

Developing a Supply Chain for Hermetic Storage of Grain in Afghanistan
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Narrative – The PICS initiative in Afghanistan started in September 2011. It was based on successful use of PICS bags for storage of a wide range of grains in Africa and the development of profitable local businesses there supplying bags to farmers, traders and consumers. The overall objective of the initiative was to lay the groundwork for development of a supply chain for hermetic grains storage bags in Afghanistan. The specific objectives were to identify cost competitive manufacturers for hermetic grain storage bags, to develop a plan for wholesale and retail hermetic storage bags distribution systems, and to launch the manufacturing and distribution by making a bag order and selling it through the system. The main partner in this effort was the Afghan Agricultural Extension Project (AAEP) funded by USDA and led by the University of California Davis, and its extension partners in the provincial Directorates of Agriculture, Irrigation and Livestock (DAILs). The activities of the project are documented in detail in eight quarterly reports; this final report is intended only as a summary.

The staple grain of Afghanistan is wheat. In most areas the wheat harvest occurs in May and June. Some grain legumes are harvested later in the summer or in early fall (i.e. July, August, September, October). With a mid-September 2011 launch date it was impossible to manufacture bags and pilot test the supply chain for the 2011 harvest. It was necessary to wait for the 2012 harvest. The initial activities of the project were to search for local manufacturers and to study the supply chain for agricultural inputs.

A survey of agricultural input suppliers in the December 2011 to June 2012 period showed that many farmers buy some agricultural inputs and that in most areas there is a well-developed system of private business ag input retailers. For example, in Nangarhar province data indicates that 92% of households purchased urea fertilizer. Typically, the Afghan ag input supply businesses had wholesale warehouses in capital cities which served retailers in the villages. Most of the retail shops were independently owned and operated, but the wholesale distributors owned and operated some village retail shops. The wholesalers prefer to sell “cash-and-carry, but do provide some credit for long term, trusted customers.

Several factories in Afghanistan were identified with the capacity to produce either the woven sacks or the polyethylene liners, not one factory was found which produced both. Shindand Plastics and Heray Ansar Plastic Materials, both located in Herat, expressed interest in producing PICS liners and manufactured some samples in early 2012. In both cases the quality of the sample liners left much to be desired. In particular, the thickness of the plastic was not uniform and a high percentage of low density polyethylene appeared to have been used. Given those quality problems, AAEP decided to import PICS bags from Lela Agro, Kano, Nigeria, for its tests and extension demonstrations in 2012.

Information collected by AAEP staff in early 2012 also raised doubts about the accuracy of published grain storage information available about Afghanistan. Much of that grain storage information dates from before the Soviet incursion in the 1970s and has not been updated. In a quick appraisal AAEP staff found that a high percentage of wheat was stored in woven bags, the use of the traditional “Kundu” mud brick storage bin was rare except in the Nangarhar area, and some storage insecticide was used. That quick appraisal also suggested that storage losses in Herat

were low and in Nangarhar storage losses were quite high, with the Balkh area at an intermediate level of grain storage damage. This information raised questions about the economic viability of the PICS bag business in Afghanistan and the AAEP plan to focus extension activities on grain storage.

To better understand the Afghan grain storage situation and the need to grain storage extension efforts, AAEP conducted a survey of on-farm grain storage practices and collected data on pest damage in wheat. A total of 200 randomly selected farmers were surveyed in 2012, 50 each in Balkh, Herat, Kabul, and Nangarhar provinces. During the last three years, the farmers each stored about 2.5 tons of wheat for home consumption, seed, and sale. In Nangarhar, about half of the farmers report storing corn and/or rice. In Mazar, half report storing barley. About one-quarter of the farmers in Herat and Kabul report storing beans. Ninety four percent of respondents store wheat in woven bags. Eighty one percent of the respondents report wheat storage losses. On average, about 40% of them say that insect damage is the most important reason for storage losses. In Nangarhar, over 90% of the respondents identified insects as the most important reason for storage losses. Overall, about 20% of respondents use storage pesticides to control losses; the use of pesticides is much higher in Nangarhar, where 70% report using storage chemicals.

The on-station and on-farm storage trial objectives were: 1) collect evidence of pest issues of stored wheat in Afghanistan, 2) evaluate performance of PICS and woven polypropylene (PP) bags in protecting grain during storage and 3) identify regions where grain storage pests are major issues. On-station and on-farm trials were done in Nangarhar, Balkh and Herat Provinces. Station results typically mirror the results observed in on-farm trials. In the PP bags insect damage and decreasing germination after several months of storage was observed everywhere. Decline of grain quality after storage was most pronounced in the Nangarhar area. For example in the Kozkonar District, after six months of storage the number of insect holes in wheat grains increased over 20% and germination declined by 35%. In Herat the increase in number of insect holes after storage in PP bags was less than 5% and germination declined about 10%. The results in Balkh were general intermediate between Nangarhar and Herat. The hypothesis is that the greater deterioration of quality in Nangarhar is related to the lower altitude and higher temperatures. On average, PICS bags performed much better than locally-available PP bags in on-farm trials than in station trials. When properly closed, wheat in PICS bags showed negligible insect damage and the decrease in germination was generally below 10%.

For grain legumes, the PICS bags advantage was clear. Mung beans going into storage trials had no insect holes. At the end of six months mung beans in the local bags had 25 holes per 100 grains, but mung beans in PICS bags still had no holes. At the beginning of storage trials mung beans had an 80% germination rate. At the end of six months germination rate for mung beans in local bags was down to 50%, while in the PICS bags it was 78%. Results for cowpea and common beans were similar.

Based on the survey which showed substantial amounts of grain being stored on farms and substantial storage damage for grain legumes in general, and for wheat and other cereals in the Nangarhar area, a pilot test of the PICS bag supply chain was planned. 10,000 bags were produced by Shindand Plastics, Herat, at a cost of \$3.05/bag. In Africa the manufacturing price for PICS bags is usually between US\$1-US\$2. The higher cost of the bags in Afghanistan is attributed higher transport and electricity costs, as well as a risk premium due to wartime conditions. The

liners were produced in Herat and the woven sacks were imported. AAEP purchased 3,300 of those bags for their extension activities and the rest were paid for with the DIV funds. An arrangement was made with NAG- Noor Herawi Brothers Company (NAG-NHBC) to sell the bags. NAG-NHBC has 300 shops in 19 provinces of Afghanistan. PICS bags were sold through NAG-NHBC their showrooms in Herat, Mazar-e-Sharif, Jalalabad and Kabul, and retailed to villages shops in the four AAEP target areas. The retail price of the bags was 200 Afs (about US\$3.53).

A voucher program was organized by AAEP to help lower the barriers to PICS bag adoption by farmers. The concern expressed by partners in Afghanistan is the recent history of free agricultural inputs makes selling farm inputs in Afghanistan difficult and the increased cost of PICS bags versus the traditional bags may psychologically be too big a jump in storage costs at one time, even if calculations indicate that it is worth it with respect to saved grain. Farmer participants in AAEP grain storage demonstrations received one voucher per adult, which entitled them to receive a free PICS bag from a participating NHBC outlet. They would also receive a second voucher that allows them to purchase up to 25 additional bags at a private merchant for 135 Afs (US\$2.37). The voucher plan is similar to the coupons that US manufacturers often provide to consumers when they launch new products. PICS partners in Africa have implemented similar voucher programs. For example, Catholic Relief Services (CRS) created a voucher system for PICS bags in Niger.

The results of the pilot test of the PICS supply chain is that AAEP distributed 2651 PICS bags for free via extension demonstrations. Six hundred and four bags were sold at the full price to NGOs in the Balkh area. No bags were sold for the discounted price of 137 Afs. There are 6,741 bags in inventory with NHBC. An assessment of the PICS supply chain market test shows that many farmer and traders appreciated the high quality of grain stored in PICS bags, but they could not bring themselves to pay even the 135 Afs (US\$2.37) voucher price. Interviews with bag retailers suggest that some bags might be sold at 100 Afs (US\$1.75), but they would sell well at 50 Afs (US\$0.88) per bag. NHBC due diligence indicates that the manufacturing cost might be reduced by manufacturing in China; a price of US\$1.70/bag delivered to Herat or Kabul was cited. Given the need for a retail margin of at least around 30 Afs/bag, this suggests that it will be difficult to sell bags below that 100 Afs price threshold unless manufacturing and transport costs can be cut.

A high value use for hermetic storage that was identified due to the PICS initiative is the storage of dried fruits and nuts from the farm until final consumer packaging. The PICS team has been working with Morvarid, a company that processes dried fruits and nuts in Herat. Morvarid used some standard PICS bags and found them very effective, but also too expensive for their cost structure. Purdue faculty are working with Morvarid to determine if a modified bag (e.g. one polyethylene liner) might be adequate for dried fruits and nuts.

The PICS team and AAEP are considering next steps in Afghanistan. Several NGOs and donor organizations have contacted AAEP about purchasing PICS bags. For example, the USAID funded Afghan Agriculture Research and Extension Development Program (AGRED) is conducting on farm trials with PICS bags in 10 villages in Herat Province. The hope is that the current inventory of PICS bags can be sold to these NGOs and donor organizations. PICS bags distributed for free to farmers by NGOs and donor projects spread awareness of the technology, but free bags are counterproductive to the development of a for-profit distribution system. The small number of people trained in the use of PICS bags for hermetic storage means that there is very limited awareness of the technology in Afghanistan. For comparison, in West and Central Africa 1.6 million farmers in almost 31,000 villages were directly involved in PICS demonstrations and

millions more have been reached by radio, TV and other media. Options being considered by the PICS team include:

- 1) Find lower cost manufacturing and transportation for the PICS bags,
- 2) Identifying a lower cost bag design that is adequate for Afghan conditions and the products to be stored, and/or
- 3) Extension education to help Afghan farmers, traders and consumers better assess the monetary and nutritional value of improved grain quality.

Indicator Table – Final Report

Number of bags sold by category of purchaser (e.g. NGO, ADT, farmers, grain traders) :	604 bags sold to NGOs for demonstrations with their clients in the Balkh area. 3300 purchased by AAEP for their grain storage extension activities.
Percent of farmers in the project catchment area trying PICS bags by gender and type of grain:	2651 bags were distributed for free by the AAEP project, one per household. That is 661 bags in Balkh; 1130 bags in Herat; 443 bags in Nangarhar and 417 bags in Kabul Province. If the AAEP target provinces are the “catchment areas” then the percent of rural households trying bags are about: Herat, 4%; Balkh, 2%; Nangarhar, 0.2% and Kabul, 6%. Almost all the free bags were claimed by men at public PICS demonstrations, but most of the households involved have women members. Twenty two bags were given directly to women who were part of a women’s group in Herat Province. Most of the PICS bags are used for wheat, but some storage of mung beans, common bean, cowpea and other grain legumes is occurring.
Cost of PICS bags broken down by manufacturing, transport, handling costs, etc.:	Shindand Plastics in Herat is offering a price of \$2 for a run of 10,000 to 20,000 bags. Triple layer bags are available from Dubai or China for \$1.70 delivered to Kabul or Herat. This compares to the first manufacturing run with a cost \$3.05/bag in Herat, Afghanistan. One important factor in the total cost is the cost of importing the outer woven bags. Noor Brothers handled the bags for AAEP for a flat 17 Afs (~US\$0.30) per bag. That is only 8.5% of the full retail price. It is likely that in the long run the retail margin would be higher than 17 Afs/bag. Manufacturing would need to be below US \$1.45/bag to get retail price below the 100 Afs retail price point. For comparison, in Africa manufacturing costs of about US\$1/bag has been seen in Accra where the factory is close to the port and raw material transport costs are at a minimum. In addition because of the availability of hydro power, electricity is relatively low cost and reliable in Ghana.

Percent physical loss of wheat in storage using traditional methods and using PICS bags:	General estimates in the literature for Afghanistan range from 25% to 35% of farm stored wheat is lost. On farm trials showed losses in PP bags exceeding 25% in some districts the Nangarhar area, but much lower in Herat and Balkh.
Percent value loss of wheat in storage using traditional methods and using PICS bags:	Official market price information is for average quality only, not by damage level. However, when wheat stored in both PICS Bags and the Traditional Woven Bags was taken to the market in Nangarhar Province there was a 10 Aft/kg difference (20 Afs/kg for wheat stored in PICS bags and 10 Afs/kg for wheat stored in the Traditional bags) in the amount the buyers would pay. In Balkh Province the difference was a little lower than in Nangarhar (15 Afs/kg for wheat in the Traditional bags and about 18 Afs/kg for the wheat stored in the PICS bags).
Increase in farmer income associated with using PICS bags:	There are many anecdotal accounts. For example - One farmer in Karokh District of Herat Province reported he lost 10-15 kg of cowpeas in traditional bag. In the 50 kgs he had stored in the PICS bags he was offered 35 Afs/kg shortly after harvest and after six months he sold the remainder of the crop for 112 Afs/kg. This represents a 3,850 Afs (about US \$68.75) profit for just 50 kgs of cowpeas.
Estimated commercial demand for PICS bags based on farmer experience in pilot testing:	Numerous NGOs, seed companies and food processing firms have expressed interest in the bags. Price of the bag is a key issue. Price point on the bags is 100 Afs (~US\$1.75).
Number of farmers trained by gender as reported by project partners:	As reported by AAEP there have been 4981 people in Herat, Kabul, Nangarhar and Balkh Provinces in AAEP grain storage training. The largest number was in Herat Province where the AAEP grain storage effort is based. Of the participants 4391 were male farmers, but included in that estimate are 45 females, 114 Extension workers, 12 NGO staff, 383 students and 43 representatives of private companies and other organizations which have shown an interest in PICS bags. Of the participants 79 were women, including 38 farm women.