

**Postharvest Loss Challenges  
Discussion Paper**

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*Office of Agriculture, Biotechnology, and Textile Trade Affairs*  
*Bureau of Economic and Business Affairs*  
**U.S. Department of State**

**OVERVIEW**

In developing countries, most food loss takes place after crop harvest, between the field and the market. However, the specific causes of postharvest loss vary widely, depending on crop type, region, culture, weather, and farmers' incomes. U.S. embassies have proposed locally based postharvest loss challenges, in consultation with USDA, USAID, civil society, academic institutions, farmer organizations, trade associations, and ministries of agriculture and trade. While there is no single root cause of postharvest loss, a number of proposed challenges identify three key issues: poor storage, lack of training, and limited data.

In Afghanistan, farmers transport their goods in locally-produced bags and woven baskets, leaving the buyer to sort fruit by size or quality. Fruit at the bottom of the container ends up bruised or crushed. In India, a country with considerably more infrastructure, inadequate cold chain storage and inefficient distribution account for losses in fruits and vegetables, milk, fish, and livestock.

Even when reliable modern storage technologies are available for use, such as the case with the grain sector in Nigeria and Ghana, workers at these facilities may lack proper training. Significant postharvest loss, up to 50%, has been attributed to the lack of adequate knowledge and implementation of sound grain storage management.

In nearly all cases, the lack of data makes it difficult for local authorities and international partners to assess the extent of postharvest loss. In many developing countries, necessary data is not available to credibly estimate the extent of postharvest loss at any phase of production and distribution.

## AFRICA

### Ethiopia

- a) **Point of Contact:** U.S. Embassy Addis Ababa, Ethiopia
- b) **Country, region, crop:** Ethiopia, teff, wheat, maize, sorghum, barley, and coffee
- c) **People Impacted by Postharvest Loss:** Ethiopia is a country with a history of severe famine (1972-1974, 1984-1985), and remains dependent on food imports to feed its population. Thus, despite significant increases in the area of land under cultivation and the yield per acre over the last two decades, food security in Ethiopia remains fragile. An estimated 40% of the population still consumes less than the minimum daily requirement of calories. Postharvest losses therefore reduce the overall prosperity of the country and contribute to undernourishment among the large minority of the population that live in fragile eco-systems and/or have little access to affordable imported food-stuffs.
- d) **Description of Postharvest Loss Challenge:** Ethiopia's geography is extremely diverse, ranging from the hottest desert on earth to mountains more than 10,000 feet high. Much of the country is arid with highly unreliable rainfall, while the rain-soaked highlands of the west feed the Nile. Because of wide variations in altitude, rainfall, and connectivity, the country is effectively a patchwork of 72 micro-climates, and the population is dependent on a variety of staples, most significantly teff, wheat, maize, sorghum and barley. The situation is aggravated by the under-developed transportation infrastructure which inhibits access to markets.

According to the African Postharvest Losses Information System (APHLIS) postharvest losses in 2012 for teff were estimated at 12.3%, for sorghum at 11.6%, for wheat at 9.9% and for maize at 16.8% . All these figures represent a marginal decline from the year before. Other data sources put that postharvest losses for pulses at 19.6% due to insects and molds alone. Furthermore, a recent study conducted by Addis Ababa University and the Swiss Agency for Development and Cooperation (SDC) in two communities in the East Gojam zone of the Amhara National Regional State showed that, in at least some locations, postharvest losses can be as high as 30% to 50%. The 2010 national grain balance estimated by United Nations Food and Agriculture Organization/World Food Program Crop and Food Security Assessment Mission estimates total postharvest losses at 2.04 million tons of grain whereas the cereal import requirement was roughly 1.16 million tones.

According to the SDC study, postharvest losses occur at different stages such as harvesting, threshing, winnowing, transporting and storage, with storage being the stage at which the biggest loss occurs. The causes of postharvest losses are multiple, however, the most significant losses are caused by pests (insects and rodents), by lack of appropriate storage facilities, by inappropriate packaging, and by inadequate means of transportation.

- e) **Available Data and/or Needed Data:** Data related to postharvest losses in Ethiopia, either for grains or horticultural crops, is scattered and a challenge to locate. However, there are

few sources, usually from international NGO's and Public International Organizations (PIOs). There is a need for data related to postharvest losses or at least to know where to locate the data. The article cited above shows just how bad the situation is in some locations in Ethiopia, but does not provide comprehensive or even comparative data. (Study: "Rapid Assessment of Status of Postharvest Loss in Grain Crops, Current Practices and Technologies for Loss Reduction among Smallholder Farmers in the Highlands of Ethiopia: The Case of Enebse Sar Midir and Enarj Enawga Woredas of East Gojam Zone of Amhara Region. A pre-feasibility study," by Abraham Tadesse of Addis Ababa University and Senait Regassa of Swiss Agency for Development and Cooperation SDC Global Program Food Security (Sub-Sahara Africa), Addis Ababa, January 2013.)

- f) **In-country technology and innovation events and resources:** Ethiopian farmers practice a wide range of techniques to reduce postharvest losses at different stages such as optimizing time of harvesting to reduce shattering, preparation of smooth and wide threshing to reduce loss before storage. Grain is stored in traditional structures as well as in sacks and it has also been observed that there is a shift to store grain inside residential structures in recent years because of fear of theft. Food processing is also used to overcome postharvest loss and provides longer shelf life and adds value to the original crop, thus helping farmers overcome spoilage and losses.

USAID/Ethiopia's Feed the Future (FtF) Program through its Agribusiness and Market Development (AMDe) project are constructing four sesame warehouses with a capacity of 5,000 MT each in FY2013 and plan to construct an additional seven maize warehouses of 5,000 MT each the following year all on a cost-share basis. The total current and planned warehouse capacity from USAID assistance is 55,000 MT, a major contribution for reducing postharvest losses of select products such as wheat, maize, sesame and chick pea.

The World Food Program's (WFP) Purchase for Progress (PfP) program began purchasing maize in 2013 from farmers' cooperative unions on a contract basis and will continue through 2016. By 2016, WFP is expected to purchase 300,000 MT of maize from 50 cooperative unions. As a result, cooperative unions are expected to maintain the quality standard of the food purchased, and through technical support in postharvest handling and storage, be able to maintain the grain quality standards WFP requires.

## Ghana

- a) **Point of Contact:** U.S. Embassy, Accra, Ghana
- b) **Country, Region, Crop:** Ghana's Northern, Upper East, and Upper West regions  
Horticulture, animal products, cereals, and root crops
- c) **People Impacted by Postharvest Loss:** Smallholder farmers, traders, agro-processing businesses
- d) **Description of Postharvest Loss challenge:**

*Cereals:* Maize suffers from a number of postharvest challenges in Ghana, ranging from poor harvesting, drying, and shelling practices, to lack of adequate storage infrastructure. Most smallholders shell their maize by hand, or by beating with sticks, leading to breakage. This is followed by drying on the ground, leading to infestation, high percentages of foreign matter, and high moisture content that can lead to mycotoxin contamination. Storage is often done in homes, without adequate protection from pests or routine fumigation. All of this leads to low quality maize that is often spoiled before it can be sold, depending on maize price trends for the season. Mobile shellers, drying equipment, cleaners, warehousing facilities, and fumigation services are present in many parts of the country, but currently lack adequate penetration or capacity to meet demand.

*Root crops:* Cassava, yam, sweet potato, and irish potato represent important parts of the Ghanaian diet, and in the case of cassava, essential food security crops. Postharvest handling of these crops is a challenge, given the uniform harvesting times and relative market glut that can occur. With the exception of cassava flour, gari, and starch processing, root crop storage and processing represents a serious challenge to the industry.

*Horticulture and animal products:* Fruits, vegetables, eggs, and dairy suffer from similar postharvest issues including, underdeveloped cold chain (trucks, warehouses, etc), poor road infrastructure, and unintegrated supply chains. With the mango industry as a possible exception, most fruit is produced on a relatively small scale and lacks sophistication in its supply chain. Egg production is growing, with the potential for a renaissance of the meat poultry industry in Ghana, though poor roads lead to inefficiencies in packing and shipping to market. The dairy industry in Ghana is virtually non-existent, due in no small part to its climate, but also lack of cold chain infrastructure.

- e) **Available Data and/or Needed Data:**

*Warehousing/Services:* The International Fertilizer Development Center (IFDC), with USAID support has a fairly good inventory of grain warehousing facilities in Northern Ghana, including their location, management, GPS coordinates, quality, equipment, and services. Mobile service providers (dryers, shellers, etc) are less well-documented centrally, but are well known within their coverage areas.

*Market/Commodity:* The “mFarms” platform is a growing database of agricultural and market information that could be tapped for information. Similarly, eSoko is another market

information service provider that has capabilities in tracking grain prices and volumes around the country. USAID has been developing a geospatial database for donors working within the agriculture sector, and hopes to improve the granularity of data over the next 2 years.

*Production/Socioeconomic:* Production data, including area cultivated, yields, etc. are regularly collected as part of USAID's reporting, as well as Government of Ghana (GOG) statistics. The Ghana Strategic Support Program (GSSP) currently supports the GOG to do an annual Ghana Agricultural Production Survey (GAPS). It was started in 20 of Ghana's 216 districts and will be scaling to 60 next year.

- f) In-country technology and innovation events and resources:** USAID has a number of projects working in agricultural technologies, including some in ICT and data needs.
- The Agriculture Technology Transfer (ATT) Project will be rolling out new shelling, drying, and storage solutions;
  - The ADVANCE Project has worked on warehousing and drying facilities by linking farmers to buyers;
  - A new USAID/Washington-funded project, implemented by Kansas State University is specifically focusing on Postharvest Handling in Ghana;
  - MCC did quite a few warehouses, some of which are equipped with dryers and cleaners;
  - A number of private sector operators are heavily investing in maize quality and storage infrastructure (Wienco, Blumberg, Ghana Nuts, Premium Foods, etc),
  - USAID's Monitoring and Evaluation Technical Support Services (METSS) program works to coordinate donors and the GOG through mapping of activities and facilities;
  - eSoko is a private-sector market information provider;
  - mFarms is an IFDC extension/market information provider;
  - The USAID FACET Project works specifically on ICT and open data issues, and has facilitated a number of ICT for development and agriculture meetings around the world.  
<http://kdid.org/projects/field-support/facet>

## West Africa (regional)

a) **Point of contact:** USDA Foreign Agricultural Service, Office of Capacity Building & Development

b) **Country, region, crop:**

- Nigeria; Kano, Katsina, Kaduna, Kwara, Nassarawa, Taraba; corn, sorghum, millet, rice, soybean
- Ghana; Ashanti, Brong-Ahafo and Bolgatanga; corn, sorghum, millet, rice, soybean
- Other countries include – Cameroon: Adamawa and North; corn, sorghum, millet, rice; Benin: whole country; corn, rice; Togo: whole country; corn, sorghum, millet; Liberia: whole country; rice, corn

c) **People impacted by postharvest loss:**

Smallholder farmers, including women; grain commodity traders; grain merchants; federal and state government strategic grain reserve personnel; extension agents; university professors and technicians; consumers.

d) **Description of Postharvest Loss Challenge:**

Findings from in-country assessments and training by Assessment/Training team from U.S. land-grant universities:

- Even when reliable modern storage technologies are available for use in some sectors (e.g., strategic grains reserve programs, processing industry, grain merchants) of the grain value chain, managers and their staff at these facilities lack proper training. Significant postharvest losses, up to 50% in some cases, are occurring due to the lack of adequate knowledge and implementation of sound stored-grain management.
- This finding is similar for storage at the on-farm level, where not only knowledge about proper grain storage is lacking, but reliable storage facilities and affordable postharvest handling technologies were unavailable.
- These findings are not limited to Ghana and Nigeria but are also seen in other countries where USDA provides trade capacity building and food security-security related training, such as other littoral West African and Sahelian countries.

e) **Available data and/or needed data:**

Available Data/Activities:

- Training courses on stored grain management to facility managers, technicians, researchers and university professors.

- Training courses for field training of on-farm storage to train farmers and agricultural extension agents.
- Use knowledge gained by the USDA Assessment/Training Team in Ghana and Nigeria from previously conducted trainings for 190 and 210 personnel, respectively. Three-day curricula were developed for stored grain management in silo complexes for bulk stored commodities and stored grain management in warehouse structures for bagged commodities that are applicable to both countries. Among outcomes from participants at grain facilities were reduced losses and improved sanitation practices causing decreased use of pesticide use and worker exposure to chemical insecticides. Training was conducted in Ghana in 2010-2011 and is ongoing in Nigeria, 2010-2014.
- Agricultural production systems are quite similar throughout West Africa, with amount of rainfall being major determinant of available crops, and knowledge gained in Ghana and Nigeria directly applicable in other countries.

#### Data Needed:

- Availability of type, quality and level of training in grain postharvest technology/stored-products protection at universities, polytechnics or technical colleges;
- Availability and/or development of short-courses for recurrent training of personnel in the industry that will help determine/scope the need in this area;
- Availability and accessibility of extension communications (publications, broadcasts, podcasts, etc.) in both the national (English/French) and local languages on stored commodity protection/grain postharvest technologies and practices;
- Needs assessment for specialty workshops on stored products protection, fumigation, workers safety, food safety, etc.
- Needs assessment on how training and extension can be scaled via online course offerings such as KS-GEAPS Distance Education Training, E-extension, Mobile Phone Data Feeds via Twitter and Texts, etc.

#### **f) In-country technology and innovation events and resources:**

- Capacity is available in the U.S. land-grant university system but most grant programs are geared toward funding technology development rather than training.
- Feed the Future programs (U.S. AID et al.) have capacity to build in activities to support data gathering/sharing efforts. West African countries all possess National Agricultural Strategies as a result of CAADP that should be consulted as efforts progress. Critical constraint will be funding for such activities, as most West African National Agricultural Strategies remain underfunded and largely dependent upon international aid.



## Uganda

- a) **Point of contact:** U.S. Embassy Kampala, Uganda
- b) **Country, region, crop:** Uganda, nationwide, maize
- c) **People impacted by postharvest loss:** Smallholder farmers (both men and women), processors, aggregators/traders, exporters and World Food Program (WFP). Of course, the final consumer is the one who pays for all the losses through the unnecessarily-inflated final retail price.
- d) **Description of postharvest loss challenge:** According to the Postharvest Losses Information System Network (<http://www.aphlis.net/>), postharvest maize losses in home storage in Uganda average 26.5% and 17.9% for the first and second cropping seasons, respectively – the difference being explained by the overlapping of the harvest of the first season crop with the July-August rainy season. However, it should be noted that there are almost no detailed, scientific accurate, objective estimates of postharvest losses (PHLs) in maize for Uganda (see below).
  - The principal PHLs in maize in Uganda occur during harvesting and handling due to grain shattering and due to spillage during transport. They also arise from bio-deterioration in all steps in the postharvest chain, including storage. Quality of maize is often low because maize is not dried properly and the resulting high moisture content can accelerate spoilage. The principal agents of bio-deterioration are molds, insects, rodents and birds. A variety of insects pests, like the Larger Grain Borer, are common in the country; they start their attacks on the mature crop in the field which then carries over into storage, where the bulk of the damage/losses occur.
  - The cost of these losses is enormous – for example, a recent USAID study (not in Uganda), estimated direct transport costs for maize to be \$81 per ton, while, product losses due to storage and handling problems between the farm and the end-market were \$79 per ton.
- e) **Available Data and/or Needed Data:** The lack of a representative survey of postharvest losses (on maize, but on all other crops as well) in Uganda, it is important that such a survey be undertaken to determine the actual scale of the problem and to provide planners with data on which interventions to address it, can be drawn up. For example, not one of the 80 studies undertaken on PHLs in Africa between 1977 and 2011 listed on the APHLIS web-site, relates specifically to Uganda.
- f) **In-country technology and innovation events and resources:** The Uganda National Agricultural Research Organization has a National Postharvest Research Unit, based at Kawanda Research Station, which is mandated to develop and promote technologies, methods and approaches that respond to postharvest needs through:
  - Reduction of postharvest food losses, Improving storage and utilization of the crops

- Improvement of the quality of products including food nutritional value and safety
- Product diversification and value addition
- Reduction of drudgery in processing and on-farm transport
- The Unit's mandate focusses on optimizing on food security, nutrition, safety and marketability of products through value addition, increased market competitiveness of farm produce and increased profitability.
- The National Agricultural Advisory Services also provides advice and some equipment to farmers to reduce postharvest losses, while WFP is currently engaged in some trials on different storage equipment in order to provide recommendations on reducing PHLs to the farmers and rural traders who they are supporting. It is also hoped that the adoption by smallholder farmers of the new postharvest technologies and infrastructure identified by this research will provide them with an opportunity for time arbitrage.
- Another approach to reducing postharvest losses is to encourage more efficient marketing channels such that surplus grain is moved off-farm quicker. When the maize is handled and conditioned by professional traders, quality can be retained and postharvest losses minimized.

## West Africa (regional)

- a) **Point of Contact:** USAID, West Africa
- b) **Country, Region, Crop:** Benin, Ghana, Liberia, Nigeria, Niger, Guinea, Senegal and Cameroon, *Rice, Sorghum/Millet, Cassava, Maize and Cowpea*
- c) **People Impacted by Postharvest Loss:** Smallholder farmers, traders, agro-processing businesses

USAID/WA's work in this area is not as extensive as USAID/Ghana's; nevertheless, we would like to showcase work done by our regional partner CORAF (West and Central African Council for Agricultural Research and Development):

- Under CORAF's Staple Crops Program, USAID/WA supported the project entitled, *"Improving Postharvest Quality and Packaging of Rice, Sorghum/Millet and Cassava Products"*, coordinated by the Songhai Centre, in Benin, with the sorghum/millet component sublet to the Institute de Technologie Alimentaire (ITA) in Senegal. The project aims at putting efficient technological packages in the hands of producers and processors in improving marketability of farm produce in nine countries. Activities seek to strengthen capacities of the target groups, mainly women to enable them to adopt best practices of agro-processing, while their access to the acquisition of simple processing equipment is facilitated through cost-sharing and linkages to relevant institutions. This was a two-year project with a duration from June 2009 to May 2011, and commissioned under USAID's Global Food Security Response (GFSR). Benin, Ghana, Liberia, Nigeria and Senegal were the target countries.
- The Department for International Development (DFID) is also supporting CORAF in this area with a program entitled, *"Promotion of Postharvest Technologies and Processing of Maize and Cowpea to Reduce Losses and Improve Market Quality in West and Central Africa"*. This is a three-year project ending this year, and is being implemented by the Institute de Technologie Alimentaire (ITA) in Senegal. Countries of focus, and partner organizations, are Cameroon (Institute for Agricultural Research and Development/IRAD), Guinea (Guinean Agricultural Research Institute/IRAG), Niger (National Agricultural Research Institute of Niger /INRAN), and Senegal (Institute de Technologie Alimentaire/ITA and Institute Senegalais de Recherche Agricole).

Further, USAID/WA will continue the good work done under the recently expired (ATP/EATP) program in areas of MIS and intra-regional trade collection data. It will be supported by our new Trade Hub and African Partners Program which should be up and running soon.

## ASIA

### Philippines

#### Postharvest Loss Challenge #1

a) **Point of contact:** Embassy Manila, Philippines, USDA Foreign Agricultural Service

b) **Country, region, crop:** Philippines, All Regions, Rice

c) **People impacted by postharvest loss:** Smallholder Farmers

d) **Description of postharvest loss challenge:** After harvest, paddy rice is dried before it is milled. Absent appropriate drying facilities, most rice farmers sun-dry their harvested paddy rice (often along paved roads). This practice results in considerable wastage as a result of unnecessary exposure and extra handling (paddy rice has to be bagged, unbagged, spread evenly, sifted and dried, collected and then rebagged), but also due to quality deterioration and decreased recovery rates during the milling process.

e) **Data available and/or needed that could help address the problem:**

Available – None. Reliable information unavailable.

Needed –

- Number and capacity of drying facilities and their locations
- Milled rice recovery rates vs. Paddy rice moisture content
- Volume of sun-dried paddy rice and paddy rice losses

f) **In-country technology and innovation events and resources:** Title I, PI480 Program Funds in National Treasury

#### Postharvest Loss Challenge #2

a) **Point of contact:** Embassy Manila, Philippines, USDA Foreign Agricultural Service

b) **Country, region, crop:** Philippines, All Regions, Meat and Poultry

c) **People impacted by postharvest loss:** Small backyard farmers

d) **Description of Postharvest Loss Challenge:** Lack of adequate cold chain for meat and poultry products. A vast majority (over 70%) of local meat and poultry products are sold warm and do not go through the cold chain process. The majority of meat and poultry sources are slaughtered and then immediately sold to consumers. Most products are delivered in unrefrigerated vehicles and displayed in wet markets without adequate cold chain equipment, which increases perishability and compromises the wholesomeness and safety of the products. The high cost of energy in the country makes it difficult for wholesalers and retailers to keep products at a proper temperature.

**e) Available data or data needed to address the problem:**

Available – None. Reliable information unavailable.

Needed -

- Number of cold chain storage facilities and capacity
- Number of triple A slaughterhouses and or dressing plants
- Number of modern supermarkets and meat shops and volume of meat and poultry produced

**f) In country technology and innovation events and resources:** None.

## Vietnam

- a) **Point of contact:** U.S. Embassy, Hanoi, Vietnam
- b) **Country, region, crop:** Vietnam, Northwest and Central Highlands, Coffee
- c) **People impacted by Postharvest:** Small holder farmers, and mid-level processors
- d) **Description of Postharvest Loss Challenge:** Coffee beans, even when raw, carry a broad range of qualities depending on ripeness, degree of fermentation after picking, post- fermentation handling to prevent mold and deterioration. As the trading system depends on turnover, the better quality beans are mixed with lower quality in traders warehouses. With the good-and-bad blended in the traders' warehouses, the entire available crop quality is reduced to a lower common denominator. Well-intentioned traceability schemes administered by "Fair Trade" Fair Wild" and other double-barreled third-partied organizations add great cost to the harvesting.  
  
Current new regulations from Ministry of Trade (MOT) Prohibit Foreign invested companies from trading directly in local markets. Left with an obscure part of the supply chain, the management system breaks down, In spite of best efforts, and the overall crop value is lower than it might be.
- e) **Available data and/or needed data:** Out of my expertise, I just do Launch Pad over here.
- f) **In-country technology and innovation events and resources:** The MOT directive to keep us out of the market may have been intended to watch after Chinese companies and cross border trade, but it's being used by local tax offices to ensure their friends' business positions as traders.

## SOUTH AND CENTRAL ASIA

### Afghanistan

- a) **Point of Contact:** U.S. Embassy Kabul, Afghanistan
- b) **Country, Region, Crop:** Afghanistan, South (Kandahar), Fruits (Fresh pomegranates, grapes and figs)
- c) **People Impacted by Postharvest Loss:** Farmers, Buyers and Transporters
- d) **Description of Postharvest Loss Challenge:** Recent project implementer evaluations peg Kandahar's postharvest loss for pomegranates, grapes and figs at 60 percent. Primary reasons for the high postharvest loss include:
- **Trading arrangements:** Buyers servicing an international market typically show at the contracted farm once at the height of the harvest season, when they are sure of a full load for their trucks. Fruit ripened at the start and end of seasons either are disposed of locally by the farmer or left to rot. *Solution floated by AID: Collection centers aggregate partial loads collected from farmers, making repeat visits from buyers worthwhile.*
  - **Packaging and Handling:** Farmers typically deliver their product in locally-produced bags and woven baskets, leaving the buyer to sort fruit by sizes or quality. As a result, only the top layers of a container are in suitable condition to command top prices. Fruit at the container bottom bruise and are crushed, receiving low prices. Furthermore, little care is taken to sort out split, damaged or rotting fruit, putting other packed fruits at risk. *Solutions floated by AID: Trellises can reduce spoilage; proper vine and tree trimming would improve quality before harvesting; properly proportioned shipping containers would reduce bruising; and proper sorting at harvest to divert fruits destined for the juicer or fee trough would reduce risk to better quality fruits.*
  - **No Cold Chain to Prevent Damage from High Summer Temperatures:** There is one privately-funded refrigerator storage facility each in Kandahar and Helmand provinces, and contacts have complained of product loss due to unsanitary conditions and mismanagement in the Kandahar facility. The cost of operating a cold chain in Southern Afghanistan requires a large volume of high-value commodities and exact management to be profitable. *Solutions floated by AID: Use of traditional cooling baths, when water is available; shaded collection centers to reduce spoilage; and a new privately-funded refrigeration center.*
  - **Transportation problems:** Transportation for produce is unreliable, and delay can affect fruit quality. Buyers are cautious about servicing outlying farms due to banditry and informal "tolls." Limited airlinks to Gulf States only partially compensate for the loss of access to overseas markets that result from fruit-unfriendly time-wasting customs procedures needed to ship fruit through Pakistan. *Solutions floated by AID: Identify reliable traders in the province to service collection points; encourage a more open trade*

*relationship between Afghanistan and its neighbors; encourage consideration of more cargo flights/destinations out of Kandahar airfield.*

**e) Available Data/ Needed Data:**

Draft Table

Commodity	Local Production (MT)	Exports (MT)	Local Sales (MT)
Pomegranate	75,000	64,000	11,000
Grape	50,000	42,000	8,000
Apricot	17,000	2,000	15,000
Fig	12,000	2,000	10,000
Melon	129,000	102,000	27,000

\*Source- August, 2013 Draft Market Report on selected Fresh and Dried Fruit. FAIDA-ABS

**f) In-country technology and innovation and resources:**

Kandahar benefits from USAID-funded agricultural programs (CHAMPS, AGRED, and Kandahar Food). Changes to basic production such as irrigation management, trellising, and pruning are Southern Afghanistan's starting point. USAID is still working to determine the best methodology (master farmer- lead training versus government-lead demonstration centers) to implement this training. Illiteracy and/or the lack of education is consistently mentioned as an obstacle to training farmers.

For the innovative traders, investments in the air cargo support system have been made at the Kandahar International Airport. A temporary holding cooler and a pallet security scanner have been installed.

Until the new technologies being advocated are adopted and implemented, there are no clear in-country resources beyond a favorable climate and production history for Afghanistan to regain some of its market share in fresh fruit.

## India

**a) Point of contact:** U.S. Embassy New Delhi

**b) Country, region, crop:** India, All, Grains, Fruit and Vegetables, and Dairy

**c) People impacted by postharvest loss:** Smallholder farmers, middlemen, and consumers are affected by Postharvest loss. Because of infrastructure constraints and limited access to buyers, smallholders are often forced to sell their products cheaply and to local buyers who can set prices below market-clearing levels. Middlemen suffer product losses due to inadequacy of handling facilities that are often in the hands of government agencies. Consumers suffer higher prices for produce.

**d) Description of Postharvest Loss Challenge:** Loss occurs at every stage of the supply chain. Following harvest, about 60-70 percent of food grain is stored on farms for variable periods, normally in traditional structures and at dangerously high moisture levels. This makes them particularly vulnerable to infestations of pests and micro-organisms. Significant losses also occur during processing, where the number of mills is insufficient to meet demand, and most processing units are small and use outdated technologies. The highest rates of loss are in perishable fruits and vegetables, where there is a lack of proper storage facilities, absence of proper handling, transportation, pre- and postharvest treatment and processing.

Dairy has generally been a success; per capita availability of milk was 290 g per day in 2012, higher than the world's average. Most of the milk is produced by small, marginal farmers and landless laborers, but an estimated 18% of the product is lost due to inadequate cold chain storage and inefficient distribution. Fish and livestock produce face similar constraints, with relatively high levels of efficient production, and poor systems of cold storage and distribution.

Mr. Pawanexh Kohli, Chief Advisor of National Center for Cold-Chain Development, told Econoff that the data in studies done thus far are unreliable and underestimate postharvest loss. He estimated that about 30-40% postharvest loss in horticulture. The farmers lack market linkages and usually sell their produce to a single buyer creating a monopoly. Kohli thinks that linking farmers to market and optimizing logistics such as improvement in infrastructure including good roads and development of cold storage facilities are the key areas of improvement. India has about 30 million metric tons of cold storage capacity out of which 10 million metric tons was built in the last 8-10 years. He also envisioned that better coordination and cooperation amongst the states will go a long way in addressing this issue but noted that the challenge lies in infrastructure, availability of suitable transportation, as well lack of knowledge in handling, packing and shipping. Kohli stated that the Government of India has addressed postharvest losses as a key area of focus in the 12<sup>th</sup> five year plan.

**e) Available data and/or needed data:** It was repeatedly noted that GOI lacks the necessary data to credibly estimate the extent of postharvest loss at any phase of its production/distribution. According to a World Bank study in 2011, postharvest loss occurs in 7-10 percent of Indian food grains from farm to market, and 4-5 percent at distribution levels. This accounts for a loss of 11-15 million metric tons (mmt) of food grains annually – 3-4 mmt of

wheat and 5-7 mmt of rice inter alia. For fruits and vegetables, postharvest loss is estimated to be about 30 percent. Other estimates vary from the official GOI figure of 0.87% grain loss to industry estimates as high as 50%. Having said that there are some sources of data on this subject and GOI continues to invest in further studies on the subject:

<http://www.assochem.org/prels/shownews.php?id=4132>

<http://www.ciphnet.in/siteMatter.asp?link=About> Ciphnet

<http://www.crosstree.info/Pages/Links.aspx>

**f) In-country technology and innovation events and resources:** An estimated two percent of food produced in India is further processed between harvest and retail sale, not counting rice and wheat milling. This indicates that food preservation technologies in addition to modernization of commodity and produce storage facilities could reduce losses significantly. Modern packaging systems are being increasingly adopted in India. These include corrugated fiber board and polypropylene boxes, plastic trays and crates, woven sacks, molded pulp trays, thermoformed trays, stretch films and shrink wrapping.

Embassy's Agricultural Affairs Office notes that technology is not a constraint on resolving the problem of postharvest loss in India as off-the-shelf technologies are already available (India's modernized and export-oriented basmati rice sector exemplifies what could be possible). The real issue is economic, primarily consisting of systemic disincentives to investment built into agricultural and food policy. The current state-dominated system of commodity marketing does not provide the necessary incentives for preserving food from farm to market. The Essential Commodities Act in particular has created a substantial disincentive to investment in bulk grain storage and processing, as it requires that grain be transported in jute bags (a habitat and vector for grain storage pests) and permits government at all levels to confiscate foodstuffs unpredictably and at will to avert "hoarding". The Agricultural Produce Marketing Committee (APMC) Acts at the state level force farmers in many states to sell their produce exclusively to municipal APMCs, and the APMCs do not typically invest in proper infrastructure for handling perishables. In addition, the GOI's Food Corporation of India (FCI) procures roughly one third of the wheat harvest annually, then stores much of that wheat outdoors on concrete plinths, and covered only with plastic tarpaulins. Official spoilage and loss statistics of 0.87% are not credible; private sector grain traders peg spoilage and loss of FCI-owned wheat at about 20 percent. These losses could all be easily averted by privatization of the marketing chains and abolition of the jute bag requirement, which would encourage private investment in infrastructure using existing, proven technologies.

The new National Food Security Act (2013) in Chapter 8, section 22, obliges the central government to create and maintain modern "scientific" storage facilities throughout the country. Various state officials have already commented to Econoff that they have been provided incentives from the center to improve their own grain storage and distribution facilities. The U.S. Trade and Development Agency (USTDA) is exploring the options of supporting India better in its grain storage and handling either through proposing a Reverse Trade Mission or a Feasibility Study to help overcome the challenges. Officials of the GOI Ministry of Finance made this request to USTDA in March 2013 and the concept is under discussion with the Foreign

Agricultural Service, the Foreign Commercial Service and the Federation of Indian Chambers of Commerce and Industry (FICCI) as well as a few other Chambers of Commerce.

With reference to fruit and vegetables in particular, adoption of small-scale technologies could produce major benefits. Low temperature drying coupled with other preservation techniques could enhance storage capacity, while higher-grade containers and packaging materials could lengthen shelf-life. Most postharvest technologies are capital-intensive, but India pioneers in development of low-cost postharvest handling methodologies, which include the CoolBot cold storages, low cost Controlled Atmosphere storage, insulated trucks for ‘cool transport’ and other no-cost methods for handling product. One of these technologies, the “CoolBot” was developed by a collaborative program between USAID’s Horticulture Collaborative Research Support Program (CRSP) led by UC Davis, and Indian institutions. CoolBot technology uses a standard window-unit air conditioner to create a cold chamber with the aid of a CoolBot controller device that overrides the temperature control, allowing the room to reach temperatures as low as 7° C. Following initial pilots, Bayer is now working with local technology providers to develop improved insulation materials that can help adapt this device to local conditions to achieve low temperatures with minimum electricity requirements.

In the state of Bihar, approximately half of the vegetables produced are wasted due to spoilage. While increasing yields is important in agricultural production, average farmers in India can dramatically increase their income if more of what they produce is not lost but instead available for sale to the market. To help farmers acquire the right resources to improve their productivity, USAID is partnering with the Confederation of Indian Industry-Food and Agriculture Center of Excellence (CII-FACE) to create two rural business hubs in eastern India focused on banana and vegetable production. In Bihar, this hub will work with small and marginal vegetable producers to develop the necessary postharvest infrastructure to reduce spoilage, provide training and link the producers directly to buyers. These rural business hubs will also bring together private and public sector entities to help organize local farmers, bring innovative solutions in farm input and postharvest management to the informal fruit and vegetable supply chains to increase incomes and create jobs.

As noted above however, the state-dominated system of food distribution does not currently incentivize adoption of even such small-scale innovations. While there is a separate Ministry of Food Processing Industry and a National Mission on Food Processing, the program is focused on expanding capacity via “MegaFood Parks” and incentives for processors, but does not address issues of getting produce more effectively to the processors.

## EUROPE AND EURASIA

### Bosnia and Herzegovina

- a) **Point of contact:** U.S. Embassy Sarajevo
- b) **Country, region, crop:** Bosnia and Herzegovina (BiH), fruit and vegetable products
- c) **People impacted by Postharvest Loss:** Postharvest losses of fresh fruit and vegetables are experienced not only by small and large individual/commercial producers/farmers and others engaged in the production of fruit and vegetables, but also market intermediaries that organize the purchase and sale of these products in the domestic and the foreign market.
- d) **Description of Postharvest Loss Challenge:** Main reasons for postharvest losses in BiH are: inadequate harvest time for fruit and vegetables (early or late harvest), improper harvesting (damage during harvesting), poor handling, lack of hygiene in packaging (wooden pallets are not disinfected) and inadequate storage after harvesting. An additional problem is that BiH doesn't have classic packing centers that collect large amounts of fresh fruit and vegetables, store, calibrate, process and package the produce for the local or export markets. Also, the producers need to be adequately trained and equipped to avoid postharvest losses. Most of the primary producers of fruit and vegetables are mainly focused on the production of fruit and vegetables, with limited attention given to harvesting, which results in bruises, damage and sometimes bacterial infection of products. Also, limited attention is given on the temperature of the product during and after harvest and this has significant consequences during the later stages of processing, packaging, storage, distribution and sale of fruit and vegetables.

An estimate shows that losses in fresh fruit and vegetable sector have been approximately 40 percent (Source: Assistant Professor Boris Pasalic, Banja Luka University). An additional investment is needed in refrigeration, automatic sorters, calibrators, packaging plants, etc. as well as in technical capacity building of producers and processors. Existing facilities are still insufficient in some cases (e.g. fresh plum, although there is high production quality and customer demand, there is insufficient capacity to meet the demanding requirements of the market, particularly quality standards). Exports of fresh cherries are also expanding but the existing capacities for storage and handling of fresh cherries will soon reach their full capacity. While some capacity in BiH already exists, there is a need for strengthening and modernizing production facilities. It is necessary to introduce modern technology and equipment to improve the quality and long term packaging and storage of fruit and vegetables to include cooling, processing, packaging and adequate storage. It is necessary to provide the so-called integrated chain of production that will establish the cold chain, introduce new technologies in the production, transportation, processing and storage of sensitive categories of products such as fruit and vegetables. Modern warehouse, equipment and supplies used in the production and processing of fruit and vegetables are key components to improve the quality, safety and efficacy of the system cold chain.

Regarding technical support to farmers, BiH has agricultural extension services working in agricultural institutions and institutes but these are mainly engaged in the administration of subsidies. There is a lack of specialist support in postharvest technology. Agricultural colleges/universities in BiH give very little attention to this issue due to lack of adequate staff and other reasons.

In conclusion, further additional investment in capacity (refrigeration, automatic sorters, calibrators, packaging plants, etc.) are required, as well as in technical capacity building of producers and processors. Existing facilities are still insufficient in some Exports of fresh cherries are also expanding but the existing capacity for storage and handling of fresh cherries will soon reach their full capacity. USAID has assisted local producers with this problem through agricultural assistance projects (LAMP and FARMA) but additional efforts (training, educations, equipment's etc.) are required, which also requires a significant financial investment.

e) **Available data and/or needed data:** Entity Agricultural Ministries don't keep track of postharvest losses but general agricultural data is kept at Entity Agricultural Ministries and Universities and is available upon request.

f) **In-country technology and innovation events and resources:**

University of Sarajevo, Agriculture and Food Science Faculty, Sarajevo

University of Banja Luka, Faculty of Agriculture, Banja Luka

Ministry of Agriculture of the Federation

Ministry of Agriculture of the Republika Srpska

Agricultural Faculty Banja Luka

Agricultural Faculty Sarajevo

USAID Fostering Agricultural Market Activities (FARMA) project

## Serbia

a) **Point of contact:** U.S. Embassy Belgrade, Serbia

b) **Country, region, crop:**

Country	Crop	Ttl. Production '000 MT	Losses est.
Serbia	Wheat	2,000	1-1.5%
Serbia	Corn	6,000	1.5-4%
Serbia	Soybean	400	2%
Serbia	Sunflower seeds	400	3%
Serbia	Potatoes	800	20%
Serbia	Apples	250	7-10%
Serbia	Raspberries	80	4%
Serbia	Tart cherries	80	3.5%

Source: Serbian Ministry of Agriculture, Department for Agricultural Analytics and Agrarian Policy, <http://www.mpt.gov.rs/articles/view/310/1349/Bilansi.html>

c) **People impacted by postharvest loss:** Small-scale farmers and agribusinesses

d) **Description of postharvest loss challenge:** Main factors responsible for postharvest loss of fresh fruits and vegetables are mechanical damage; spoilage by fungi, bacteria, insects, and other organisms; and physiological deterioration. The main constraints causing postharvest losses in Serbia's fruit and vegetable sector are: lack of adequate storage capacity; lack of knowledge in the commercial sector; weaknesses in cooperation between stakeholders in the cold chain (R&D institutions, wholesalers, producers and other partners); and slow implementation of EU/UNECE quality standards.

e) **Available data and/or needed data that could help address the problem:**

The Serbian Ministry of Agriculture does not currently systematically collect data about postharvest losses. In 2006, the Ministry of Agriculture expressed an interest in formally quantifying postharvest losses by collecting data specifically relating to the Serbian fruit industry, but the initiative was never formally launched. However, the Serbian Ministry of Agriculture regularly estimates these losses in their Production, Supply and Distribution reports for Serbia's leading agricultural commodities (available on-line at <http://www.mpt.gov.rs/articles/view/310/1349/Bilansi.html>). It is important to note, though, that the methodology does not distinguish in the commodity balances between postharvest losses and other losses due to the gray market economy still present in the West Balkan region. Thus while losses for wheat are reported as 1.5% and for corn up to 4%, the Serbian Grain Association estimates Postharvest loss on a country-wide level to only be 0.5 – 1% for wheat and 0.5% for corn in elevators and 1-2% for corn that is stored on farm. In Serbia, half the corn is stored in elevators and half is stored on farm.

Similarly, the Serbian Fruits and Vegetables Association estimates that absolute losses are no higher than 10%, but the sector does suffer commercial losses from fruit that deteriorates in storage that has to be sold to the processing sector as it is no longer suitable for the fresh market.

This type of postharvest loss in the Serbian fruit industry could be as high as 30%. However, no detailed studies have been performed.

The Serbian Ministry of Agriculture recognizes postharvest loss as a serious issue, especially for fruits and vegetables. It has been supporting Serbian farmers and agribusinesses through various mechanisms since 2004. For example, the Ministry has provided subsidies (30-50% of the cost) for building cold storage facilities, controlled atmosphere warehouses and grain silos, as well as providing subsidies for HACCP certification for the facilities to monitor critical points in the food chain to increase food safety/quality and cut down on loss. Currently, Serbia's total refrigerated/frozen storage capacity is estimated to be 500,000-600,000 MT, of which 29 controlled atmosphere (CA) storage facilities account for 50,000- 60,000 MT.

During the last 5 years, Serbia's universities and extension service have begun to address some of the postharvest issues relating to diseases and pests that impact fruits and vegetables postharvest; the proper timing for harvesting fruit; the proper handling of fruits to diminish mechanical injuries to the fruit; the best hygiene practices and favorable storage conditions to decrease postharvest loss. However serious and knowledge transfer to farmers/agribusinesses still need improvement.

From 2004-2013, USAID and USDA provided extensive training, including creating postharvest management manuals to build local capacity and reduce loss, particularly in the fruit sector. U.S. and other international donor organizations in Serbia also have been working to improve the knowledge base of Serbia's agribusinesses, academia and extension service in the areas of integrated pest management for fruits and vegetables, food safety and HACCP standards, Good Agricultural Practice (GAP) for harvest and postharvest management. Still more attention is needed to increase the knowledge transfer from Serbia's universities to its county extension services and smallholder farmers. The biggest losses are registered by small family households, since they lack the resources to invest in cold/CA storage facilities. Also, the extension service faces significant challenges reaching such a large number of small producers to offer the GAP harvest/postharvest training and other tools to address this critical issue. Significant postharvest losses can also be attributed to poor logistics and marketing. Stronger, market oriented fruit and vegetable producers associations are needed to overcome these obstacles.

**f) In-country technology and innovation events and resources:**

- University of Belgrade, Faculty of Agriculture, Belgrade
- University of Novi Sad, Faculty of Agriculture, Novi Sad
- Institute for Science Application in Agriculture, Belgrade and Serbian State Ag Extension Service
- Fruit Research Institute, Cacak
- National Association Fruits of Serbia
- Serbian Grains Association
- USAID Mission in Serbia (former Community Revitalization through Democratic Action Project (CRDA) and Agribusiness Project)

## Tajikistan

- a) **Point of contact:** U.S. Embassy Dushanbe, Tajikistan
- b) **Country, region, crop:** Tajikistan, entire country, potatoes, vegetables, melons; northern provinces, apricots, pears, plums, apples, cherries, pomegranates, figs, nuts; Khatlon Province, wheat, barley, horticultural crops; Sughd Province/Khatlon Province/Gissar Valley, rice
- c) **People impacted by postharvest loss:** The people primarily impacted by postharvest loss are the "dehkan" farms (small and medium-sized peasant farms) which lose revenue on product spoiled during pre-market transit, processing and storage, as well as consumers, who find the supply of local produce significantly reduced in winter months due to lack of proper long-term storage facilities. Reduced supply can lead to higher food prices.
- d) **Description of postharvest loss challenge:** Postharvest losses can be seen through the entire value chain; from harvesting to processing. Losses are highest for vegetables and fruits, though cereals report a 15% loss rate as well. Outdated technology, lack of resources, and poor practices are the main causal factors for postharvest losses. Soviet-era harvesting mechanisms are outdated and in disrepair. Poor road conditions, inappropriate packaging and sub-standard transit equipment and facilities leads to additional spoilage during transportation. Rough handling, outdated equipment, and inappropriate packaging (using glass jars instead of plastic packages, for example) cause losses during processing. Lack of air conditioning equipment, ventilation, or warehouses capable of climate controlled storage leads to heat/frost-related spoilage. In many cases, farmers lack any sort of warehousing capacity, leaving produce exposed to losses from rodents, birds, insects and fungus. Most small and medium agricultural producers lack the equipment and skills to properly grade, sort, package, transport or market their products before they spoil. This is particularly true for oil crops, vegetables, and fruits.

The United Nations Food and Agricultural Organization (UNFAO) in Tajikistan recommends that farmers pool resources to construct communal climate-controlled storage facilities. The ability to store perishable produce for longer periods would smooth out the supply/demand curve and have significant benefits - at present farmers take all their produce directly to market at harvest time, resulting in a supply glut and price crash, followed by winter months with local produce in short supply. Cold-storage facilities would allow farmers to sell later in the season, keeping prices higher and extending the availability period in local markets. UNFAO recommends that producer groups pool resources, because the agricultural sector's access to external financing is extremely limited.

- e) **Available data and/or needed data:** Lack of reliable government-collected and maintained data remains a significant challenge. The first step to addressing any deficit is to analyze data and make recommendations to policy makers and private sector players. In Tajikistan, a USG Feed the Future focus country, basic, reliable postharvest loss data is not available.

Most data on postharvest losses is gathered by governmental entities, private industry or

international/local NGOs, but it is insufficient to properly quantify the problem. The only direct research found was completed by the Foreign Agricultural Office (FAO), which reported a postharvest loss rate for cereals equal to 15%. The State Statistics Agency has requested that "dehkan" farms (small and medium-sized peasant farms) submit information regarding their productivity using the FARMER-1 form. However, this form does not include a column for reporting losses. Data on postharvest loss of vegetables, fruits and milk, where significant spoilage occurs in long value chains, would be necessary to establish a baseline for addressing the structural problems. Surveys breaking down the key challenges by geographic region and climate belt, as well as cataloguing capacities of suppliers and processors would also be necessary. UNFAO believes that if data on losses were collected, it could spur the GOTI to invest in modernization of processing plants and warehouse facilities.

- f) In-country technology and innovation events and resources:** Tajikistan is a USG Feed the Future focus country. USAID is piloting an extension system targeting impoverished, smallholder farmers in the target area of implementation. USAID will work with the Government of Tajikistan to establish an Agriculture Implementation Support Unit within the Presidential Office to support policy analysis and evidenced-based decision making. This Unit would benefit from postharvest loss data and analyses. The Tajik State Agrarian University could also play a role as a technology and innovation resource.

**Sources:** United States Agency for International Development (USAID), the International Finance Corporation (IFC), Development Alternatives, Inc. (DAI), and the United Nations Food and Agricultural Organization (UNFAO).

## Uzbekistan

- a) **Point of Contact:** U.S. Tashkent, Uzbekistan
- b) **Country, Region, Crop:** Uzbekistan, fresh fruits, vegetables, meats, seafood
- c) **People Impacted by Postharvest Loss:** Producers, processors
- d) **Description of Postharvest Loss Challenge:** “Cold chain” refers to the supply and distribution of perishable agricultural commodities (such as fresh fruits, vegetables, meats, seafood, etc.) that must be kept within a defined temperature range throughout the post-production, transit, storage, wholesale, retail and home consumer cycle and the management of that cycle. If, at any time in the chain, a sensitive commodity is exposed to temperature and humidity outside the defined ranges, irreversible damage and spoilage can occur resulting in loss of product and profit, or rejection of an entire shipment. Assuring the integrity of perishable, temperature and humidity sensitive products along the critical control points of a cold chain requires comprehensive information management to protect financial interests and public health through better data documenting and auditing of the processes involved.
- e) **Available Data and/or Needed Data:** Governments generally do not collect this sort of data. Private enterprises involved in the cold chain for perishable commodities collect data but only on their own operations. Minimal sharing is practiced unless a dispute arises on the origin of damage.

Time series and cross-section data (i.e. panel data) on temperatures and relative humidity for produce and products by control point could be collected, trends analyzed, weak links identified and corrected, and results shared to reduce spoilage and loss all along the cold chain.

Only a handful of packers, cold store operators, transporters, wholesalers and retailers are presently monitoring their individual cold chains. Inexpensive “In-Transit Data Loggers” (ITDL) can monitor and record data to register how goods are treated, where lapses in the system are located and objectively determine failures at critical control points.

- f) **In-country technology and innovation events and resources:** Both single-use and reusable ITDLs record produce and product data from picking, packing, sorting, grading, transit, truck delivery routes, distribution centers, retail facilities, coolers and storage rooms. Loggers are easily cloud-enabled for retrieving, analyzing, storing and sharing on a central and secure web server with information accessible 24/7. Trip data and graphs could be produced immediately after the loggers are downloaded at the receiving facilities allowing receivers to take immediate action with a carrier if evidence of out-of-range conditions occur and take steps to reduce losses. Search, multi-graph views and other analyses will identify frequent temperature abuse patterns and improve the decision making process at the operational level.

## **Latin America and the Caribbean**

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

### ***Understanding the Problem***

Postharvest losses cause severe reductions in the quality and quantity of foods, affecting incomes and impacting the livelihoods of the rural poor in Latin America and the Caribbean (LAC). IICA conducted a screening survey during November 2012 and a follow-up on August 2013 to gather preliminary information from a sample of countries about the current situation regarding postharvest losses in LAC. The results indicate a diversity of commodities affected by postharvest losses from several causes. At the end of the report, a summary of the mayor challenges that LAC countries face to reducing postharvest losses is presented.

### ***Central American Region***

In Central America, IICA is implementing and administering the Red SICTA Project, an initiative financed by the Swiss Agency for Development and Cooperation (COSUDE).

The project carries out actions aimed at promoting the adoption of technological innovations by small-scale corn and bean growers, and at strengthening the Central American System for the Integration of Agricultural Technology (SICTA), which means that the project works closely with the national agricultural research institutes and the ministries of agriculture of each country in Central America.

The Red SICTA Project, together with its counterparts, conducts studies of the corn and bean production chains and encourages the evaluation, promotion and adaptation of technologies intended to reduce postharvest losses. These technologies include the mechanical threshing and shelling of beans and corn; the production of certified hybrid seeds; hermetically sealed bags for storing seeds; plastic covering to dry beans; the use of improved bins for storing corn; micro drying tunnels; plastic covering for beans; early harvesting for corn; and metal silos for grain.

## Guatemala

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

In Guatemala, postharvest losses have been reported in the fruit, vegetable and staple food crop sectors. However, except in the case of staple food crops, where some data is available, not enough information is available to quantify losses nationwide and their impact on the economy.

The greatest losses in staple food crops, mostly corn, occur in the northern region of the country (Ixcan, Polochic and El Peten) due to heavy rainfall and high temperatures throughout most of the year. This region is very important because it accounts for approximately 36% and 25% of domestic corn and bean production, respectively. However, postharvest losses in both crops can be as high as 50% at the farm level.

According to data obtained from the Purchase for Progress Program (P4P), being implemented under the IICA-WFP partnership, losses in corn in this region can be attributed to high humidity levels (19-21%) and the traditional practice of storing harvested corn in a structure known as a *troja comun* (a type of grain storage bin), where it is exposed to the elements, insects, diseases and animals. After four or six months in storage, losses range between 40 and 45%. In the case of beans, harvests are sold at once because growers lack the necessary storage facilities and because they require money immediately to support their families and continue farming.

The Red SICTA project mapped the corn and bean production chains and found that the bottlenecks identified at the postharvest stage in the four regions of the country (northern, southern, eastern and western) are similar and can be summed up as follows: the limited dissemination of information on good practices for grain storage, a lack of storage facilities and insufficient economic resources. Furthermore, it is necessary to define the problem and determine its scope, provide technical assistance, disseminate information on good practices and promote research and technological innovation aimed at reducing postharvest losses.

For more than 20 years, the Ministry of Agriculture, Livestock Farming and Food (MAGA), through its Postharvest Program, has been distributing metal silos, promoting their use and providing training on their construction. Initially, the program received economic support from the Swiss Agency for Cooperation and Development (COSUDE), but is now funded from the national budget.

The MAGA, in the section of its 2011-2015 Agriculture Policy that deals with the subject of food and nutritional security, tasks the Food Storage Department of the Office of the Deputy Minister for Food and Nutritional Security (VISAN) with undertaking strategic actions aimed at promoting the storage of staple food crops in order to ensure the food security of families. The policy does not contain specific proposals for other crops. For example, fruit farming generates 41,000 permanent jobs in rural areas, which contributes to the economy of the country and reduces poverty. Even though fruit growers report postharvest losses, such losses are neither quantified nor addressed.

## **El Salvador**

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

In El Salvador, the most significant postharvest losses occur in white corn and red beans (8%), with losses also being reported in rice and sorghum (6%). Postharvest losses in these four products, which are considered staple food crops in El Salvador, occur throughout the country because all farmers and ranchers grow at least corn and beans for their own use.

At present, small-scale corn and bean farmers account for most of the domestic production. They continue to apply certain postharvest practices which, in most cases, tend to increase postharvest losses. These include spreading grain on the ground, plastic or pavement to dry by exposure to direct sunlight, which adds to contamination and holds in moisture, and storing grain in places where humidity, insects and fungi cannot be controlled.

The Swiss Agency for Cooperation and Development (COSUDE) has been financing the Postharvest Program in El Salvador for 21 years. The program has provided small- and medium-scale farmers with access to storage systems which ensure that products will not be damaged and that there will be no loss of quality. According to COSUDE, one of the tangible results of this cooperation has been the distribution of 133,000 metal silos, which has reduced losses by some 11% and improved the food situation of 16% the rural population.

## Nicaragua

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

In Nicaragua, postharvest losses in staple food crops (corn, beans and rice) total at least 15%, and an even higher percentage in humid areas such as the Caribbean coast of the country. Added to problems related to climate is the poor quality of existing storage infrastructure, which does little to prevent contact with pests that damage stored crops.

Those most affected by postharvest losses are small- and medium-scale growers, who grow mostly beans and corn in the rural areas of the country. Because growers have limited resources and can invest little in their farms, one of the challenges they face is to find low-cost technologies that will solve the problem.

For corn and beans, most damage occurs immediately following the harvest, in the pre-drying and drying stages, so it is important for growers to have a place to store the harvest on the farm or even in their dwelling. Losses during storage (12-18%) are caused by insects, rats, fungi and humidity. When the products are not consumed by pests, they can be contaminated with excrement, which affects their quality and causes diseases such as leptospirosis in humans.

## Panama

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

The most significant postharvest losses in Panama, as high as 20% in corn and beans and 12-26% in tubers such as cassava, tiquisque (*Xanthosoma* spp.) and taro, are reported in the provinces of Chiriqui and Veraguas and the Azuero region. In the province of Chiriqui, losses of from 18 to 33% are reported for vegetables such as tomatoes, potatoes, onions, cabbage and lettuce.

Most vegetables and fruit in Panama are sold as fresh produce. Some statistics indicate that losses due to postharvest mishandling of products reach as high as 30% of total production, depending on the crop. If the amount of fruit and vegetables that are rejected because they do not meet market requirements is taken into consideration, losses rise considerably and can be as high as 60%.

Individual small- and medium-scale farmers account for most postharvest losses because they lack appropriate technologies for postharvest handling and treatment of products: the most serious problems are related to packaging, packing, transportation, the management of cold storage chains, etc.

In the case of mechanized rice production, when demand is highest during harvest time, mills face limitations in terms of receiving, pre-cleaning and, especially, drying the rice. Due to this lack of drying capacity, rice can remain on trucks for several hours or days, which has a significant impact on the quality of the grain as reflected by an increase in the number of stained and split grains.

Statistics unconfirmed by government agencies indicate that the non-mechanized production of rice, mostly on family farms, supplies 10% of national demand. All of this rice is consumed by those living in poverty and extreme poverty, who do not have the wherewithal to buy rice in traditional markets. There is little infrastructure and equipment in the country for handling and storing such rice.

One of the problems found in the postharvest handling of corn is that of ensuring the timely and proper use of drying and storage facilities in the country. In the case of beans, one of the challenges is to improve the efficiency of drying and threshing activities.

The government of Panama is working to establish a cold storage chain that will ensure the quality of products, via an integrated system, thereby reducing losses and maintaining safety and traceability.

The “Cold Storage Chain” project in Panama has two main components:

- **Integrated logistics system:** This involves the design, construction, equipping and implementation of the system, which includes the reception of products in collection centers, their preparation and storage under optimum conditions and the design of routes for the distribution of produce to marketing centers.

- **National network of markets:** Plans call for the construction of eight centrally located markets throughout the country that will have the infrastructure required to assure producers and consumers that the products they sell are safe.

***Andean Region***  
**Peru**

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

Postharvest losses in root crops, including potatoes, which are a staple for the rural poor, reach 40% in some areas of the Andean Region. Postharvest losses in grains such as quinoa, amaranth and barley range from 10 to 15%, while losses in corn, beans and wheat reach 15-25% on the lower slopes of the Andes. In the *Selva* and Coast Region, losses in yellow corn intended for human consumption and as feed for livestock range from 15 to 25%. In addition, losses in coffee held in storage are a problem in Peru, totaling up to US\$80 million in 2011.

Small- and medium-scale farmers and those in the family agriculture sector account for most postharvest losses because they generally do not have effective systems for storing their harvests. Damage to and deterioration of agricultural products during the pre-harvest and postharvest periods have an accumulative effect and occur successively at two levels, in the field and throughout the postharvest process: sorting, packing, transportation, storage, marketing, processing and packaging.

In Peru, there is no official detailed quantitative study or evaluation of postharvest losses in the principal agricultural products that would make it possible to determine the weaknesses of the producer-consumer chain, and the losses that occur in each link, and introduce necessary changes.

It is important to promote sound postharvest practices among producers and merchants, and to adopt technical criteria and standards related to the handling, packing, packaging and storage of products in order to minimize damage. It is also important for professionals responsible for establishing standards and regulations to train other professionals in basic postharvest principles; to provide technical assistance to producers; and to improve transportation, marketing and storage infrastructure.

## **Ecuador**

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

Ecuador reported losses of 25-50% for fruits and vegetables.

In the case of corn, a principal source of income and nutrition, postharvest losses range from 10 to 30%, for an average of 20%. The percentage of loss depends on how harvests are stored. In general, losses occur when the corn is stored unprotected in the producer's dwelling, which exposes it to rodents and insects.

In Ecuador, beans are one of the short-cycle crops that are viewed as strategically important for rural and social development, represent a long-standing production tradition and fulfill a role both as a source of nutrition and a contributor to socioeconomic development. Postharvest losses can reach 20%; 10% during the threshing process and 10% caused by insects and rodents.

In general, losses in quinoa occur at the level of the plant. When it is not harvested in time, there is a risk that the grain, when rain is present, will germinate on the stalk. This phenomenon is on the rise due to climate change, as evidenced by the fact that in recent years rain during the summer months has caused losses to be as high as 5%.

The National Storage Unit has been operating in Ecuador since 2008. Its functions include: to provide producers of staple food crops with comprehensive storage services, to lower the cost of marketing products for mass consumption, to increase the incomes of direct producers, with a view to encouraging more production of staple food crops and ensuring an uninterrupted domestic supply at favorable prices for both producers and consumers, and to provide at its facilities services related to receiving, storing, treating, conserving, safeguarding and sorting short-cycle agricultural products.

## ***South Region Paraguay***

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

In the Central Department and the urban areas of Paraguay, the principal crops grown are vegetables, sugar cane and fruit such as tomatoes, pimento, onion, strawberries and bananas. In the rural areas of the other 16 departments, these crops include roots and tubers (cassava, sweet potato, potato), fruit (banana, watermelon, cantaloupe, orange, pineapple, tangerine, grapefruit), legumes (peanut, beans, peas, broad beans), oilseed crops (soy, sunflower, canola, tung, sesame, spurge) cereals (wheat, corn, rice, sorghum) vegetables (carrot, garlic, onion), sugar cane, yerba mate and stevia.

Paraguay has no studies or official data on postharvest losses for its principal crops. However, unofficial data indicate that the crops most affected are horticultural products, with losses ranging from 8 to 15%, strawberries (12%), and cereals and oilseeds (approximately 5%).

Small- and medium-scale farmers, and those in the family agriculture sector, account for most postharvest losses because they do not have access to the infrastructure and technology needed to prevent losses caused by pests and diseases, to information and support networks or to different types of insurance available today.

Small-scale producers can lose up to 50% of a harvest, while medium- and large-scale producers can lose between 5 and 20%, a difference that can be attributed to the fact that the latter have the infrastructure, technology and information they need during the harvest and postharvest periods. For example, large companies that produce soybeans, cotton, wheat, rice and corn have specific studies on losses that occur in different links within the chain.

The MERCAAGUAZU is implemented in the Department of Caaguazu. This market has a system for classifying products for packaging, cold storage chains and good practices, to reduce postharvest losses, and is based on market studies of some twenty agricultural products which evaluate the number and characteristics of farms per district, the main agricultural crops, the distribution of farms by size of crop, the distribution of producers by crop, the area under cultivation by district; land tenure issues, and the characteristics of producers, etc.

Paraguay must first conduct a preliminary assessment of the problem, which will involve a study of the entire production chain of each crop to identify the most important points in need of improvement. One of the first steps will be to link governmental institutions, trade associations and production cooperatives, which, once the problem has been defined, can formulate strategies, monitor activities and propose standards for postharvest handling based on good agricultural practices (GAP). It will also be necessary to ensure that producers receive instruments and tools for postharvest handling (as part of good practices); to facilitate access to infrastructure, training and market information; and to encourage the establishment of efficient production chains that involve as few intermediaries as possible.

Other challenges to be overcome are: the need for producers to have access to long- and short-term weather forecasts, in order to mitigate its effects and adapt postharvest management to prevailing conditions; the creation of a line of insurance policies to cover postharvest losses for family agriculture as well as small-, medium- and large-scale producers; the dissemination, via information networks, of early warnings on sanitary issues and extreme weather events to all participants in the production chain; and research aimed at reducing postharvest losses.

***Caribbean Region***  
**Trinidad and Tobago**

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

In Trinidad and Tobago the products presenting the greatest postharvest losses, according to production regions are:

- Victoria: tomato, hot pepper, papaya, pumpkin, pineapple, cassava.
- St. George: cassava, sweet potato.
- Caroni: tomato, hot pepper, papaya, pumpkin, cassava, sweet potato.
- St. Andrew and St. David: tomato, hot pepper, papaya, pumpkin, watermelon.
- St. Patrick: hot pepper, watermelon.

Postharvest losses for tomatoes are estimated to be 24% to 35% in the wet season and dry seasons respectively. The losses have been attributed to the cultivar, the market type and the seasonality of production.

Similarly, peppers destined for export faced losses of 39% to 52%. Losses during marine shipments of pumpkins to North America were reported to be as high as 55% and on numerous occasions, as much as 100%.

The people most impacted by postharvest losses are smallholder, small-scale farmers, consumers, wholesalers, produce managers, supermarkets, roadside vendors, exporters, and mobile vendors; in short, postharvest loss impacts from the small-holders, roadside vendors, supermarkets to the final consumer.

Generally, due to labor shortages during periods of harvest, produce is sometimes harvested in the latter parts of the day when field temperatures reach as high as 30 - 33°C. In most instances, once harvested these commodities are not protected properly from direct sunlight which overheats the produce, causing transpiration and evaporation. Mechanical injury during transportation, often invisible, further shortens the shelf life. There is often a lack of affordable harvesting crates that are suitably designed to minimize damage to harvested produce. With little or no precooling, shelf life is reduced. It is particularly important to maintain the cold chain for fruits and vegetables destined for export markets but this is often a major challenge.

Postharvest losses in pumpkin are commonly due to:

- The application of excessive levels of poultry manure during growth and development;
- The failure to recognize and implement appropriate maturity indexes, resulting in mixed batches of immature and mature fruits;
- Fruits being overloaded in trailers or pick-up trucks in heap piles which are transported over poor quality roads;
- The failure to implement fruit curing protocols;
- Rough handling during the loading and unloading operations;

- Packaging of fruits in poorly ventilated polypropylene “feed bags” which thereby promote heat build-up and condensation that leads to softening and decay;
- Inadequate sanitizing of the fruit surface with chlorinated water; and,
- Frequent inclusion of known culled fruits with physical and pathological infections to meet shipment quota.

In many instances some or all of the following are factors contributing to the postharvest losses of fruit:

- Fruit maturity and the absence of harvesting guidelines associated with maturity indexes;
- Rough handling during harvesting, resulting in physical injuries and secondary infections;
- Fruits being thrown at field collection points;
- Collection of fruits in heaps at row ends and placing fruits directly on soil surfaces;
- Over packing of fruits in field containers;
- Limited protection of fruits prior to and after harvest operations;
- Poor sanitary conditions at packinghouse;
- No precooling of fruits;
- No application of sanitizing agents on fruits;
- Poor stacking methods in packinghouses and retail and wholesale markets;
- Limited use of refrigerated storage facilities;
- Storage of fruits at low relative humidity and absence of wax application;
- Susceptibility to chilling injury particularly for fruits marketed by supermarkets; and,
- Limited protection of fruits at roadside markets against climatic conditions and environmental pollutants.

Cassava suffers from significant postharvest problems as well, due to the fact that small farmers are still harvesting it manually using low technology (machete or more often, a fork) and human force to pull plants, which breaks the roots and reduces its commercial value. In the last 10 years midsize and large-scale farmers have adopted semi-mechanical harvesting techniques to facilitate harvesting. However, its impact on postharvest losses has not been quantified.

Sometimes cassava roots are harvested when they have passed their maximum maturity and they begin to lose starch. They are often left in the sun while completing the harvesting process. Moreover, cassava has a short shelf life of 3 - 5 days before they undergo internal oxidation and begin to blacken. Some waxing is practiced at NAMDEVCO but not on a continuous basis. Harvested roots are transported in bags and are typically handled with minimum care. In most instances, the overfilling of jute bags (over 200lbs) results in compression damage. Mishandling or injuries during harvesting are two of the major causes of physical damage to cassava roots. Similar conditions exist for sweet potatoes.

Other challenges that Trinidad and Tobago face in reducing postharvest losses include identifying the critical points and assessing the seasonality of production, the socioeconomic factors, and the reliability of data.

## Haiti

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

In Haiti, loss of basic food crops such vegetables, fruits, roots and tubers, cereals, and legumes are reported to be as high as 35%. The main crops impacted by postharvest losses according to their corresponding production region are the following:

- Salagnac: lettuce, cabbage, carrot, citrus, guava, yam, sweet potato, potato, beans, maize, coffee.
- Leogane: spinach, mango, citrus, sweet potato, cassava, beans, maize, banana
- Arcahaie: watermelon, mango, sweet potato, cassava, beans, rice, banana
- Camp-Perrin: spinach, eggplant, citrus, mango, pineapple, cherry, sweet potato, cassava, beans, maize, peanuts.
- Beaumont: cabbage, lettuce, carrot, guava, citrus, mango, yam, sweet potato, beans, maize, coffee.
- Kenscoff: carrots, cabbage, lettuce, spinach, tomato, broccoli, citrus, guava, soursop, potato, yam, dasheen, sweet potato, beans, peanuts, coffee, bananas.
- Artibonite: lalo (*Corchorus olitorius*), tomato, eggplant, onion, mango, sweet potato, cassava, beans, rice.
- Dondon: yam, potato, coffee, cocoa.

All stakeholders are impacted by postharvest losses. Urban populations are particularly impacted by losses due to the incapacity to send products to the market.

Farmers, usually smallholder farmers, have to overcome the lack of transportation and of rural roads. Sometimes they have to carry their products to the market using animals, such as donkeys or even horses. When there is transportation, the bags or baskets they use to package the crops are inappropriate or unsuitable, especially when transporting vegetables and fruits. The postharvest period continues even once products reach the market. Those crops that have been affected during transportation are rejected by retailers and the price of the others is considerably reduced. This lack of infrastructure is a major challenge.

Inappropriate technology in management and manipulation of the harvesting is also an important constraint. For roots and tubers, postharvest losses are mainly a matter of inappropriate storage systems which promote the reproduction or multiplication of parasites, such as insects, nematodes, and fungi.

In Haiti there is a need for surveys and data to sufficiently document the issue of postharvest losses, market data and socio-economic measurements, as well as technology that provides adequate knowledge about the seeds and other planting materials.

## **Saint Lucia**

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

Throughout the island of St. Lucia, the bulk of postharvest losses occur around the production of vegetables, pineapples, cocoa, cassava, and bananas. The problem is considered severe with unofficial estimates indicating that approximately 30% of total production is lost after harvesting.

Postharvest losses in the above-mentioned crops impact the various demographic groups within the country in varying ways. Smallholder and large-scale farmers are affected directly by the loss of income as a result of crops which cannot be sold. In the case of vegetables and pineapples, the country is negatively impacted by the loss of foreign exchange, due to the large volumes of imports to compensate for lower supply volumes. In some cases, rural and urban populations are affected by higher prices paid for imported vegetables and pineapples, or for produce during acute shortages. In the case of cocoa, cut flowers, cassava, and bananas, there are also indirect negative impacts such as reduced employment, especially in rural communities, due to the inability of farmers to maintain the profitability of their farms.

While the postharvest challenge has many facets which vary from crop to crop, some critical aspects in Saint Lucia are consistent across all crops. One of the main limitations is the lack of adequate storage facilities, refrigerated or otherwise, for agricultural crops after harvest. Most crops go directly from the field to the market and due to their perishable nature, losses increase for the crops with shorter shelf lives. This problem negatively impacts export crops which must await the arrival of transport carriers (by air or ship). Many losses are incurred when there are delays in arrival, since the crops are not in storage facilities while they wait. The majority of produce comes from smallholders who rely heavily on seasonality for their production scheduling. This means that most years are characterized by periods of scarcity and gluts, especially for vegetable crops. During periods of gluts, postharvest losses are particularly heavily due to the lack of adequate storage facilities. In the case of cocoa, where demand far outstrips supply and most of the cocoa is sold in its wet form, postharvest loss mainly results from poor knowledge among producers of the management of the maturity indexes for the various varieties. Some varieties are often left on the trees for too long.

Postharvest losses of cassava are particularly severe when the onset of early rains coincides with harvesting. In recent years, erratic rainfall has created enormous problems for cassava farmers and their communities. These problems are compounded by poor road networks in most rural areas, which cause bruising of harvested crops, and poor knowledge among farmers of the postharvest treatment of crops (packaging, control of temperature, humidity, etc.)

The lack of any systematic gathering, analysis, and use of data complicates the implementation of immediate solutions to some of the postharvest problems. Limited data on the market demand makes production scheduling by farmers difficult. Most farmers look for unscientific signals to determine when to produce any particular crop. IICA has begun assisting Saint Lucia in the establishment of an Agricultural Marketing Information System (AMIS), but this remains a work

in progress and funding for all its components has yet to be identified. Data is required for all aspects but primarily for production and marketing data. There is also a need to establish an effective market surveillance system. Policy information and socio-economic measurements are readily available from the National Statistics Department.

The human resources are readily available as there is a Ministry for Agriculture with research, propagation, and extension departments. There is also a statistics department and other support agencies for the agricultural sector, as well as a vibrant private sector for trade in agricultural produce. The use of modern technologies is still lagging in many aspects, especially as it relates to information and communication technologies, which can simplify and enable more efficient services from agricultural and rural service provider agencies to reach producers and rural and urban communities. There has been some training of farmers, agro-processors, and agricultural technicians. There is a continuous need for more, although financial resources are lacking. Plans already exist for the construction of a national clearing house for agricultural produce but funding has not yet been identified for this activity and it is not clear when it will happen.

### **Challenges to LAC countries to reducing postharvest losses**

*Prepared by the Inter-American Institute for Cooperation on Agriculture (IICA) for the US Department of State (September 2013)*

From the information provided we are able to identify a series of common situations and challenges confronting the agricultural sector when seeking to reduce postharvest losses in the Americas. We present these here with suggested options for addressing them.

1. The lack of scientific and consistent information on postharvest losses needs to be addressed in general in the region. There is a need to conduct national surveys and studies to provide a better understanding of the problem along the different value chains to be able to value the economic costs and to identify potential solutions.
2. The consistent lack of access to cold storage facilities across the region by producers is a major contributor to postharvest loss of fruits and vegetables. Establishment of an effective “cold chain” to preserve fruits and vegetables, especially those destined to export markets would contribute significantly to reducing associated losses.
3. The means of drying and storage of basic grains is essential to ensuring quality and reducing losses due to high humidity, plant pests, and general deterioration. Most small and medium producers, the principal producers of basic grains in the region, do not have ready access to low-cost, drying or storage facilities. This lack of local drying and storage facilities contribute significantly to postharvest losses. Many potential solutions are being tried in different regions, including small metal storage facilities, plastic based storage products, among others. Many of these are being made available by the private sector. Also, many low- technology low-cost processes have been developed by farmers themselves which are being identified and shared among producers.
4. Appropriate infrastructure for ready access to markets also contributes to postharvest loss in the region. Low quality roads, high costs of transporting products to markets, and lack of access to ports and information increases losses when sending product to export markets.

5. Lack of appropriate technologies and innovations related to reducing postharvest losses imply that there is a need to promote and finance greater research and technological innovation at the public and private level, to reduce postharvest losses.
6. Lack of access to credit, infrastructure and appropriate technologies contribute to postharvest losses. Often producers do not have ready access to the money needed to reach markets or to invest in needed improvements or new technologies that would reduce their postharvest losses. It is also not evident due to lack of studies and supportive information that investments will provide the needed returns associated with reduction in losses. Therefore there is a need for greater technical assistance, information, appropriate technologies and credit in order for the needed investments to take place to enable postharvest loss reduction.
7. Lack of access to adequate technical assistance and dissemination of good agricultural practices for farmers in the areas of harvesting, packaging, transport and storage of products is another area which is essential for achieving reductions in postharvest losses.
8. There exist little meteorological information available to farmers or warning systems related to extreme weather and its potential impact on products postharvest.