed countries.

Potato producers need to be better informed about existing technologies and how their use can contribute to enabling environments and improve performance. This requires keeping

extension services up to date with the latest technological developments and applications as well as the most appropriate media through which information can be disseminated to farmers. This will necessitate providing regular and appropriate training to extension service staff.

RECOMMENDATION 3: Translate available technology into usable information and formats for use by extension staff; arrange for training of extension staff in the Participatory Market Chain Approach (PMCA) and the Farmer Field School (FFS) approach, and enhance their capacity to engage with the private sector.

Risk is one of the main constraints to potato production in developing countries. Risk reduction strategies provide significant scope to create a more favourable enabling environment for potato production. There are many forms of risk and each form requires the adoption of a different risk reduction strategy, which can be provided by either the public or private sector or by working together in partnerships.

For example, for the public sector, production risk can be mitigated through crop insurance, the adoption of technologies (e.g. use of robust varieties and disease-resistant varieties), the promotion of irrigation equipment in drought-prone areas, adoption of contour farming in areas prone to soil erosion, etc. Similarly, for the private sector, risks of post-harvest losses can be mitigated through the construction of storage facilities and processing capacities, and price and market risk can be mitigated through vertical integration and forward contracts.

RECOMMENDATION 4: Promote public policies and private sector initiatives that reduce the risk of potato farming.

Technology

Technologies associated with production, processing and distribution operations in value chains are essential determinants of chain performance. This includes the methods, processes, facilities and equipment used in the value chain operations plus aspects related to research and development, and technology adaptation and adoption.

The technology for potato production therefore exists, but there is a significant gap between actual and potential performance in developing countries. Even though technological advances have resulted in significant increases in potato production in developing countries, their productivity remains low at 14.9 tonnes per ha – barely a third of what is being achieved in some of the world's main potato producing countries. Of course, continued technological research is still needed but, at the same time, existing technologies need to be scaled up and scaled out to ensure better accessibility and application for farmers.

As part of the scaling-up process, proven technology needs to be adapted to local conditions to maximize the potential gains. This requires research into making technology more adaptable which, in turn, makes it more accessible and suited to the local environment. This should be undertaken in association with the various value chain actors – researchers,

producers, the private sector and consumers – to ensure that all their needs are considered.

As part of the scaling-out process, the availability and application of existing technologies need to be communicated to all farmers. Not enough attention or effort is given to the dissemination of such information. This requires the translation of technology into usable information and formats for dissemination by the extension service.

RECOMMENDATION 5: Scale up and scale out available technologies; allow for local adaptation of these technologies to increase accessibility and effectiveness.

Risk-averse smallholder farmers tend to prefer technologies that reduce production risk. Technological advances have resulted in breeding of high-yielding potato varieties but, under adverse conditions, there can be relatively high variations in yield from year to year.

Considerable scope exists to further the development of robust potato varieties that consistently do well under the marginal conditions faced by many farmers in developing countries such as drought, disease and low fertility. Breeding of robust varieties does not concentrate purely on yield maximization. Qualities that provide consistent yields increase the ability of potatoes to contribute to food security and poverty alleviation.

RECOMMENDATION 6: Promote the development and use of robust varieties that will perform reasonable well under adverse conditions and over successive years.

Market structure

Market structure at each stage of the value chain has a large impact on the chain's overall performance as well as the performance of the individual chain actors. While it is difficult to alter the structure of the value chain in developing countries to promote food security and income generation among smallholder producers, the conduct of individual actors can benefit the entire chain.

For example, organizing smallholders into larger producer groups can benefit the entire value chain. Collective organization and post-harvest strategies, such as storage, can significantly increase the bargaining power of producers while reducing transaction costs, thus benefiting the entire chain. Furthermore, marketability can be improved by pooling production, enabling farmers to create larger potato batches for sale that that have been graded and selected specifically for the target market.

RECOMMENDATION 7: Organize smallholders into producer organizations in order to reduce transaction costs, add value through grading, selection and storage, and gain bargaining power.

Linking producers and producer groups directly with other value chain participants, such as wholesalers, processors and retailers, will enable smallholders to meet the specific demands of the value chain, thereby adding value and boosting incomes. Promoting an understanding of the market and the demands of the value chain to smallholders will ensure the right product, in terms of variety, grading and packaging, is delivered to the right place at the right time.

RECOMMENDATION 8: Directly link producer groups with markets, including wholesalers, processors and retailers.

Producers generally have insufficient knowledge of the market to aid their decisions on when and where to sell their potatoes. Increasing their understanding of the market and the demands of the value chain necessitates better provision of market information and greater transparency along the chain. There are good examples of farmers in developing countries making informed marketing decisions when they have received effective price and market information through various channels, including radio, newspapers and mobile phones.

RECOMMENDATION 9: Promote the availability of market information through media and other channels.

Firm management

Effective management at every stage along the value chain is necessary if individuals are to allocate resources efficiently, respond to consumer needs and adapt to market changes. While the technology for improved potato production exists, there remains a significant gap between actual and potential performance in developing countries. Effective business administration is often overlooked at the individual level to capitalize on this potential in favor of more technical approaches to further increasing production.

RECOMMENDATION 10: Provide business development services to producers and producer associations as a complement to technical training.

Chain coordination

Chain coordination harmonizes the physical, financial and information flows along the value chain and can facilitate performance. However, coordination among farmers to facilitate activities along the value chain is lacking in developing countries.

RECOMMENDATION 11: Explore and test ways to coordinate stakeholders in the potato value chain through such mechanisms as platforms, roundtable discussions and commodity associations.

Inputs

Inputs such as seed and fertilizer, and services such as credit, extension, research and information need to be available and accessible at every stage of the value chain if efficient performance is to be realized. Lack of good quality, clean seed is the most limiting element of the potato value chain and the main reason for poor productivity in developing countries. The availability and accessibility of good quality clean seed has potential to close the potato yield gap between developing and developed countries.

RECOMMENDATION 12: Promote availability of and accessibility to good quality clean seed.

There is a need to recognize the importance of the informal seed system in providing affordable seed in developing countries. As the informal seed system is the major supplier of seed to farmers in developing countries, effort should be made to link it with the formal seed system so that the benefits of good quality clean seed can percolate down to the farming community.

RECOMMENDATION 13: Link informal and formal seed systems.

There is a need to link seed production with effective storage, distribution and supply functions in developing countries. For this, efforts need to be made to initiate a strong cooperative movement involving farmer self-help groups, the private sector and public sector agencies.

RECOMMENDATION 14: Organize farmers into self-help groups and foster links with private sector seed firms and public sector seed producers.

A large number of developing countries grow exotic varieties as they do not have a good domestic variety breeding system in place. A good variety evaluation system is needed to identify those exotic potato varieties most suited to the specific agroclimatic conditions of individual developing countries and regions within countries. To be effective, one also needs to understand the needs of all stakeholders within the value chain (e.g. farmers, processors, retailers and consumers) to ensure all potato quality and supply demands are met.

Prospects for potato development beyond 2008

The implementation of IYP confirmed that potato will continue to play an increasingly important role as a global food crop, and billions of people around the world will continue to depend on potato as a staple food, high value and cash crop. Prospects for enhancing the potato value chains in developing countries will be achieved through the understanding of the challenges existing in the main three distinct economic typologies in the developing world, as follows.

- **For agriculture-based economies – mainly in Sub-Saharan Africa:** it is crucial to increase productivity. Research for development needs to provide breakthroughs in overcoming intractable problems, such as lack of clean seed potato, diseases such as late blight and viruses, and storage problems.
- **For transforming economies – in many countries of Africa, Asia and the Near East:** The challenge for these countries is to manage intensive systems sustainably, increasing productivity while minimizing health and environmental risks.
- **For urbanized economies – typical of Latin America, Central Asia and Eastern Europe:** The challenge is to ensure the social and environmental sustainability of potato-based systems, and to link small potato producers to new food markets.

RECOMMENDATION 15: Public and private sector needs to collaborate to evaluate imported exotic seed varieties.

RECOMMENDATION 16: Increase access to markets for smallholder farmers through diversification.

Product demand

Product demand is paramount since value chains cannot perform if demand does not exist. There are many examples of potato producers in developing countries adding value and diversifying into new potato markets. For example, adoption of post-harvest techniques such as grading, selecting and storing, and application of the marketing concept through product, packaging, promotion, place and price strategies has added value and provided access to new markets.

"The International Year of the Potato in 2008 raised awareness of the need for a coalition of stakeholders and for increased investment to work toward improving the productivity, profitability and sustainability of potato-based systems and value chains, and encouraged a renewed sense of responsibility on the part of the international community for agriculture and rural development"

ISBN 978-92-5-106627-0

I1710E/1/08.10