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# POST-HARVEST HANDLING AND STORAGE OF FRUITS & VEGETABLES

KOSOVO CLUSTER AND BUSINESS SUPPORT PROJECT



**October 2006**

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# POST-HARVEST HANDLING AND STORAGE OF FRUITS & VEGETABLES

THIS REPORT DESCRIBES THE ASSISTANCE PROVIDED TO FARMERS IN PERFORMING GRADING, SORTING AND PACKING OF FRESH PRODUCTS DESTINED FOR PROCESSING THAT REQUIRES STANDARDIZATION THUS ENHANCING THEIR VALUE-ADDED CONTENT

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Kosovo Cluster and Business Support Project – Post Harvest Handling and Storage of Fruits and Vegetables  
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## PURPOSE OF ASSIGNMENT

The primary avenue toward creating more employment and higher incomes in the Kosovo fruit and vegetable sector of the agricultural economy is to assist associations and companies become more vertically integrated. This can be accomplished by enhancing the value-added content of their existing products and by creating new products, which will then allow them access to new markets. The first steps in this process are to perform grading, sorting and packing of fresh products or products destined for processing that require standardization. The second step is to create alternatives to immediate post-harvest sales or processing, when market prices are depressed, through cool or cold storage.

The purpose of the assignment is to continue assistance in both of these areas, post-harvest handling and storage establishment, which were initiated in the past year by the KCBS Project. The original group of beneficiaries of this assistance will be doubled from three to six.

## BACKGROUND

Currently, the output in Kosovo of fresh or processed fruits and vegetables able to compete in the marketplace is extremely limited. The only place domestic products retain favorable acceptance is in the traditional open green markets. Domestic products are not exported regionally or internationally because they do not meet the basic standards of sizing, color, shape, maturity, packaging, labeling, etc. This is true for products for the fresh market as well as products destined for processing. Unfortunately, the result is that domestic products have lost market share locally to imports and, at the same time, have not penetrated export markets. Further impeding expansion of this sector is the nearly total lack of storage facilities to maintain product integrity. All of this must change if the Kosovo fruit and vegetable industry is to survive and expand.

To assist fruit and vegetable associations and private entrepreneurs who are interested in improving their products' qualities, the KCBS Project engaged a specialist in post-harvest handling and storage requirements. As much as possible, the consultant worked to enhance the efficiency and effectiveness of existing equipment, while proposing new cost-efficient equipment when necessary. The most important aspect was to provide designs of integrated systems combining manual labor and equipment to solve as many post-harvest bottlenecks as possible. The consultant provided multiple sourcing options, including installation and maintenance cost, based on cost benefit analysis.

# EXECUTIVE SUMMARY

The fruit and vegetable sector of the agricultural economy of Kosovo has tremendous potential. There is ample land for production expansion and good technical knowledge of production methods. However, if the ability to increase agricultural production, with resulting higher incomes and employment is to be realized, farmers, associations, groups of farmers and companies in the sector must become more vertically integrated.

To accomplish this, linkages must be developed between the growers and those new markets offering outlets for increased sales volumes and higher prices. Higher prices for fresh fruits and vegetables require improved quality. High quality can only be achieved through proper grading, sorting, packing, storage and handling of fresh fruits and vegetables but requires a certain level of new technology to accomplish it.

There is very little postharvest technology applied to fresh fruits and vegetables in Kosovo and also very little understanding of the need for improved handling of produce. In the past the marketing system did not require differentiation of quality levels although the concept is understood to some extent by some participants in the production/marketing chain. Growers harvest their crops, take them to market and hope for a good price before the produce deteriorates. They have not known any other way to market.

The KCBS project is developing new linkages for local and export markets for fresh and processing fruits and vegetables. To enable growers to participate in these market opportunities, new technology has been introduced and the growers trained in its use.

The technology needed is simple grading, sorting and packing methods that adequately meet the needs of the growers for achieving the quality levels necessary for new, high-value markets.

During the first phase of this assignment, visits were made to the target associations of the project to develop an understanding of the needs of the growers. Plans for tables for grading, sorting and packing fresh fruits and vegetables were drawn up and sent to a carpentry shop to be built.

The second phase of the assignment was to take the tables to the associations and train the growers in their use. Some of the growers responded well to the technology and understand the importance of employing it. Over sixty growers attended the training sessions and about half of them are expected to adopt the new technology

As when any new technology or concept is introduced, there are those who will adopt it, those who will "wait and see" and those who may never adopt it. To ensure that the technology is adopted by some of the more progressive growers and as an impulse to generating new and viable market linkages, a proposal is under consideration to provide tables to some of the more progressive growers. This is a good plan and should definitely be pursued to get the improved marketing system off to a sustainable start.

In addition to the grading, sorting and packing tables, a single-wheeled cart was introduced to make tomato-packing greenhouses more efficient. Some growers have also expressed interest in using the carts for harvesting and packing field grown tomatoes.

Other growers and companies requested information on equipment and technology. This information, described in the body of the report, was provided. Other technical assistance, also described in the report, was provided to produce processors.

# FIELD ACTIVITIES TO ACHIEVE PURPOSES

## PHASE 1: 14 - 24 AUGUST 2006

### ***14 August 2006: KCBS Project Office, Wholesale Green Market in Fushe-Kosova and Agroproduct Company in Podujeve***

The consultant was brief by the F&V Cluster team on the current status of postharvest handling of fresh fruits and vegetables from farm to market and the project objectives with regard to improving the handling and storage systems currently employed by local growers.

The briefing also included a discussion of the collection, handling and sale of blueberries. Wild blueberries are picked in the mountains and brought to collection centers where they are sold “farm gate” to local and regional buyers. Some collectors sell directly to buyers from Serbia. There are three collection centers where everything is sold fresh with no attempt at sorting the product.

The consultant then visited the local green market in Fushe-Kosova – Pristina and made the following observations:

- Tomatoes are packed two layers in wooden boxes with large fruits on top and smaller fruit on the bottom. This practice is apparently not so much to hide the smaller fruits, but for convenience of packing. The only drawback to this packing is the slight damage done to the top layer of fruits as they press against the thin wooden slats on the sides of the box.
- Tomatoes with calices attached are packed on the top layer of some boxes. This practice serves to make the tomatoes more presentable to the buyer and shows that there is some awareness of the value of good presentation of the product. The price differential for this was not clear.
- Potatoes, peppers, onions and small tomatoes are offered for sale in plastic net bags. Other products are displayed in wooden boxes or recycled cartons such as banana cartons or cartons in which imported produce was received.
- All produce is well displayed and most is shaded. Some sellers sprinkle their produce to keep it fresher.
- The general quality is mediocre with good quality produce mixed with poor. Except for a possible difference in price according to size, there was no apparent attempt at differentiating prices according to quality factors.

In the afternoon the consultant visited Agroproduct-Commerce Company in Podujeve. This company's main products are mushrooms (whole fresh, whole frozen, sliced dried and boiled) and frozen blueberries. The company needs equipment for cleaning and sorting (sizing) blueberries. A cleaning machine has been built by the company, but is not as effective as required. The consultant agreed to search for sources of the needed equipment in the United States before his return to Kosovo in October.

### **15 August 2006: Fruti Association in Kravarice-Gjilan**

Fruti Association is an apple growers' association that has received assistance from the KCBS Project, including technical assistance in apple production and handling. The association has an insulated, but unrefrigerated storage room that has insulation on the exterior walls and instruments for monitoring temperature and relative humidity. Improvements were also recently made for improvement of airflow and maintenance of higher relative humidity, both of which will improve the storage life of the apples.

In the field the consultant was informed that a tree is picked one time. This may or may not be a good practice as an apple harvest usually takes place over a six to ten-day period. Depending on varieties, orchard conditions and local weather, a difference in maturity may be found in different parts of the tree. The level of maturity is very important when apples are to be stored. The apples should be mature, that is, of a physiological condition that will allow them to continue to ripen without becoming mealy and insipid, but not so immature that they will not ripen properly or be of low sugars (Brix).

On the next visit iodine staining tests will be conducted on some apples to determine at what stage of maturity they are being picked and if there is a difference depending on the location of the apples on the tree.

This association has one set of tables for sorting and packing with which they are not satisfied. The tables have a very narrow working space and are designed so each worker does all the operations of sizing, sorting and packing.

The tables have been used and different tables of simple design will be built and introduced to the growers during the next visit.

### ***16 August 2006: Pema Association in Kovrage-Istog and Agrproduct-Syne in Syne - Istog***

Pema Association - This apple growers' association has 20 hectares of production, mainly, Red and Golden Delicious, Ida Red and Granny Smith. The concept of sorting is understood, but currently is poor not done due to lack of equipment or tables for that purpose.

This association plans to obtain a semi-automated line for grading, sorting and packing through a KCBS grant, but will receive training in, and use, the simple sorting and packing tables designed by KCBS for the current season.

Some apples are stored, but the one facility visited (a barn with four rooms and no insulation or ventilation) is inadequate. A relatively simple modification of the building with insulation, night-air vents and exhaust ventilation fan would significantly improve the storage life of these apples.

Agroproduct-Syne in Syne – This company is an intermediary for collectors of juniper berries, and herbal and medicinal plants. The owner has a machine for processing (sizing) the juniper berries, but this machine, like others he has, does not function well.

The machine is a "Clipper" type sizer using three screens for separation. The screens are square wire mesh and would function better if they were made of round, perforated metal. The screens can be easily replaced and a source of perforated metal will be located.

### ***17 August 2006: Agrcompani Association in Qyshke – Peje and UVB Association in Blagaje – Peja***

Agrocomani Association - This association is currently processing 50 - 60 tons of potatoes a day. Most of the potatoes are exported without any sorting or sizing.

The association has a concrete block building that measures about 40 m by 6.5 m. There are plans to use this building for sorting, sizing and storage of their potatoes. There is a door located on one side in the middle. If the building is to be used as a processing and storage facility it would be advisable to put a door at one end of the building so the potatoes could be received, processed (sorted and sized) and then put into storage in a straight-line flow.

The association would like to obtain a sizing machine through a KCBS grant. They have seen excellent equipment at reasonable prices from Germany and The Netherlands, but they have yet to decide exactly what they want.

The equipment lines they have seen do not include equipment for cleaning or washing the potatoes. One problem that might occur with this equipment line is malfunctioning due to dirt accumulating in the moving parts. If the potatoes are not washed or cleaned prior to sorting and packing, then in addition to being a potential problem for the machinery, the unwashed potatoes will undoubtedly result in lower prices compared to washed or cleaned potatoes.

An alternative to washing, which requires large volumes of water under pressure, is brushing the potatoes to remove the loose dirt. Roller brushes could be built into a conveyor line that would also serve as a sorting line. An additional piece of equipment, an automated weigher/packer, has been requested, but is not recommended. The money would be better spent on a cleaning and sorting line or a potato washer.

Potatoes, like all other fruits and vegetables have to be sorted to fetch better prices. Until such time as the association has better equipment, the packing tables designed for the project will be introduced and the association members trained in their use.

UVB Association – This apple growers' association has plans to install refrigerated storage systems by converting five buildings using a KCBS grant. Two of the buildings were visited on this trip. One is adequate and the other appears to be too small. This association understands the need for sorting apples prior to storage. The new tables will be introduced and growers will be instructed in their use.

The technical data in the current request for quotation for the cooling systems states that the apples should reach zero C within four days of being placed in storage. This should be changed to three days because the longest recommended cooling time for apples that will be held in regular storage is three days. Some varieties, when being cooled for controlled atmosphere storage, are cooled at a slower rate in order to achieve the correct levels of O<sub>2</sub> and CO<sub>2</sub>. If the apples are not cooled in three days, or less, moisture released by the heat of respiration of the fruit may condense on the fruit surface and provide a medium for the development of decay-causing fungi. *Rhizopus*, for example will not grow at temperatures below 4.5° C. Most decay-causing fungi spores will germinate in 18 hours.

#### **18 August 2006: Viles Company in Pristina**

This company is one of two wooden box manufacturers who make the ubiquitous wooden boxes used for the packing of a variety of fruits and vegetables from local farmers. The logs are usually supplied by people from local villages for whom logging is a source of income. The small boxes are 0.25 Euros each, and the large boxes are 0.45 Euros each.

#### **19 August 2006:**

Developed the designs for packing tables. The KCBS Project will contract a local vendor to construct these items.

#### **21 August 2006: Braha Company in the Prizren Wholesale Green Market and Perdrini Association in Krushe e Madhe - Rahovec**

Braha is an import/export company dealing in fresh produce. The facilities, which have cold storage serve as a distribution center for produce bound to local markets and a collection center for an increasing amount of locally sourced produce, mainly sweet peppers. A new company, Visaria, has been formed by Mr. Braha to serve as the export branch of his company.

This company has the potential and interest in being a middleman for the export of local fresh F&V. Participation in this arrangement will require that growers understand the need for grading and packing and have the equipment to do so.

Perdrini Association in Krushe e Madhe: This is an association of pepper growers who currently are producing two tons or more of peppers per day for sale to local wholesale markets. This is apparently the only outlet they use. Some discussion was held about peppers for processing, but at the moment none are being sold to processors for this purpose.

It was suggested that the association consider selling peppers to Braha. To facilitate a marketing arrangement with Braha they will have to grade the peppers to three classes:

#1 – for export markets, fresh

#2 – for local markets, fresh and for domestic or export processors

#3 – for domestic or export processors

In order to have an understanding by both parties on the criteria for quality levels, specifications will have to be developed to avoid any future misunderstandings on quality. These specifications should be written, not verbal.

### ***22 August 2006: Apple farmers in Gjakova area and greenhouse vegetable producers in Mamushe area***

The consultant visited Mr. Pjeter Frrokaj, an apple farmer (with also blackberry and raspberry production) participating in the Swiss Project for Horticultural Promotion – Kosovo (SPHPK/IC). He has 70 ari of apple production in twelve varieties. This number of varieties will be reduced after observations have been made on production. There are plans to increase the production to about double the current hectareage.

The grower would like to store apples and we discussed how he could use an existing facility (barn) to store apples using night air as his cooling agent. This would be accomplished by placing closable vents along the bottom of the building's sides and installing a fan in the ceiling about in the center of the building. The vents would be opened at night and the fan would draw the cool night-air over the stored fruit and exhaust it through the roof. The placement of small heaters at both ends of the storage rooms was also recommended for use when the ambient temperatures are low enough to lower the temperature in the storage rooms to less than -1° C.

This storage is adequate for 2 – 3 months for those varieties such as red and golden delicious and others that normally would store for 6 months in mechanically refrigerated storage.

Greenhouse Vegetable Producers in Mamushe area: These producers have greenhouses build under a project with FAO. Beefsteak type tomatoes are grown on 102 hectares. The average greenhouse is 10 aris and produces 10 – 12 tons of tomatoes. Harvest is begins about the end of May or beginning of June.

Tomatoes are picked vine-ripe and packed in the greenhouse. The picker/packer places a wooden box on the ground, picks the tomatoes and packs into the box. To improve the efficiency of the worker a single-wheeled cart will be made and brought to the growers. The cart will be designed so it can be easily duplicated using cheap local materials and local craftsmanship.

### ***23 August 2006: Pestova Company in Vushrri and As-Promet in Leposavic***

The Pestova Company produces potato chips. The project has given them a grant for 500 stackable wooden boxes to be used in the cold storage room that is nearing completion. The company contracts local growers for raw material and the new storage facility will allow them to be in production during eleven months of the year.

As-Promet Company: this company dries freezes and boils fresh mushrooms. They also freeze raspberries. They are seeking a grant for a HACCP certifiable facility to replace currently old and dispersed rooms used for cleaning, preparation, freezing and cold storage.

Currently the plans are to have one part of the facility devoted to pre-cooling or pre-conditioning the product to 2 ° C prior to cleaning and processing. This is an unnecessary step. A recommendation will be made to eliminate this and create a better product flow through the system.

The consultant also undertook an unscheduled stop at Bujaria Company. This company imports fruits and vegetables, mainly during the off-season in Kosovo. The produce is distributed to local wholesale markets and supermarkets.

The company has an excellent facility that includes four state-of-the-art cold storage rooms. We spoke with one of the owners who told us he would be willing to purchase local produce for distribution if the quality met that required by his customers.

There was very little product in the store rooms (mostly citrus), but some potatoes were seen that were washed and bagged.

#### ***24 August 2006: Xerxe 2000 in Xerxe - Rahavec***

This association has 148 members who produce a variety of products including: peppers, field and greenhouse tomatoes, cabbage, eggplant and cucumbers.

One function of the association is to provide grower/members the use of tractors and cultivation equipment for a fee and use the funds for maintenance and the purchase of new equipment.

This association seems to function well with members who appear interested in improving quality and seeking new markets. They understand the need for sorting produce for quality. They also know that better packaging is needed for peppers. Currently they, like all pepper growers, use woven plastic bags for packing peppers. With their diversity of product they have potential for packing produce for local supermarkets and exporting through a company such as Visari.

#### ***25 August 2006 – 1 September: KCBS Project Office***

Finalized plans for packing tables and final preparations of technical handouts to be distributed.

Continued sourcing information on equipment and materials needed by various associations and companies.

Developed PowerPoint presentation on postharvest handling designed for training Kosovan growers. Presentation focuses on handling (sorting, sizing packing, cooling and storage for product destined to local and regional markets rather than product destined for high-quality export markets. The English version of the script for this presentation was left for translation.

Designed and had built, single-wheeled greenhouse packing cart to make packing of tomatoes in greenhouse more efficient.

## **PHASE 2: 18 SEPTEMBER – 7 OCTOBER 2006**

### ***18 - 20 September: KCBS Project Office***

Reviewed program schedule for field visits. Purchased plastic and foam rubber for cushioning packing tables. Visited carpentry shop making packing tables. Purchased potassium iodide to use for testing apple maturity.

Visited carpentry shop making tables to discuss delivery of the tables. Assembled greenhouse packing cart and “curtain” used to slow fruit roll on packing table. Edited PowerPoint post-harvest presentation and delivered script to be translated.

Upholstered packing tables and arranged for their movement to Krushe for demonstration at Perdini Association.

### ***21 September 2006: Perdini Association in Krushe e Madhe***

The consultant visited Perdini Association in Krushe e Madhe to demonstrate sorting/packing tables and train growers in their use. Eight growers participated in the training. Unfortunately the association president completely rejected the concept of grading, sorting and packing, but demanded project help in marketing non-graded products at premium prices, indicating a profound lack of understanding of solutions to the serious marketing problems being faced by his association members. The growers who would have participated in the training were intimidated and left. Two or three were there to support the president. However, several members present did understand the need for sorting and were interested in being linked to Visari Company as an intermediary for export of their peppers to Albania if they could sort their produce to a satisfactory quality level. Only one grower received the handout on use and plans for the tables. The tables were transferred to Xerxe.

### ***22 September 2006: Xerxe 2000 Machinery Ring Association in Xerxe***

The consultant visited Xerxe 2000 Association for training on use of sorting/packing tables. Nine growers attended and some showed genuine interest in using the tables. The greenhouse packing cart was introduced at their request. All growers received the packing table handout.

These growers have a variety of fresh vegetables that they produce, including peppers, tomatoes (both field and greenhouse) cabbage, potatoes, cucumber and eggplant. This diversity could serve the association well in dealing with supermarkets that tend to prefer purchasing as many products as possible from suppliers.

Peppers are packed in plastic net bags. The sorting/packing tables are designed for packing into boxes or cartons. A design for a metal ring to replace the packing ledge on the tables and hold the net bag while it is being packed was given to a local shop.

In the office, in the afternoon, a meeting was held with the F&V cluster team to discuss the situation in Krushe and strategies for grower involvement and understanding of need for classification of fresh F&V by size, quality, color, etc.

### ***25 September 2006: Mamushe***

The consultant traveled to Mamushe with the KCBS Project field officers to meet with greenhouse vegetable growers.

The principle product produced in the greenhouses is tomatoes. The greenhouse packing cart was introduced. The growers were skeptical at first, but on trying the cart agreed that it

improved the harvesting/packing system, which is currently done by placing the box on the ground and packing into it. The cart brings the box to a comfortable level and makes movement through the greenhouse easier.

The growers were also interested in the sorting/packing tables. The ring for packing peppers in plastic sacks was introduced and tested. It was agreed that this is a better method for packing peppers than using the packing ledge (which is for using boxes/cartons).

It was the first day of Ramadan and only three men attended the meeting. Fortunately, these three are the unelected "leaders" in the local agricultural community and if they accept the new technology then others will also adopt it.

### ***26 September 2006: As-Promet***

The consultant visited with As-Promet company along with the F&V and MTL teams to present suggestions for revisions to the original floor plans for the HACCP building under consideration for a KCBS grant. It will be a facility for processing, cooling and/or freezing and cold storage. After discussions with the owner it was decided to redesign the floor plan to allow for better product flow through the facility. A pre-cooling room is to be included for receiving product and a design for a simple forced-air system will be provided to increase the rate of pre-cooling raspberries.

### ***27 September 2006: Agroproduct Commerce***

The consultant visited Agroproduct Commerce to deliver information on equipment available for cleaning and sorting blueberries made in the US. Information on similar equipment was obtained by the project and the company on a study tour to Serbia. The information provided by me is an alternative source and is equipment that can be used for fresh or frozen berries.

While at the facility the consultant mentioned that KCBS had heard of the intended cooperation between Agroproduct and As-Promet. When the forced-air cooling design for As-Promet was mentioned, Mr. Avni Shabani of Agroproduct-Commerce expressed an interest in a similar design for pre-cooling mushrooms. A return visit will be made to present and explain a design that uses one of his cold rooms.

### ***28 September 2006: Returned to Agroproduct***

The consultant returned to Agroproduct to discuss design for a forced-air cooling system for mushrooms. Information was given on the type fan and other equipment and materials needed for the system (curtain, false bulkhead) and the method of operation. The owner also plans to put the system in his freezing room. Apparently, cooling and freezing are slight bottlenecks and his production capacity will improve with the faster cooling provided by the forced-air system.

If this system is installed, the owner of As-Promet should visit the facility to see it in operation so he can if a similar, but smaller, system should be installed in his planned facility.

The employment of a forced-air system would be the first in Kosovo and could be used an example for that time in the future when a cold chain is developed for the produce industry.

### ***30 September 2006: Agrocompani***

The consultant visited Agrocompani to demonstrate packing tables and train potato growers in their use. Twenty-four growers attended, some from the association, two members from another association and nine from other parts of Kosovo. Two farmers were not members of

any association. All of the attendees were potato growers, but some of them also grow peppers, tomatoes, onions and carrots.

Most of the growers were interested in the tables and five or six demonstrated enough interest that they will possibly have tables built for themselves. Handouts with the plans and descriptions were given to each person in attendance.

The need for a new “packing ring” to hold the net bag was discussed, in order to accommodate three sizes of bags. The current ring design will only hold the smallest of the three sizes, the one used for peppers.

An interest in the greenhouse packing cart was expressed for use in the field where the rows are wide enough to accommodate the cart.

### ***2 October 2006: Agrocompani***

The consultant traveled with Husnija Beskovic of UVB to Agrocompani to see the tables. He liked the two-stage sorting and packing table and expressed interest in having one built. He also asked for several copies of the plans and descriptions to give to members of the association. This man is obviously a leader and if he builds and uses a table, others will copy him.

During the visit the consultant saw the three proposed apple cold storage rooms that I had not seen on the previous trip. Both are adequate buildings and should be very easy to convert to cold storage.

In one building apples were piled in bulk on the floor against the end wall as if they were potatoes. This grower needs improved handling methods before he ends up wasting money on cold storage.

### ***3 October 2006: Agroprodukt and Pema Association***

The consultant visited Agroprodukt to deliver information on round-hole perforated screens. The blower suggested by the consultant can be attached to the machine at a point in the product flow just before the elevator carrying the berries to the top or first screen.

The owner does not think the machine operates well in terms of its motion. When he has better screens it should work well. At his request I will send a design for a clipper with horizontal vibration movement that he may be able to make locally. I will also look for company that makes a machine for compressing leaves into 60 cm X 60 cm bags of 50kg, although a machine can probably be made locally to do this task.

Pema Association –Seven growers attended demonstration of tables and picking bag. The grower/host found a similar bag that is apparently not being used. The consultant also demonstrated apple maturity testing. There was a definite difference in maturity depending on the position on the tree from which the apples are harvested.

This association is interested in purchasing a semi-automated packing line. If they are short of labor then a line is absolutely necessary and they should get it. However, sorting of apples will do them little good if they do not improve their storage techniques. Their existing storage room has no cooling and the cartons used are banana boxes. These boxes do not have adequate holes for air circulation. In addition, the room does not have a fan for air circulation to assist in maintaining the apples at a reasonable temperature.

**4 October 2006: Fruti Association in Kravarice – Gjilan**

Eleven growers attended the training, most of whom showed good interest in the tables. The consultant again demonstrated maturity testing and the growers were very interested. The remaining iodine solution was distributed to three or four growers.

At UVB one member of the board has been doing maturity testing. Information on source of chemicals should be obtained from him.

**5 October 2006: Pestova**

The consultant delivered potato chip “dips” that we had talked about on a previous visit. The introduction of the dips was meant to be a “social” event, but Mr. Kosumi decided to pursue dips as a new product line. We discussed how dips are made and packaged and what marketing methods might be used to introduce them to the local market.

**6 October 2006: KCBS Project office**

The consultant participated in final meetings with the F&V cluster team and made a presentation to USAID in afternoon.

# TASK FINDINGS AND RECOMMENDATIONS

## **Phase 1: August – September 2006**

Note: This visit was scheduled to occur with ample time to continue or to initiate recommendations or make modifications to existing facilities well in advance of the harvest season.

### **Task 1: Follow-up on activities made by the previous STTA working on this subject in November 2005.**

*Findings/Recommendations.* The previous STTA was a specialist in the postharvest handling of apples. His visit was during the time of harvest and he made recommendations and trained growers on the handling and storage of apples.

As might be expected, some growers responded and improved their handling and storage methods and conditions. Others still need improved handling of their apples and modifications to their cold storage facilities.

Sorting tables were designed and provided to growers. At Fruti Association in Gjilan the growers said they were not satisfied with the design. While the tables are an improvement over packing on the ground, they are very too small and poorly configured to improve efficiency. These tables were also seen at UVB, but are apparently not used there as sorting is done from the field box to the storage box.

At the farm visited (a member of Fruti association) there is an insulated storage facility established with KCBS assistance that has ventilation and the grower has been instructed in proper stacking methods to ensure good airflow in the facility. He will also be using wooden crates to store the apples. Many apple growers store their apples in banana that do not have adequate ventilation to allow for removal of the heat of respiration. These boxes accelerate senescence and seriously limit the length of time apples can be stored.

This structure should serve as a model for those farmers who want to increase their apple storage capability without the expense of refrigeration equipment. It would be best if all growers were to have refrigerated storage facilities, but this is a definite improvement over the current practices of most growers.

The tables used at Fruti Association could be refigured to be more accommodating to the sorting and packing process, but tables of a simple design that can be made locally and used in the field or a packing shed would be more practical.

The growers at Fruti informed the KCBS team that during harvest they pick all the fruit from the tree at one time. This is a questionable practice as the normal harvest procedure is to pick a tree at least two times over a period of 6 – 10 days, depending on the variety and orchard conditions.

There are three tests that can be used to measure the maturity of apples. One is a test in which a penetrometer is used to determine the firmness of the apple. Each apple variety has a firmness, determined by the force of penetration in pounds or kilograms, at which it is ready to be stored, shipped or eaten.

Another measure is the Total Soluble Solids (TSS) or sugar content measured by a hand-held refractometer. As fruit matures on the tree the TSS increase and at various amounts known as the Brix or percentage of sugar the fruit is ready to be stored shipped or eaten.

The third measure of maturity is the starch content of an apple. The starch content can be measured by using an iodine stain solution. When the solution is applied to the cut surface of an apple the starch is stained by the iodine. Immature apples contain mostly starch, which convert to sugar as the apple matures. The amount of staining, depending on the variety, will

demonstrate the maturity of the apple and indicate if the apple can be stored, shipped or eaten.

There is a formula for calculating the maturity of apples based on a combination of these three tests. However, the best single test of maturity is the iodine staining. It was decided that iodine tests would be conducted on the follow-up trip.

The KCBS Project is reviewing a possible grant to assist the UVB Association growers in refurbishing existing storage buildings and installing refrigeration units to increase the storage life of the apples.

All five of the buildings that are proposed for refrigerated storage were seen and one, a low building near the association president's home may not be a good storage unit.

The owners of these five facilities have followed many of the recommendations of the previous STTA and should be considered "leaders" for other association members and other growers.

The request for quotations for the refrigeration units for the five buildings was reviewed and the data and specifications provided to the engineering firms were complete and correct. The rate of cooling from field temperature to the holding temperature was listed as four days. It was recommended that this be modified to three days. This will mean an increase in the cooling capacity needed but should not create a significant increase in cost. Cooling in three days rather than four will increase the life of the apples and lessen the chance that decay-causing fungi will develop during the cooling period.

## **Task 2: Create implementation plans for each of the six organizations based on their needs and resources.**

The six targeted organizations in the original scope of work were:

1. Pema Association in Istog which wishes to establish a grading/sorting/packing line for fresh apples but also needs inexpensive forms of apple storage.
2. Fruti Association in Gilan which wishes to establish a grading/sorting/packing for apples (and has established a cold storage facility through KCBS assistance)
3. Agrocompani Association in Qyshiku that wishes to establish a grading/sorting/packing line for potatoes.
4. UVB Association in Peja which wishes to create a storage room (or rooms) for apples, but also needs simple forms of grading/sorting/packing.
5. Zahaqi Association in Rugova which wishes to add a frozen storage room for blueberries to its current cold storage room for blueberries.
6. Delta Pomfrit Company in Gilan which wishes to build a chamber for storing frozen French fries"

Zahaqi Association and the Delta Pomfrit Company were dropped from this list and the following six were added, making a total of 10.

1. Perdrini Association in Krushe will receive training in manual G/S/P of sweet peppers using specially designed tables.
2. Greenhouse vegetable producers in Mamushe area will receive training in the use of specially designed, small, single-wheel carts for more efficient direct packing of tomatoes during harvest.
3. Agroproduct Company in Podujeve will receive detailed information on suppliers of simple, cost-effective equipment for cleaning and sorting blueberries. [This information will also be provided to Dragash Association.]

4. As-Promet Company will be provided with a revised floor plan for the processing building they have designed. The new plan will eliminate the (un-needed) refrigerated “preconditioning room.”
5. Xerxe 2000 Machinery Ring Association will receive training in manual G/S/P of sweet peppers and cucumbers using specially designed tables.
6. Agroproduct-Syne in Syne - Istog will receive contact information for suppliers of perforated metal screens that perform badly in their seed cleaner.

*Findings/Recommendations.* All of the organizations listed above were visited during the initial visit with the purpose of understanding the particular needs of each organization and determining their needs with regard to G/S/P and equipment or technical information needs. These visits and observations are described in the section “FIELD ACTIVITIES TO ACHIEVE PURPOSES.

During the first visit plans for designs of tables were drawn for two grading/sorting/packing tables to be built at a local carpentry shop. A detailed description of the table components and the use of the tables was also provided, and it was translated into Albanian.

In the approximately three weeks between trips to Kosovo the tables were built and the plans and descriptions were translated for distribution to local growers.

The tables, the plans and descriptions of which are include in the annexes are suitable for most fruits and vegetables. Special modifications to improve ease and efficiency of use can be made if the number of products to be handled is limited.

### **Task 3: Meet with local equipment manufacturers and packaging suppliers to investigate sourcing.**

*Findings/Recommendations.* Currently produce is packed in small wooden boxes, with the exception of peppers, potatoes, green tomatoes, onions and gherkins that are packed in plastic net bags.

A wooden box manufacturer in Pristina was visited. The company produces the small wooden box used for several products and also produces a larger box. The cost of the small box is €25 and the larger box is €45. The larger box would be a good box for storage of apples as it provides good ventilation and can be re-used several times.

Large plastic crates (roughly 45cm X 30 cm X 20 cm) are available and used by some growers for harvest and storage. These crates have several advantages, including durability, good ventilation and ease of disinfecting. All containers used for harvesting or storage should be disinfected at the end of each season to prevent the build-up of disease-causing pathogens. Apples growers should be especially concerned with disinfecting as their storage conditions are very conducive to the germination of disease-causing fungi. There is a local manufacturer of plastic containers, but the factory was not visited. Sources were found for the materials needed to upholster the G/S/P tables after they were built.

### **Interim between visits:**

During the time between visits a single-wheeled greenhouse packing cart was built by local high school students. The cart was brought to Kosovo to be used for demonstration and as a model for a simpler, less expensive model that can be made by local metalsmiths. The cart was designed and built to be collapsible so it could be carried in my luggage, therefore no plans were drawn.

A post-harvest PowerPoint presentation was made for training local growers and others in the marketing system about handling fresh produce. The program was adapted from other presentations to reflect the level of postharvest and marketing activity in Kosovo.

Contacts were made to obtain sources of equipment and materials needed by KCBS clients.

## **Phase 2: September – October 2006**

Note: This visit is to occur approximately in the mid-point of the harvest of the crops involved.

### **Task 1: Review progress on implementation plans and make recommendations for last-minute solutions to unresolved problems.**

*Findings/Recommendations.* Upon his return, the consultant reviewed plans for training sessions and final arrangements made to advise the growers about the sessions.

The tables were finished and materials were bought to upholster them. When the technical staff and I finished preparing the tables, we familiarized ourselves with their use and made arrangements to have them delivered to Krushe where the first training session was planned.

During this time the chemicals needed for maturity testing of apples was purchased and the solution was made to be taken to the country for demonstration during the apple G/S/P training sessions.

At this time a revision was made in the request for quotations on the refrigeration units for UVB Association to make the cooling time three days instead of four.

### **Task 2: Conduct training and refine use of equipment and develop training materials for future seasons.**

*Findings/Recommendations.* Seven associations received training sessions with both of the tables. In Mamushe the growers were presented with, and practiced with, the greenhouse cart built specifically for their greenhouse packing needs. The cart was taken to other association training sessions, too.

Each of the attendees was given a copy of the plans for the tables and a description of their construction and use. Much of the time at all training sessions was spent explaining the use of the tables, how they might be modified to meet individual grower's needs and the basic principles of why proper postharvest handling is necessary.

The training sessions and discussions with the growers attending resulted in some modifications with regard to the use of the tables. These are:

- a) The slope of the tables must be adjusted to ensure that the product will roll from the dump or sorting side to the sorter or packer. Apples, for example need a very slight slope as they roll easily and are easily bruised by contact with other apples. Peppers, especially the red "elephant ear" type need a greater slope. The one-tiered sorting and packing table was made with a steeper slope than the design called for, but the slope does work well for peppers.
- b) The single-tiered table has a "dump ledge" intended as a place to rest the carton prior to dumping the produce on the table. This is meant to allow for better control of the dumping to prevent the produce from falling too hard and fast and causing damage to the produce. It was decided that another way of using the ledge would be to place the container of produce on the ledge and then sort the produce from the container onto the table from which it would be packed.
- c) The growers were advised that the table legs could be made of other materials such as wood or 5 cm right-angle iron for the frame, and wooden

planks could be used for the large flat surfaces of the tables instead of more costly plywood.

- d) Some growers determined that the greenhouse cart could be used in open fields for tomatoes because the usual between-row spacing provides enough room to move the cart in the rows.

### **Task 3: Make or recommend changes to use of equipment based on actual operations.**

The most significant change made to the tables was to make a “packing ring” for packing peppers. The ring (see annex) is made of round steel about 1.5 cm in diameter. The diameter of the ring is 20 cm and has small protrusions along its bottom edge to hold the bag in place. The ring has a 10 cm rod and metal plate so it can be attached to the front of the table.

Several rings would take the place of the packing ledge of the table. If the packing ledge is not removed then bag will not hang low enough to be filled. One suggestion was made that if the table is to be used for packing into boxes and into net bags, the rings could be attached to the sides of the table. This will work, but the reach to the center of the table might be too far for some people.

After the ring was made and introduced it was learned that there are three sizes of net bags for packing produce. The pepper bag is the smallest of these bags. It was decided that a rectangular “ring” would be better for all three bag sizes. This ring has a width of 40 cm and a depth of 20 cm. It attaches to the front of the table the same as the round pepper bag ring.

One important note is that when potatoes or other heavy produce are being packed, there must be a box or other hard surface a few centimeters below the bottom of the empty bag. If not, when the first produce is packed the weight will cause the bag to be pulled free from the ring.

#### **Related task assignments:**

**Agroprodukt – Syne** requested information on screens for use in the “Clipper” type sizer they currently are unable to use for sizing juniper berries. The wire mesh screens in the machine do not permit movement of the berries over the sizing screens.

The reason for the request is that different size berries have different uses and prices. The returns to the owner will be greater if the berries are sized.

This problem can be solved by using round hole perforated metal sheets. A source was found for these screens and given to the owner of the company. There are four screens to separate the berries into five sizes. The owner can determine what five sizes he needs and order the screens. The replacement of the screens is fairly simple.

The owner does not think the machine’s vibration is adequate for sizing. I have offered to send him a design based on another machine that he can have made locally, but I think the new screens will solve his problem without additional vibration.

Another need he has is to compress the leaves and other soft, voluminous products he receives into more compact packages for shipment and sale. He can probably have someone locally make a machine, but I will look for this type of equipment at home and provide KCBS with information about what equipment is available and its cost.

**As-Promet Company** in Leposavic presented a design to the project that included a “pre-conditioning room” and a poor product flow. A revised plan was produced and presented and then it was learned that the pre-conditioning room was actually for pre-cooling.

A new design was made with the participation of the owner that improves the flow of product through the proposed facility. This plan does not change the original dimensions of the facility, it only makes better use of the planned floor space.

It was also suggested that a forced-air cooling system be used to make the pre-conditioning room more efficient. The only drawback to this might be the limited space available for cooling. If cooling is a bottleneck in the production system, then it may be required regardless of the space needed.

**Agroproduct-Commerce** requested information on equipment for cleaning and sorting blueberries. There is one company in the U.S. that makes this type of equipment. Information about cleaning and sorting equipment for fresh or frozen blueberries and price quotations were received from the manufacturer and delivered to Agroproduct-Commerce. This information was also sought at a trade fair attended by the local staff in Belgrade and may be less expensive than the equipment that I sourced from the US.

While talking with the owner of the company the consultant mentioned that As-Promet, with whom his company has plans to cooperate, was considering putting in a forced-air cooling system for mushrooms and raspberries. He did not know about this type of system and we went into his cold room to discuss it.

He said he would like to install a forced-air system in his pre-cooling room and also in his freezer for faster cooling and freezing of mushrooms. One of the bottlenecks in his system is cooling and freezing. If he is able to cool and freeze faster, he can increase production.

The following day the consultant returned to Agroproduct-Commerce to discuss plans and equipment needed to install a forced-air cooling system. The information will be given to a local engineer to source the fan needed. The remainder of the equipment can be made by the company or by local craftsmen.

During the first trip we visited the potato chip manufacturer in Pestova to see the wooden potato storage bins provided in part by a grant from KCBS.

While in the office he showed the KCBS project team a new potato chip they were producing. It was a "ripple" type chip and I mentioned that it was a chip designed for dipping. The owner did not know about dips for potato chips and I told him I would bring some dip with me on the next trip. During the return visit I him some dips with the idea that he would enjoy them. The owner has decided he would like to start a new product line and we spent more than an hour discussing how dips were made, packaged and marketed.

## **Observations and Recommendations**

1) UVB Association in Blagaje is expecting to receive refrigeration equipment and it seems they are upset that the equipment has not arrived. However, none of the proposed storage rooms has been prepared to receive the equipment. If equipment were delivered today it would not be of any use.

There is knowledge of good handling practices in this association and before a grower is given a grant or spends money on a cold storage facility it should be made clear to him that he must handle and store the apples properly.

2) Perdrini Association in Krushe has been removed as a client due to the recent behavior of the president. However, the consultant believes that there are individual members of the association who would like to continue working with the project. The association members have a large production of peppers and appear to desperately need a market for them. If this association cannot be revived, perhaps a new one could be formed with those growers who are interested.

3) In Gjakova the consultant visited a farmer who is working with the SPHPK/IC project. The grower has 70 ari of production of 12 varieties of apples and needs a cold storage facility. Drawings and specifications were provided to him and the project for an apple storage room using "night-air" cooling.

This is a passive form of cooling in which night air is drawn through vents along the bottom of the walls by a fan in the ceiling of the building. This form of cooling only allows for short-term cooling, but should give at least two or three months of storage over non-cooled space. As with all storage systems, the apples placed in this storage must be of the proper maturity for storage.

4) Agrocompani Association in Qyshiku plan to purchase a potato sorter. The information I have seen for the equipment looks good and the price is very good. One problem they will have with this equipment is that they will experience maintenance or mechanical problems in a short due to the dirt from the potatoes accumulating in the machine.

It was suggested that they set up a conveyor line with brushes to clean the potatoes before they are sized. The line would also serve as a sorting line to remove defective potatoes before they reach the sizer.

The consultant has contacted Simoni Company in Italy and have received a message that they produce brushes that can be used for this purpose. The consultant has since asked for a quotation for eight of the brushes will forward the information to KCBS.

# CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY

There is a definite need and market for improved quality fresh fruits and vegetable in Kosovo. The first step in meeting the requirements for entry into higher-value markets is proper handling, grading and packing of fresh produce.

This can be accomplished by providing assistance to the associations as stated in the goals of the KCBS Project. The assistance provided in this phase of the project to train the growers in grading, sorting and packing and the low-technology equipment to accomplish these tasks is a good start. Recommendations for follow-up activity include:

**New equipment:** During the training sessions the consultant observed the growers' attitudes and responses to the new equipment. As with the introduction of any new concept or technology, there are those who will adopt it, those who will wait and see what others do and how successful they are, and those who may never adopt it.

The idea to get some tables and carts into the field to be used by those growers to whom other growers look for leadership is a good idea. The vegetable season for this year is finished except for potatoes and a few peppers. Apples are still being harvested, but it is unlikely the growers will take the time from their busy harvest to have tables made.

Over sixty growers attended the training sessions and perhaps half of those would make good use of the tables or greenhouse packing carts.

**Proper handling:** Local supermarkets have produce sections of various sizes. I visited four of the local hyper-markets to see their produce sections. As in many countries, they are off in a corner and poorly managed. Of the four visited, only two had their refrigeration unit running to keep their display case cool. I did not see if they had any cold storage for fresh produce, but it appears there is none. The handling of the produce is very poor, with a large amount of damaged produce and a high percentage of waste.

The hyper-markets are an outlet for high quality fresh produce items, but need assistance in the proper handling of produce. A training program in conjunction with a program to put high quality local produce in the markets would be a worthwhile endeavor.

**Diversification of product lines:** Supermarkets prefer to purchase fresh produce from suppliers who can provide a number of different items. This method of purchasing is often called "one-stop shopping." Today in the US and Western Europe most supermarket chains use purchasing companies to source and provide their needs for fresh produce. These companies also prefer to buy as many items of produce from as few suppliers as possible.

There is a diversity of fresh produce items available in Kosovo and opportunities for growers to diversify their product lines. Some thought should be given to forming an association that would serve as a supplier to supermarkets by sourcing various high-value fresh produce items from local growers.

The Bujaria Company imports off-season produce for distribution to local supermarkets and greenmarkets. The facility has four state-of-the-art cold rooms and space for other items. One of the owners told us that he was interested in purchasing local produce if the quality meets the requirements of his clients. This possible outlet for some of the associations' produce should be pursued at least as an introduction to high-value markets.

**Renew focus on the vegetable sector:** Until recently apples were the focus of the project. The apple industry is important to the economy, but the potential for new markets, expanded production and employment and increased income is in the underdeveloped vegetable sector. Vegetable production and marketing in Kosovo is presently little more than taking a

product from the field, putting it in some kind of package and hoping to sell it before it deteriorates.

**Post-harvest handling:** Until recently, prior to the work of the Fruit and Vegetable Cluster section of the KCBS project, growers have not seen a need to improve the postharvest handling of their produce because few market linkages existed requiring grower to modify or improve his postharvest handling methods.

Often, in the development or improvement of a production/marketing system postharvest handling, the bridge between the producer and the market is assumed to exist or its need is not well understood. Most often projects are involved in developing export program for fresh fruits and vegetables and the postharvest system exists and needs varying levels of improvement.

In Kosovo there is essentially no postharvest handling system for fresh fruits and vegetables. As was mentioned, produce is handled postharvest, but only in a rudimentary way. Market linkages are being developed and simultaneously, postharvest handling systems have to be introduced.

The introduction of improved technology is simple: you take what has been shown to work and make it available. In Kosovo, however, the problem is two-fold. First, growers do not have the technology and secondly, most growers are not familiar with, or do not understand the need and principles of, post-harvest handling. In the past there was not much need for them to do so.

Fruits and vegetables, especially vegetables, have tremendous potential in Kosovo. What is essential is finding a way to “kick start” the improved harvesting, grading, sorting, packing, cooling, storage, and transport of fresh produce.

The introduction of tables for grading, sorting and packing is a good start. Growers responded well to the tables and it has been determined that some growers will use them. Inevitably, as growers use the improved technology and move their produce into higher value markets, others will see the results and imitate them.

The problem is getting those first growers using the tables to grade, sort and pack so they can take advantage of better markets. It's easy to assume that a grower sees and understands the value of having a table built and using it, but the reality is that appreciation of a concept does not necessarily result in its adoption.

If the vegetable production sector of Kosovo agriculture does not improve its handling methods to the point where it can penetrate new and larger markets, it is likely that production will remain static or more than likely decline. A few seasons of good production and low market prices will force some out of business. The increasing awareness of the consumers of high quality produce will cause the market to favor imported produce over local produce.

KCBS is considering providing tables to some of the growers who are known to be the “leaders” in their agricultural associations and communities. This is undoubtedly the best way to ensure that growers are ready to participate in those markets that will bring them increased incomes.

In addition to the improved technology being introduced – the potato sorter at Agrocompani, the new facility at As-Promet, the packing line at Pema, the cold storage facilities at UVB Association and the others mentioned earlier – the growers need training in postharvest handling. The training should be for representatives from all the sectors in the production/postharvest/marketing system. Training growers, market intermediaries and others in the production/marketing system on how to use technology to improve or maintain quality must be complemented with training them “why” the technology is critical.