USAID | KOSOVO

FROM THE AMERICAN PEOPLE

KOSOVO NEW OPPORTUNITIES FOR AGRICULTURE PROGRAM

LETTUCE COOLING AND PACKAGING REPORT

DECEMBER 2011
This publication was produced for review by the United States Agency for International Development. It was prepared by Tetra Tech ARD.

LETTUCE COOLING AND PACKAGING REPORT

.

Prepared for the United States Agency for International Development, USAID Contract Number EDH-I-00-05-00006-00, TO AID-165-TO-11-00001, Kosovo New Opportunities for Agriculture Program, under the Rural and Agricultural Incomes with a Sustainable Environment (RAISE Plus) Indefinite Quantity Contract (IQC).

Implemented by:

Tetra Tech ARD
159 Bank St., Suite 300
Burlington, VT 05401

DISCLAIMER
This report was prepared by the New Opportunities for Agriculture project team of Tetra Tech ARD based on a Final Report prepared by Short Term Technical Advisor, Richard Brown, a Farmer to Farmer volunteer. The authors' views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

CONTENTS

BACKGROUND ……...……1

PURPOSE OF ASSIGNMENT……..1

EXECUTIVE SUMMARY……2

FIELD ACTIVITIES TO ACHIEVE PURPOSES ……..…….4

TASK FINDINGS AND RECOMMENDATIONS……..8

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY…….15

ANNEXES……...16

BACKGROUND

USAID supports economic growth in Kosovo through programs that strengthen and improve competitiveness of Kosovo agribusinesses, improve the business environment, and encourage local economic development. Accordingly, USAID/Kosovo has awarded Tetra Tech ARD the task order for the New Opportunities in Agriculture in Kosovo Program.

The goal of the program is to increase economic growth in Kosovo through expanded, environmentally sustainable production and sales of value-added agricultural products by enabling producers and processors to compete regionally and globally. The program has the following components:

1. Products and farmers linked with markets:
2. Agriculture products diversified and increased;
3. Food quality and safety improved;
4. Increased affordable and accessible credits;
5. Improved coordination with the agriculture sector.

Lettuce was the second crop listed of the top ten crops in the Kosovo Agriculture Opportunity Strategy. Through the focus on lettuce, the Program aims to contribute to the development of diversified and increased agriculture production by introducing new lettuces varieties and extending harvest and post-harvest shipping season.

Lettuce demand in Kosovo is increasing and baby leaf bagged salads have been introduced by the Program. The Program also introduced iceberg, romaine, endive and baby leaf lettuces to Kosovo lettuce farmers during this first year of programming. As the Program moves into Year Two, the focus will be on bridging the gaps in the lettuce value chain: introduction of pre-cooling of whole lettuce and bagged lettuce, improving trimming and packing, and grading and packaging of lettuce and bagged lettuce. There currently is no pre-cooling system for lettuce in Kosovo, and it is not being practiced within the value chain.

PURPOSE OF ASSIGNMENT

The purpose of this assignment was to introduce new post-harvest pre-cooling technologies to extend the shelf life of lettuce. The consultant was asked to design a small scale Kosovo model for the manufacturing of value-added bagged salads for fresh-cut processing, handling, packing and packaging of head lettuce. The goal was to develop a better presentation and marketability of romaine, iceberg, baby leaf, green leaf and butter leaf and/or other high demand lettuce varieties. The program has introduced new varieties of winter greenhouse lettuces and spring, summer and fall varieties of iceberg and romaine, Italian arugula and baby leaf types of lettuces. This has increased diversification and shelf life of domestically produced fresh whole and fresh cut lettuce. The Consultant created a model for small scale manufacturing of value added bagged salads; and introduced lettuce pre-cooling by low cost options to vacuum cooling.

EXECUTIVE SUMMARY

The current assignment centered on post-harvest handling of fresh leafy vegetables. Included is the need for consistent quality and attractive, marketable appearance. Previous work by Dr. Matthew Mullanax identified the need for pre-cooling of product to maintain freshness. Vacuum cooling, a standard industry practice for leafy vegetables, was suggested as a primary opportunity for future study.

In order to ascertain the best methods of cooling produce in Kosovo, the Consultant began the assignment with the customer (supermarket, corner market, wholesale market, and green market) and worked backward through transportation and packing facilities, and finally to the farm. Preconceived notions of proper temperature management at point of sale were shattered. Only one supermarket visited had any leafy vegetables under refrigeration, at an unacceptable 14.4°C. At the wholesale market, only one vendor had refrigerated cold storage, and it featured proper separation of ethylene sensitive and ethylene producing items. This merchant imported his produce from Italy. The corner markets and green market displayed their produce in direct sunlight. The lack of cold chain throughout the handling meant the consumer was routinely faced with wilted produce. Under these conditions, vacuum cooled lettuce delivered to the customer would look like uncooled product within a few hours, depending on weather.

To offer an attractive product with market appeal across a wide range of distribution channels, it quickly became evident that the farmer would need to provide a means of both pre-cooling the produce and maintaining a cold chain. Ice injection was determined to be the only effective way of accomplishing both. Crushed ice in a slurry with water carries away the initial field heat, and small "nugget" ice crystals lodge between and among the leaves to provide further pre-cooling. Additional "top" ice is added to the carton above the product to a depth of 5 – 8 cm. The use of a liner bag slows melting by reducing the convective heat load from wind.

During the 2011 growing season, Tetra Tech ARD team members introduced new varieties of iceberg, romaine, endive and baby leaf lettuces. Some of this product was grown in open fields and others in greenhouse environments. The seed trials produced mixed results as would be expected upon first introduction. A lack of understanding of industry standard maturity guidelines was evident in observed growing plots and at the wholesale market. Training was provided to the farmers during a group presentation which included videos of wrap lettuce production, romaine field harvest, and romaine hearts packing. The PowerPoint presentation, in English and Albanian, is available on the project website, www.noakos.com.

Included with the presentation were several samples of bags used in packing fresh leafy vegetables. Wrap lettuce, sleeve romaine, green leaf and red leaf lettuces, and romaine hearts in two, three and six head configuration were displayed. Specialty salad bags with full color print, and oxygen transmission rate specific bags (OTR) for use with modified atmosphere packaging (MAP) were also available. Several farmers took the opportunity to take samples for their own testing and evaluation. Initial contacts were established between the Chief Technical Officer with the Program and AsenovaKrepost, a major plastics supplier located in Asenovgrad, Bulgaria (near Plovdiv).

The goal of introducing new varieties focused on the range of products offered by Rijk Zwaan Seed Company of the Netherlands. The Salanova® line of multi-leaf lettuces will provide Kosovo farmers with the option of selling whole heads of new, attractive lettuces, or to core those same heads and market the blended leaves in 150gr packs as baby leaf or "spring mix" products. Farmers were shown photos of Salanova® during growing, harvesting and packing. A coring tool was demonstrated during the presentation on iceberg lettuce and discussion included its use on multi-leaf lettuces and salad production. Other tools for harvesting baby lettuces were demonstrated and made available to the farmers for inspection. A vendor relationship was established between Tetra Tech ARD contractors and the Rijk Zwaan representative for Kosovo. Seed for eight new and unique multi-leaf varieties within the Salanova® line has been arranged for 2012 planting.

During the presentation one of the foci was on packaging Salanova® as a baby leaf salad. Photos of equipment commonly used for small scale salad production were presented and discussed. This included a wash system for cleaning and pre-chilling the tender leaves, a centrifuge for drying, and a packing table for efficient filling of salad bags. Sealing and case packing the bags with top ice was also discussed.

During the assignment, team members discussed issues relating to food safety and the need for Global Gap certification with each farmer visited. A small portion of the farmer presentation focused on recent foodborne illness events in Germany and Colorado, food safety expectations going forward, and farmer certification. The goal is to provide consistent, safe produce to the consumer. A majority of the Q&A session centered on food safety procedures and requirements because the interest is high and the need is great. The current practice of inadequately composting cow manure was addressed, and standards for proper composting and microbiological certification offered a lively discussion. The majority of farmers know that Global Gap certification allows sales beyond their current customer base. They also want to provide a safe, nutritious product. Food safety training should become a priority with the goal of Global Gap Certification for all participants in all crops by midsummer 2012.

This report provides specifications on equipment, seed varieties, and packaging. Methods of icing whole head lettuces are discussed in detail. Step by step procedures are provided for small scale production of salads in a food safe way. Additional details supporting Global Gap certification are included.

USAID is providing a valuable opportunity for Kosovo lettuce producers to improve their offerings and add value to their products. Consumers everywhere gravitate to superior quality fruits and vegetables when given a choice. Once the icing equipment is in place and operational, consumers will quickly see the improvements, and the project will gain traction rapidly.

FIELD ACTIVITIES TO ACHIEVE PURPOSES

A. Grower Visits:

Company	Producer	Location
Agrovisioni	LabinotSpahiu	Llugaxhi/Lipjan
	Mehmet Selmani	Babush/Ferizaj
	SabitZhegrrova	Mazgit/Obiliq
	VedatHaradinaj	Stanovc/Vushtrri
Agroserra	GaniHajzeri	Mitrovicë
Hibridi	XhelalRamadani	Perlepnic/Gjilan
Moni	HakiMorina	Mamusha

B. Preface:

The primary purpose of the current Farmer to Farmer visit was focused on post-harvest handling of leafy vegetables. Observations of the cultural practices used in greenhouse and field lettuce production is intended for educational and discussion purposes.

During the visits it became apparent that exposure to alternative methods of production, either in Western Europe or the USA, has been limited. Internal conflicts and language barriers have certainly added difficulty in obtaining best practices information from outside sources.

C. Observations:

1. **General farm cleanliness:** Weeds, trash and piles of packaging materials were evident at most farms visited. This debris provides shelter for insects and plant disease vectors, as well as safe harbor for rodents and general vermin. Recommendation: Create a buffer zone around each greenhouse free of weeds and debris. A zone 3 meters wide or more is preferable.

2. **Weeds in the greenhouses:** most locations had weeds and dried weed debris located throughout the inside of the greenhouses. Near side and end walls, around poles and structural pillars, and general uncultivated areas were typical weedy locations. These weeds harbor insects, disease, and fungus spores, all potentially detrimental to the commercial crop. They also uptake fertilizers intended for the crops and add additional weed seed to the beds.

Recommendation: Remove extraneous weeds and keep uncultivated areas inside the greenhouse clean and tidy.

3. **Field/meadow mice burrows:** Holes and burrows were evident at most sites. Mice foraging on butter lettuce was observed at one location, although evidence of mouse forage was commonplace. This creates an economic loss for the farmer. Droppings from this activity is considered an adulteration of the product and grounds for rejection and/or financial claim. Rodent activity, in conjunction with the use of uncomposted manures is especially troubling as it provides another vector for inoculation of pathogenic bacteria on the edible portion of the lettuce leaves.

Recommendation: Provide poison bait stations outside the greenhouses and in areas of heavy infestation. Place non-poisonous traps inside the greenhouses at 10m to 15m intervals along the exterior walls. Monitor the traps and record data. Maintain an exterior buffer zone free of green vegetation and hiding places.

4. **Weedy beds/mulch film:** Most farmers used mulch films with punched holes properly spaced for transplanting leafy vegetables. On those few occasions where mulch film was not used, the quantity of seedling weeds was significant. The warm, moist and fertile environment provided in the growing beds was leading to rapid germination of weed seed which will likely interfere with the growth of the crop as it approaches maturity. There is potential for economic loss from fertilizer absorption and general interference with proper growth.

Recommendation: Expand the use of weed blocking mulch films to all greenhouse grown leafy vegetables.

5. **Lack of furrows/pathways:** The farmers are naturally trying to maximize productivity within the greenhouse plot and this encourages excess density. A 1/3 m gap in planting rows every 2 to 3 meters is necessary so that pesticides and fungicides can be properly applied without crop damage. The furrows would also allow easier crop weeding during the growing cycle.

Recommendation: Encourage the use of furrows within the greenhouse seedbed.

6. **Overlap spraying:** One farmer brought to our attention the issue of backpack sprayers and double spraying random areas of the seed bed. The lack of furrows meant the applicator was distracted while spraying so as to avoid stepping on plants. The use of a hand wand sprayer added to the double spraying likelihood.

Recommendation: Utilize a simple spray boom mounted on skids or bicycle tires to promote uniform distribution of pesticides and fungicides. Use a spray tank and boom designed for application of crop pesticides. Verify and document sprayer flow rates in accordance with pesticide labels.

7. **Transplant size and depth:** Transplants offer several benefits including the elimination of careful control of seedbed moisture during germination across a wide area. Thinning to a stand is also eliminated, reducing seed cost. Transplanting at a young age is preferred as it reduces the likelihood of "air pruning" of roots in the germination trays, and mechanical damage to the roots and stem during transplanting. Root damage causes setback from "root shock." Recently transplanted fields appeared to have been planted when the plugs were too large as compared to USA best practices. Setback was evident with non-uniform frame size at some locations. In only one case did we see evidence of transplanting too deep (resulting in occasional botrytis die-off).
Recommendation: Transplant when plants are just beginning to form their 2nd true leaf.

8. **Production schedules:** Some seedling nurseries were in precisely controlled rooms, some were sub-heated within a greenhouse environment, some were in cold tunnels within a greenhouse, and some trays were simply placed on the soil within a greenhouse. Overall impression was that plantings were spaced to allow for reasonably orderly harvest. When plantings were reaching maturity, sales contacts were made and produce was packed and shipped to buyers. When harvest of a greenhouse was completed a time interval of days or weeks occurred before the next house was ready for harvest. It did not appear that advance planning was made to ensure a consistent, reliable volume for harvest on which a customer could depend.
Recommendation: Work with growers to develop a planting date model working backward from desired harvest date. Historical data can be used to initially populate the database and interpolation of the data can fill in gaps. Day length and soil temperature are key considerations in the development of these models. Models for field plantings should be distinct from greenhouse plantings. Days for seedling germination through growth rate to first true leaf is a variable that should be controlled to aid in consistent harvest.

9. **Greenhouse glazing:** Essentially all of the greenhouses visited utilized single layer polyethylene covering. In a few cases, a second layer was suspended below the primary structural layer to aid in heat retention, but condensation was poorly controlled due to the flat nature of the interior plastic sheeting. During discussion it was stated that double layer inflated greenhouse plastic glazing should only be used when the structure would be heated and offered no benefit otherwise. This prevailing belief is not supported in historical and scientific literature.

The primary purpose of pressurized double glazing is to enhance the wind load capability of the structure and extend the covering's useful life (the airfoil shape prevents flapping against structural members). A secondary benefit is thermal insulation, reducing the heat loss to about 60% of single layer glazing. Single and double layer polyethylene offers the same "R" value as single and double layer glass.
Recommendation: Staff investigate options for modern greenhouse glazing methods and report their findings to the associate farmers.

TASK FINDINGS AND RECOMMENDATIONS

A. Food Safety

While not originally part of the scope of work, it became apparent that food safety issues would need to be addressed in detail during the grower presentation. It was surprising and disturbing to see the routine use of uncomposted cow manure as a soil amendment during leafy vegetable production. Manure is a known carrier of several intestinal bacteria and parasites, and its use is regulated in the US.

The presence of Escherichia coli 0157:H7 in cattle manure has been known for decades. Several studies have included sampling of manure for shed E.coli bacteria (specific 0157:H7). While the results vary depending on the herd location and timing, positive results are the norm rather than the exception. The following are some examples:

1. Epidemiological data indicate that *E. coli* 0157:H7 may be present in up to 8.3 percent of dairy and beef cattle, and that it is shed asymptomatically in the feces. Current manure-handling guidelines suggest a composting period before application of the manure to a field as fertilizer. Research has demonstrated the long-term survival of *E. coli* 0157:H7 in manure held under a variety of conditions, so even strict adherence to the guideline may result in the application of manure containing culturable *E. coli* 0157:H7 to production fields.[1]

2. The amount of E coli 0157 shed in manure is estimated to be between 3-50,000 cfu/gram of feces. Note that E coli 0157 infective dose for humans is about 10cfu – the lowest of the common human food-borne pathogens.[2]

3. Tests at the California Department of Health Services laboratory in Richmond found that E. coli O157:H7 bacteria detected in three cow pies produced the same genetic fingerprints as the strain found in human victims and in the bags of spinach they had purchased.[3]

4. *Salmonella*, *E. coli* O157:H7, *Campylobacter jejuni*, *Vibrio cholerae*, parasites and viruses can contaminate produce through raw or improperly composted manure, irrigation water containing untreated sewage or manure, and contaminated wash water.[4]

5. E. coli O157:H7 bacteria and other pathogenic E. coli is believed to mostly live in the intestines of cattle (Elder, et al., 2000) but has also been found in the intestines of chickens, deer, sheep, and pigs. A 2003 study on the prevalence of E. coli O157:H7 in livestock at 29 county and three large state agricultural fairs in the United States found that E. coli O157:H7 could be isolated from 13.8% of beef cattle, 5.9% of dairy cattle, 3.6% of pigs, 5.2% of sheep, and 2.8% of goats. Over seven percent of pest fly

[1] http://aggie-horticulture.tamu.edu/extension/newsletters/vpmnews/may02/art2may.html
[2] http://www.vetmed.ucdavis.edu/vetext/INF-DA/pathog-manure.pdf
[3] http://articles.sfgate.com/2006-10-13/news/17317271_1_dole-baby-spinach-spinach-field-spinach-outbreak
[4] http://www.ext.colostate.edu/pubs/foodnut/09369.html

pools also tested positive for E. coli O157:H7 (Keen et al., 2003). Stx-producing E. coli does not make the animals that carry it ill. The animals are merely the reservoir for the bacteria.[5]

6. The concentration and prevalence of *Escherichia coli* O157 in cattle feces at the time of slaughter was studied over a 9-week period from May to July 2002. Fecal samples (n = 589) were collected from the rectums of slaughtered cattle, and the animal-level prevalence rate was estimated to be 7.5% (95% confidence interval [CI], 5.4 to 9.6%) while the group prevalence was 40.4% (95% CI, 27.7 to 53.2%). Of the 44 infected animals detected, 9% were high shedders that contained *E. coli* O157 at concentrations of $>10^4$ CFU g^{-1}. These 9% represented >96% of the total *E. coli* O157 produced by all animals tested.[6]

7. Root Crops and leafy vegetables have the greatest risk of infection from manure application to soil. They can also become contaminated through direct or indirect contact with cattle, deer and sheep. *E. coli* O157:H7 is most prevalent in ruminants in general and in cattle in particular (both beef and dairy). Other known carriers include birds, insects and squirrels. While the bacteria do not appear to make these animals sick, the animals carry and shed the bacteria in their feces.[7]

8. The USDA 120-day limit was inadequate in our experiment with the 1 June manure application because vegetables harvested 17 weeks (119 days) later still contained detectable levels of S.enterica serovar Tryphimurium and E. coli.[8]

9. "I would say in the summertime, you could assume that 20 percent of all the cattle manure could have enterohemorrhagic E. coli," says Francisco Diez-Gonzalez, an associate professor of food safety microbiology at the University of Minnesota. "That's the one that's been linked to a lot of the recently publicized outbreaks of spinach, ground beef, lettuce." Pathogen research on horse manure is relatively rare, he says. But salmonella, Dr. Diez adds, "is fairly prevalent in chickens. What I've read is that it's found in about 5 to 10 percent of all chicken manure." While it "varies from farm to farm," he says, those numbers can apply both to industrial-scale poultry operations and smaller, organic hen houses.[9]

Studies to determine the frequency of shed E.coli have been performed in several countries. The discovery of pathogens in animal feces is commonplace regardless of the herd setting. Pastured animals are just as likely as confined animals to excrete pathogenic bacteria and more likely to excrete parasites.

The USDA had established a 120 day window between application of raw manure and crop harvest. This guideline has been superseded by various States and organizations because it has been proven to be inadequate protection for the consumer. California Leafy Greens Marketing Agreement mandates a waiting period of 1 year prior to planting a leafy or root vegetable after the application of raw manure. There are ongoing studies to investigate

[5] http://knol.google.com/k/about-e-coli#
[6] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC154535/
[7] http://www.ext.colostate.edu/pubs/foodnut/09369.html
[8] http://aem.asm.org/content/68/6/2737.full.pdf
[9] http://topics.blogs.nytimes.com/2009/05/08/manure-safe-or-not/

whether the waiting period should be extended due to delayed bacteria breakdown during freeze conditions.

During this visit a common theme was that people of Kosovo have superior immune systems because they are closer to the land and not such a sterile society. While there may be some anecdotal evidence or wives' tales to support the theory, the lack of adequate national health reporting is the likely reason for fewer newsworthy incidents of food-borne illness.

The global community has evolved rapidly and with it the ability to extend shelf life of fresh fruits and vegetables with refrigeration and controlled atmospheres. Production shifts from the home garden to the commercial farm, and transportation to far away markets means fresh foods are available to consumers year 'round. The vast majority of fresh produce is safe and nutritious. Because of the commercial nature of modern farming, an accidental or unanticipated contamination of fresh produce impacts many more people in many more places, sometimes leading to a severe health crisis. Scientific research has lagged modern distribution channels. For example, Louis Pasteur documented pasteurization methods 150 years ago, yet its standardized use on milk isn't much more than 90 years old. Interstate sale of unpasteurized milk wasn't halted in the USA until 1987. The correlation and documented causation of animal feces (manure) as a prime source of pathogenic intestinal bacteria is much more recent. The US Centers for Disease Control (CDC) developed methods of collecting data and modeling results to improve the identification of the source of a food-borne illness outbreak. Health departments in all American States and most countries have collaborated on improving uniform standards to collect and share information. There are not more incidents of food-borne illness occurring worldwide, just greater knowledge brought forth to identify the incidents and isolate the causes. Animal feces is the prime source of contamination in meat, eggs, dairy and produce outbreaks.

Included with this report are website links to the foundation documents for Global GAP as it applies to fruit and vegetable farmers. Additional information is linked to support the effort of training small groups of farmers who may be reluctant or overwhelmed by the program.

B. Product Cooling Recommendations

As previously stated, the farmer will need to provide both the pre-cooling step and a continued cold chain for successful delivery of a fresh, appealing product. Ice packing has been determined as the best method given the current lack of refrigerated storage and display capability at the wholesale and retail level.

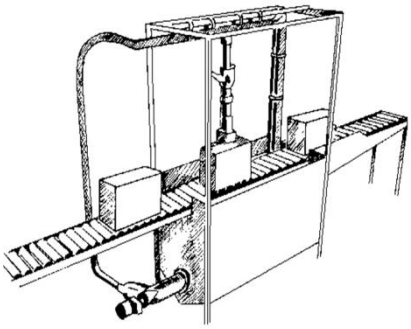
Ice Overview:

A mixture of crushed ice and water (slurry) is created so it can flow into the cartons or crates. Ice nuggets smaller than 10mm is desirable, but a variety of shapes and thicknesses is acceptable. Sodium hypochlorite (liquid) or calcium hypochlorite (dry powder) is added to the mixture to maintain a free chlorine level of 70ppm to 90ppm. When the total level of chlorine, the sum of free chlorine and bound chlorine, exceeds 200ppm, the slurry should be discarded and replaced.

During the icing process a significant portion of the field heat is removed with the water. Ice particles are carried into the void areas between and among the lettuce heads where they become lodged. Slurry continues to be added until the ice has built up around and above the produce. In the first photographs shown, a wax impregnated corrugated carton is used and the last photograph features a wooden wire-bound crate. While corrugated wax cartons are utilized in the USA, a reusable container of plastic or wood is the preferred recommendation. A liner bag with perforations to allow for water drainage is suggested to offer improved sanitary conditions and reduce the melting of ice due to convective heat loads from wind. While clear bags are commonplace, a colored bag in white or silver may help reduce radiant heat loads and further prolong ice retention.

Fragmentary ice is the simplest technique for making ice for the proposed application. The ice is formed in sheets and is broken up in a random pattern for storage. The ice is stored in an insulated, but non-refrigerated storage container for later use. Some ice continues to melt, but the mass of ice contained in the storage container does not tend to freeze in to an unmanageable block. The fragmentary ice generator mounts directly above the storage container and the ice is distributed through gravity.

When needed the ice is shoveled from the storage container and added to the slurry ice injection equipment to be mixed with water. The equipment has a drain station (pictured to the right of the injection hose) where water can continue to drain back into the slurry tank for a time before carton is closed and palletized.



C. Value Added Opportunities:

Another goal of the NOA project is to develop programs which target uptrend markets and higher price points. In support of that goal the Salanova® line of multi-leaf lettuces was introduced to the participating farmers. Salanova is unique in that when cut, the individual leaves resemble baby leaf lettuces. These leaves are actually harvested at full maturity resulting in superior shelf life and reduced respiration when compared to baby items. As with baby leaf lettuces, the Salanova line does not require modified atmosphere packaging to prevent enzymatic browning and pinking.

Recommended procedures for harvest and processing are:
Harvest a variety of heads. The preferred method is to select 1/3 red items and 2/3 green items. This selection can vary depending on which variety is mature at time of harvest. (It is important to note that red leaf items grow at a slower rate and will require 8-12 more days on average to reach maturity).
Remove the cores. This step can be performed with a knife blade or a sharpened coring tube as demonstrated during the farmer presentation. Proper sanitary conditions in accordance with good manufacturing practices begin with this step.
Gently Blend. Loose leaves should be blended carefully to incorporate the colors for an attractive finished product.
Fill Centrifuge Basket. Small scale salad processing equipment uses a "batch" method for washing and drying product rather than a continuous conveyor system. The centrifuge basket is first used to hold product during the wash step and then use during the centrifuge dry step.

Agitation Cycle. The filled centrifuge basket is placed in the wash chamber for gentle cleaning. The chamber features chlorinated water (70-100 ppm free chlorine) and ice which chills the baby leaves during washing. After a 3 to 5 minute wash cycle, the leaves should be approximately 1°C.

DT-35 Dip Tank

Basket Drain. A delay of 3 to 5 minutes between washing and centrifuging is desirable to allow for the majority of free water to drain away. This results in less leaf weight and less potential bruising during centrifuge spinning.

Centrifuge Dry. The spinning action draws away free moisture from the leaves and extends shelf life. Superior centrifuges start slowly and continue to speed up to maximum sustained RPM over a period of approximately 30 seconds. This ramp up procedure helps prevent mechanical damage from leaves slipping during acceleration.

Packing Table. Dried leaves are poured from the centrifuge basket onto the packing table. If additional blending is necessary, it can be done at this point. The packing table features filling cones at the table corners. Bags are slipped around the cones and product is pushed down into the bags. The small tables below the filling cones allow placement of product scales for precise weighing of each bag.

Bag Sealing. Packages can be sealed on a variety of machines. The continuous band sealer offers the greatest speed and throughput, while the impulse sealer with vacuum and gas flush capability allows the flexibility of line extensions into shred and chop iceberg lettuce and other mature head packaged salads. Both machines can be ordered to include hot embossed code capability so that use-by dates and trace-back identifiers can be printed on each bag.

Case Packing. Finished bags are packed into cartons or totes for distribution. The current plan includes the use of top ice around the finished bags to ensure a stable cold chain through delivery to the customer. As cold chain management improves, the use of standard dry corrugated cartons can replace wet capable ones.

Cold Storage. It is important that packed cartons are held in a cold environment (<3°C) prior to shipment to protect the product and reduce ice melt. If the farmer does not have an existing cold room, a possible solution is the stand alone refrigerated chamber, sometimes referred to as a "walk-in box."

D. <u>Future efforts:</u>

Packaging materials: In order to utilize ice refrigeration the carton or tote will need to withstand water and melting ice. The current choice of used banana boxes will not perform under ice refrigeration conditions even with the use of plastic liner bags. During discussions with growers it was determined that manufacturers exist within Kosovo for injection molded plastic totes and wood crates. At least one supermarket chain may have returnable plastic containers available for produce. Farmers will need to wash and sanitize any reusable container prior to packing. Staff members should prioritize sourcing of suitable packaging materials.

Plastic liner bags and baby leaf salad bags can be sourced from the US initially and shipped in a container with ice equipment. A relationship with a local plastics broker or manufacturer should be established to service ongoing needs of the farmers and manage credit issues.

Ice production: The proposed fragmentary ice equipment would have the capacity of 1500 to 2000 kg/24 hours. Approximately 12 kg will be used for each carton of 24 heads packed, and 8 kg for each flat of 12-15 heads packed. Roughly half of the ice is consumed chilling the water slurry and removing initial field heat, while the remainder is left in the carton for cold chain management. The capacity of the ice equipment assumes carton icing will be provided to neighboring farmers and not held exclusively for the participant. Smaller capacity equipment is readily available at lower prices. Water filtration and UV-C sterilization equipment should be specified in the request for quotation to insure safe, potable ice. As a practical matter, 3 phase electricity should be considered due to compressor

horsepower and long term utilization. This should be verified at the farmer's site prior to proposal acceptance.

Ice storage: Locally built storage made of insulated, urethane core metal panels is recommended both to save cost and to allow customization for the individual farmer's needs. Local businesses that construct cold rooms have the capability of providing these units. A 2m cube with a single door will suffice. The local supplier can recommend proper floor insulation. Specifications should include interior wash down capability and drainage featuring a water trap. The ice machine sits atop the storage unit so it must be constructed to adequately support the weight.

Ice injection: Stainless steel equipment will need to be custom built, preferably from existing designs. Individual carton icing was replaced by full pallet injection decades ago in the US. The fabrication can be performed in the US or locally. Specifications should stipulate only food grade welds, fittings, pumps, etc. Purchasing multiple units should defray design costs.

Salad processing: The suggested equipment is intended for pilot line and small scale production. It may be oversized for short term anticipated demand, but it can be properly cleaned and sanitized as part of good manufacturing practices. Sanitary standard operating procedures (SSOP's) should be in place and the crews trained prior to salad production. Critical control points should include, but not be limited to, free chlorine levels, water temperature and wash times (duration).

Standardization: It is highly recommended that standards and specifications be established for containers, packing techniques and icing procedures. All participating farmers should agree to those SOP's and Specs so the customer is presented with a uniform, reliable product. This consistency will help build demand for the product and increase sales. Discussion should be encouraged on establishing uniform pricing so participating farmers don't inadvertently undercut each other. Farmers need to aim for a high price and work together. Growers Associations and weekly conference calls establishing price and volume should be encouraged.

Global Gap: Every participant should be certified before the end of 2012. Food safety is everyone's business and everyone's obligation.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY

As the Program moves into year 2, the focus will be on bridging the gaps in the lettuce value chain: introduction of pre-cooling of whole lettuce and bagged lettuce, improving trimming and packing, and grading and packaging of lettuce and bagged lettuce. There currently is no pre-cooling system for lettuce in Kosovo, and it is not being practiced within the value chain.

As the Program moved forward in year 1, the Salanova® line of multi-leaf lettuces was introduced to the participating farmers. Salanova is unique in that when cut, the individual leaves resemble baby leaf lettuces. These leaves are actually harvested at full maturity resulting in superior shelf life and reduced respiration when compared to baby items. As with baby leaf lettuces, the Salanova line does not require modified atmosphere packaging to prevent enzymatic browning and pinking.

The farmer will need to provide both the pre-cooling step and a continued cold chain for successful delivery of a fresh, appealing product. Ice packing has been determined as the best method given the current lack of refrigerated storage and display capability at the wholesale and retail level.

Food safety training should become a priority with the goal of Global Gap Certification for all participants in all crops by midsummer 2012. The current practice of inadequately composting cow manure was addressed, and standards for proper composting and microbiological certification offered a lively discussion. The majority of farmers know that Global Gap certification allows sales beyond their current customer base. They also want to provide a safe, nutritious product.

This report provides specifications on equipment, seed varieties, and packaging. Methods of icing whole head lettuces are discussed in detail. Step by step procedures are provided for small scale production of salads in a food safe way. Additional details supporting Global Gap certification are included. This assignment enabled NOA to focus on the equipment, food safety practices and the technology needed to ensure that lettuce and a variety of other vegetables can be cooled and packed.

USAID is providing a valuable opportunity for Kosovo lettuce producers to improve their offerings and add value to their products. Consumers everywhere gravitate to superior quality fruits and vegetables when given a choice. Once the icing equipment is in place and operational, consumers will quickly see the improvements, and the project will gain traction rapidly.

ANNEXES

Annex 1 – Potential Suppliers

1. Supplier contacts
    a. Fragmentary ice suppliers
        i. Vogt Ice Company: 1-502-635-3000
        ii. Scotsman Ice Systems: 1-847-215-4500
        iii. Manitowac Ice: 1-920-682-0161
        iv. Hoshizaki America: 1-770-487-2331
        v. North Star Ice: 1-206-763-7300

    b. Salad processing equipment manufacturers
        i. Key Technology: 1-509-529-2161
        ii. North Star Engineered Products: 1-419-726-2645
        iii. Heinzen Manufacturing International: 1-408-842-7233

    c. Slurry ice filling system builders
        i. Semco Manufacturing: 1-956-787-4203
        ii. El Camino Machine and Welding: 1-831-758-8309
        iii. Heinzen Manufacturing International: 1-408-842-7233

    d. Sealing equipment suppliers
        i. Packaging Aids Corporation: 1-415-454-4868
        ii. CVP Systems: 1-630-852-1190
        iii. Promarks: 1-909-923-3888

2. Food safety services
        i. Primus Labs: 1-805-922-0055
        ii. NSF International: 1-734-769-8010

3. Plastic bag suppliers
        i. Donau Poly: Ivan Georgiev: 359-895-601-962 (Bulgaria)
        ii. Destiny Packaging: Albena Rabchev: 1-831-455-8000

4. Salanova Supplier
        i. Rijk Zwaan Budapest: Bence Lányi 36-309-408-778

5. Kosovo dealer: Cevdet Sala/Muhammed Sala 377-44207-204