USAID | KOSOVO

FROM THE AMERICAN PEOPLE

KOSOVO NEW OPPORTUNITIES FOR AGRICULTURE PROGRAM

LETTUCE PRODUCTION TECHNICAL ASSISTANCE

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

LETTUCE PRODUCTION TECHNICAL ASSISTANCE

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, Dr. Matthew Mullanax, 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 3

TASK FINDINGS AND RECOMMENDATIONS 4

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY 4

ANNEXES 15

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.

One of the crops recommended for development in Kosovo in USAID's Agricultural Strategy, the AgStrat report dated 2009, was lettuce, which was the second crop listed of the top ten crops in the Strategy.

This proposed activity contributes to the development of diversified and increased agriculture production through the introduction of new lettuce varieties and the extension of the harvest season.

PURPOSE OF ASSIGNMENT

The demand for lettuce in Kosovo is increasing. In food service and in restaurants almost every meal is served with some lettuce. In addition, from the perspective of greenhouse producers, lettuce is an important crop that is produced in a short period of time, and which can provide a second or third crop in the winter without heating due to some lettuce varieties being freeze tolerant. However, greenhouse production is limited by the space available in existing greenhouses. Open field production, once adopted, will significantly increase the possibilities for increasing production and extending the growing season, thus making Kosovo lettuce suppliers more responsive to buyers' demands.

The purpose of this assignment was to introduce new types and varieties of lettuce to Kosovo, including heat tolerant varieties of romaine, iceberg and/or butter leaf that are in high demand in European markets. In addition, the volunteer was to introduce improved technologies for greenhouse as well as open field production of lettuce that will enable local farmers to extend the lettuce production season.

EXECUTIVE SUMMARY

Kosovo has a small leafy vegetable production industry that supplies about 30% of the lettuce consumed in the country. Due to this, lettuce is a vegetable that deserves much focus in Kosovo. The lettuce project assignment completed focused on two objectives: introduce new heat tolerant Iceberg, Romaine lettuce varieties and lettuce blends to extend the production season; evaluate the current lettuce production practices and recommend improvements for increased yield and extend the season.

There were many findings with respect to lettuce production in Kosovo. In Kosovo, it was observed that all existing lettuce growing operations are small but efficient. In regards to the construction of the lettuce production sites, all six lettuce growers visited have metal frame greenhouses with adequate heating and ventilation capabilities. Lettuce growers in Kosovo manage their water efficiently, and report no problems with pests (disease or insect) within their lettuce production. Within the six visited greenhouses, only one grower uses composted manure for fertilizer. Unfortunately, there is no vacuum cooling or cold chain for maintaining product quality after harvest. This is a gap that NOA might be able to fill.

It was observed that lettuce growers in Kosovo could be performing a variety of techniques in order to improve their yield, and diversify their lettuce production. The recommendations noted through this FTF assignment are as follows: Use an injector system for transplant fertilization to improve root development; Use the minimum temperature during the composting process must be 131ºF (55 C) for a minimum interval of 3 days to minimize pathogens and parasites; Incorporate 30 kg/ha of complete fertilizer into the soil before transplanting; Use an injector system to apply fertilizer through the irrigation system during greenhouse and open field production; Encourage the use of post-harvest vacuum cooling and product cold storage.

A verbal report on the findings, weaknesses, potential and next steps for Kosovo's lettuce production program were presented. Those in attendance were attentive and participated in the discussion.

Throughout the assignment, it was observed that lettuce growing operations in Kosovo are small but highly productive. High density plantings allow the growers to produce 2.6 times more plants per unit area than in the United States. In Kosovo, lettuce growers have greenhouses with adequate heating and ventilation capabilities for winter lettuce production. This is a real opportunity for lettuce growers to take advantage of. They certainly also benefit because there seem to be few pest (disease or insect) problems in lettuce production and because they do manage their water efficiently. Although there is a lack of available services such as vacuum cooling and cold chain management in order to maintain product quality post-harvest, these are issues that NOA could potentially assist with.

In general, it is recommended that the Kosovo lettuce growing season can be extended by planting new lettuce varieties introduced by this project in areas where open field lettuce is not grown and by making small changes in current fertilizer programs.

FIELD ACTIVITIES TO ACHIEVE PURPOSES

1. Initial debriefing with USAID

The initial debriefing for USAID was with Brian Fahey, Senior Agricultural Advisor, Economic Growth Office. The major findings from the field visits, as well as strengths and weaknesses of the lettuce growers visited, were discussed. The discussions centered on introduction of new technology for improved lettuce production and food safety issues. New technology for the leafy vegetable industry in Kosovo would be the introduction of vacuum cooling, cold chain for fresh vegetables and improved fertilizer application methods.

2. Field visits

Over the course of the assignment, field visits were undertaken to observe lettuce growing operations in six different sites: Peja, Pristina, Gjilan, Mitrovica, Mamusha, and the area near Mamusha. These field visits provided an opportunity to interview growers and collect data on individual production practices. Comments and suggestions were made, as appropriate, and are detailed below.

3. Development of the design of greenhouse and open field production systems

Specifics on transplant production systems; ground preparation for transplants, including fertilization/nutrition programs, pre-plant open field/greenhouse preparation, transplant production, and post-transplant cultivation in open field/greenhouse; irrigation methods, including sprinkler, micro-sprinkler, drip and surface flood; pest control; harvest; post-harvest product handling; and technology are presented for each site visit below, with recommendations following.

Reference was made to a detailed plan for constructing high tunnel plastic greenhouses developed by Pennsylvania State University. More informationon the document "Design and Construction of the PennState High Tunnel" may be found on the websites: http://plasticulture.cas.psu.edu; and at http://www.plasticulture.org
The design of open field and greenhouse production systems was prepared by the sub-contractor Rural Development Center (RDC). While the Farmer-to-Farmer volunteer agrees with and approves these plans and system designs, seed for transplants should be planted each week and continue through mid-October. This will allow weekly transplanting in the field and allow for the collection of data on the adaptability of the new lettuce varieties.

4. Summary of the presentation to stakeholders

A verbal report on the findings, weaknesses, potential opportunities, and next steps for the NOA lettuce program was presented. The presentation was received favorably. More details on these findings and the material that was presented are available below.

5. Plan of Activities and timetable for lettuce value chain development

Annual timetables for seeding, transplant and harvest of open field and greenhouse vegetable production are presented in Annex I.

TASK FINDINGS AND RECOMMENDATIONS

The temperate climate of Kosovo is conducive for lettuce production. A range of lettuce types is produced on a limited scale in greenhouses as a second crop after tomatoes or peppers and in open field situations. Discussions with growers, vendors at the local vegetable wholesale market in Pristina and observations of the produce sections of local hyper markets indicate a steady but stagnant demand for leaf and butter head lettuce. Iceberg lettuce offered in the market place, whether local or imported, is small.

4.1 Initial Briefing with USAID

The initial briefing with USAID was with Brian Fahey, Senior Agricultural Advisor, Economic Growth Office; Gregory Olson, Economic Growth Office; Martin Wood, Chief of Party, New Opportunities for Agriculture project; Mike Kimes, Chief Technical Officer, New Opportunities for Agriculture project; and Ismet Babaj, Vegetable Production Specialist, New Opportunities for Agriculture project.

4.2 Field Visits to Lettuce Farmers

The following seven production system topics were evaluated during each growing area field visit: transplant production systems, ground preparation for transplanting, irrigation methods, pest control, harvest (open field and greenhouse), post harvest, and greenhouse technology. Notes on growing practices for each location are detailed below under each respective topic. Additionally, a general assessment, explanation of actions taken, and recommendations are presented for each production system topic.

A summary of production inputs and system characteristics by site location is presented in Annex II.

1. <u>Transplant production system</u>

A. *General assessment of transplant production systems:*

Positive aspects:

The growers have selected commercial growing media and commercially available trays for seedling production rather than formulating their own; Some growers are using complete fertilizers that contain nitrogen, phosphorous, potassium and micro-elements.

Negative aspects:

Some growers use no fertilizer for transplant production or only apply fertilizer when the plants show nitrogen deficiency (leaves yellow); In general seedling roots are not uniformly distributed through the growing medium.

Actions Taken:

The transplant fertilization problems were discussed at the USAID debriefing, as well as with NOA staff during the field visits.

Recommendations:

Use an injector system for transplant fertilization to improve root development;
The nutrition programs for transplant production should be adjusted to ensure uniform root development in the seedling tray, uniform seedling development and optimum establishment and growth after transplant in the field. A soluble fertilizer solution containing 70-100 ppm nitrogen should be applied every other week (or every other water application).

B. *Specific assessment of transplant production within six sites:*

Peja - Lettuce transplants are grown in plastic trays filled with commercial growing media composed of peat moss and perlite. At the time of the visit, seeded trays were placed outside near the greenhouses. No fertilizer is applied during growth unless the seedlings are yellow. An application of 20-20-20 (% nitrogen, phosphorous and potassium) soluble fertilizer is applied to green up the plants. No rate of application was given.

Pristina - No lettuce transplants were observed at the time of the visit. The grower was using plastic trays and commercial growing media for melon transplants.

Gjilan - At this location, two brothers run a diversified greenhouse operation and grow vegetable transplants for local farmers. They produce greenhouse lettuce only during the winter and early spring. Production of lettuce seedlings begins August 15th. Lettuce transplants are grown in 144 cell styrofoam trays filled with commercial growing media composed of peat moss and perlite. The grower specifically mentioned that no manure compost is used. Seeded trays are placed on the greenhouse floor where buried pipes circulate hot water for temperature control. Two applications of soluble 20-20-20 fertilizer (0.1% in water) are made during growth. An application of soluble 11-44-11 fertilizer (0.1% in water) is made just before transplanting.

Mitrovica - The grower uses a pressure washer to clean all transplant trays and sanitizes with copper sulfate before use. The 216 cell styrofoam trays are filled with commercial growing media and seeded. Trays are placed in a commercial germination room that is temperature- and humidity controlled for optimum seedling growth. The germination room can also be used as a cold room for product storage.

Near Mamusha - The operation is managed by three brothers, each with a specific responsibility: production, employee management, sales. They use two methods for producing seedlings. The first is a commercial germination room with temperature- and humidity control, which also serves as a cold room for product storage. The second uses heat released from composting cow manure and straw. After the compost is covered with plastic, wooden pallets are placed on the plastic. Styrofoam 187 cell trays are filled with commercial growing media and placed on the pallets. This is a simple and effective system to utilize heat from the composting process and circulating air to prune roots emerging from the bottom of the trays.

Mamusha - The grower at this location repacks and markets tomatoes and cucumbers for 30-40 other growers in the area, as well as growing greenhouse lettuce during the winter. At the time of the visit, there were no lettuce transplants or trays available. The grower indicated that transplants were ready in two to three weeks.

2. Ground preparation for transplanting

A. *General assessment of ground preparation for transplanting:*

Positive aspects:
The growers visited have adequate equipment to prepare good planting beds for lettuce; All lettuce growers visited use a plant density of 20-21 plants/m^2 or about 2.6 times the plant density used in the United States; Complete fertilizers containing nitrogen, phosphorous and potassium are available and used in most cases.

Negative aspects:
The growers do not rely on soil testing to determine the nutrient status of their soils; Fertilizer rates are variable from grower to grower. The general practice is to apply most of the fertilizer in one application before transplanting; The use of manure and composted manure pose food safety issues; On farm and off-site manure storage and disposal increases the risk of food borne illness; Bacteria and viruses in manure products can infect humans and cause serious diseases.

Actions taken:
Efficient fertilizer application/distribution was discussed with NOA staff.

Recommendations:
Incorporate 30 kg/ha of complete fertilizer into the soil before transplanting; Growers should implement soil testing programs; Knowing the chemical and nutrient status of the soil is a component of good farm fertility management; The minimum temperature during the composting process must be 131º F (55 º C) for a minimum interval of 3 days to minimize pathogens and parasites. More details are available from USDA, reference below.[1]

B. *Specific assessment of ground preparation within six sites:*

Peja - The grower has adequate farm equipment (tractor, plow, roto-tiller, disk, cultivator and harrow) for ground preparation prior to transplanting in the field or greenhouse. The fertilizer program for the first crop is composted cow manure, and 300 kg/ha 15 15 15 is rototilled into the soil. Two weeks post-transplant, 50 kg/ha calcium nitrate (28% nitrogen) is applied. For the second crop, 50 kg/ha Urea (32%

[1] From USDA National Organic Program: *To reduce the risk of microbial contamination manures must be composted to achieve a documented increase in temperature. Composting begins in the mesophilic range (50ºF - 105ºF) and moves into the thermophilic range (in excess of 105ºF) as decomposing organic matter releases energy as heat. Compost must achieve a recognized minimum temperature of at least 131ºF (55 C) and remain there for a minimum interval of 3 days to minimize pathogens and parasites. Compost piles must be turned or be managed in some other acceptable way to ensure that all of the feedstock heats to the minimum temperature. Composting materials must be passively or actively aerated by the design of the pile or through turning. After achieving a minimum temperature of 131ºF for a minimum of 3 days, compost should cure in the mesophilic range (50ºF - 105ºF) for at least 45 days or until the producer can document that it is suitable for soil application. The National Organic Standards Board recommends that processed manure test negative for the presence of Salmonelloa and fecal coliform organisms that are responsible for human health problems. Mature compost should also be tested for excessive nutrients or salts that may be antagonistic to plant or soil heath.*

nitrogen) is applied before plowing. Black plastic mulch is applied before transplanting the spring crop.

Pristina - Before transplanting, the grower roto-tills 20 kg/300m^2 15-15-15 fertilizer into the planting area. Ten days post-transplant, soluble 15-15-15 fertilizer is applied through the irrigation water at the rate of 1 kg/200 liters of water. After the application is completed, the irrigation line is flushed with clear water.

Gjilan (Six rows of lettuce, three drip lines) - Before transplanting 25 day old plants, the grower incorporates 400 kg/ha 15-15-15 and covers the soil with black plastic mulch. The plastic is inexpensive (€50/1100m^2) and used for only one crop season. Autumn transplants receive 30 kg/ha soil-incorporated 20-20-20. During crop growth and development, two foliar applications of potassium nitrate and a 0.1% solution of 11-44-11 are applied.

Mitrovica - A complete fertilizer 11 44 11 is used for open field lettuce production. Calcium nitrate or potassium nitrate is applied two to three weeks before harvest.

Near Mamusha - The grower has adequate farm equipment (tractor, disk, roto-tillers, and cultivator) to prepare soil for greenhouse and open field production. Before transplanting, 700 kg/ha 15-15-15 is incorporated into the soil. After transplant, a starter nutrient solution of 11-44-11 (1 g/plant, 2 liters/m^2) is applied. Additional applications of soluble 20-20-20 (up to 2 g/plant) may be supplied.

Mamusha - Composted cow manure is incorporated into the soil before transplanting. No additional fertilizer is applied. The grower relies on the fertilizer remaining after the greenhouse tomato and cucumber crops.

3. Irrigation methods

A. *General assessment of irrigation methods:*

Positive aspects:
All growers are using efficient water distribution systems. There was no evidence of excess water application; all irrigation systems observed were well-maintained and none are wasting water.

Negative aspects:
At one location, drip irrigation tape was wrapped around a small diameter stick for storage. The tape tends to twist and break the internal emitters; Surface flood irrigation contributes to several problems. When manure or composted manure is used for fertilizer, surface flooding can spread human pathogens in the manure to the lettuce. Flood irrigation washes surface soil into the leaves of the crop. Chemical and/or biological contamination of open water sources (wells, canals, streams or reservoirs) increases the risk to human health. Chemical contamination can occur from improper cleaning of application equipment and/or disposal of pesticides. Biological contamination of open water sources can occur from unregulated movement of wild and domestic animals. Leaching from public and private waste disposal sites can also contaminate water sources.

Actions Taken:
The storage of drip irrigation tape was discussed with the grower. It was suggested that the tape be rolled on a large diameter spool to reduce or eliminate twisting of the tape; Surface flood irrigation was discussed with the grower. The soil is sandy and dries out quickly during the summer. The grower feels that surface flooding is the most efficient method for his conditions.

Recommendations:
Use an injector system to apply fertilizer through the irrigation system during greenhouse and open field production; Apply suggestions for storage of drip irrigation tape: roll on a large diameter spool to reduce or eliminate twisting.

B. *Specific assessment of irrigation methods within six sites:*

Peja - Three methods of irrigation are used to produce lettuce. During the winter, lettuce is grown on plastic mulch with drip irrigation. Sprinklers are use for the spring crop and surface flooding is used during the summer. The sandy soil dries down quickly and it is difficult to maintain adequate moisture for crop growth. Water is sourced from a well on the property.

Pristina - Micro-sprinklers from Israel are used for water distribution. Unlimited public canal water is available on 15th June for €100/ha. In hot weather, mister sprinklers are operated at night to cool. Lettuce is then harvested early in the morning before gaining field heat.

Gjilan - Three drip lines are used to irrigate six rows of lettuce. Water is sourced from a hand-dug well adjacent to the greenhouse.

Mitrovica - Drip irrigation is used to water greenhouse and open field lettuce. Emitters are spaced at 20 cm for optimum water delivery. The well water is very high quality with an electrical conductivity level of 0.8. This indicates good quality water with a very low level of dissolved salts.

Near Mamusha - All greenhouse and open field lettuce is drip irrigated.

Mamusha - All greenhouse lettuce at this location is drip irrigated.

4. Pest control

A. *General assessment of pest control*

Positive:
There were no pest control programs at any of the locations visited; There was no evidence of insect or disease in any of the lettuce production fields visited.

Negative:
Insects such as aphids, thrips and leafminers can introduce viruses into greenhouse or open field crops. It is important to monitor the growing crops for the presence of

insects; although no lettuce diseases were observed, open field crops should be monitored because many native weed species can harbor crop diseases; One grower mentioned that Botrytis rot can be a problem in greenhouse lettuce. For his situation, the hot water circulating tubes on the soil surface create an unfavorable environment for Botrytis.

Actions Taken:
The conditions contributing to Botrytis rot were discussed.

Recommendations:
Growers should institute pest monitoring programs for greenhouse and open field production, to prevent introduction of detrimental insects, weeds or crop diseases.

B. *Specific assessment of pest control within six sites:*
Although each of the six sites were visited and observed for pest issued, none of the six sites had visible or reported cases of any pests (disease or insect).

5. Harvest: open field and greenhouse

A. *General assessment of harvest:*

Positive aspects:
Each grower has worked out a production schedule that fits the local environment and current market.

Negative aspects:
The lettuce heads are generally small, which is probably the result of harvesting at 21 to 30 days. Lettuce is generally a minimum 90 day crop.

Potential:
Four iceberg lettuce types and four Romaine types with characteristics for summer production have been identified for open field and greenhouse production in each of the growing areas visited. Six baby leaf lettuces for salad mix products were identified for production in each growing area.

Recommendations:
Institute open field and greenhouse trials for identified lettuce types, following these steps:

1. Select growers in each area for trial sites.
2. Develop a plan for open field lettuce trials in specific sites (Gjilan and Mamusha) using the summer-adapted iceberg lettuce varieties.
3. Develop a plan for open field lettuce trials of all lettuce varieties and baby lettuce salad mix.
4. Develop a plan for greenhouse production trials of iceberg, Romaine and baby lettuce.
5. Begin open field ground preparation.

6. Work with growers to develop a trial plan for transplant nutrition. Select seed varieties for trial.

Additional recommendations for baby leaf lettuce production is available in the Conclusion section, below.

B. Specific assessment of harvest within six sites:

The transplant-to-harvest interval is reported to be 3-4 weeks for either system (open field and greenhouse) at all locations visited. Lettuce grown in Kosovo is currently available year round. Greenhouse lettuce is available from September through April; open field lettuce is available from March through November.

Peja - Greenhouse transplanting begins in early October and continues through March. The greenhouse lettuce harvest begins in late October and continues through April.

Pristina - Greenhouse lettuce production begins with transplant on the 20th of September, with harvest continuing from October through March. Open field lettuce production begins with transplanting on April 17th and ends with the last harvest in late September. Harvest for an individual planting lasts 10 to 14 days, start to finish. Approximately 5,000 heads are harvested every two weeks. Total production for greenhouse and open field is 100,000 heads.

Gjilan - This area produces only greenhouse lettuce. There are two winter crops and one spring crop. Transplanting for the first winter crop begins in August for September harvest. A second cropping cycle begins with transplant during the last week of November and harvest from December through the end of March. Total production for the two cycles is 130,000 heads. Data for produce prices shows February/March wholesale at €0.30/head. Total annual production is 130,000 heads.

Mitrovica - The first greenhouse transplant begins at any time space is available, with harvest beginning 30 days after transplant. The soil surface is heated with circulating hot water tubes on soil. Open field transplanting begins on March 15-20th and continues through October 20th. Harvest begins in late April and continues until late November. Harvested heads may be washed depending on the amount of soil on plant material and are packed in banana boxes.

Near Mamusha - Greenhouse lettuce is transplanted from September through early March. Harvest begins in October and continues through early March. Open field transplanting begins March 15th and continues through September. Harvest begins in early April and ends in late October. Total production is 90,000 heads/year.

Mamusha - Greenhouse transplanting begins during the last week of September and continues through October. Harvest begins in October and ends during the last week of November. There is no open field lettuce in this area. Harvested product is distributed to the Turkish army (350 heads/day) and ELKOS hypermarkets (500 heads/day).

6. Post-harvest product handling

A. General assessment of post-harvest product handling:

Positive aspects:
The growers harvest early in the morning and begin delivery of product to customers by 7:00 AM; Most lettuce is harvested, packed and taken to market in banana boxes. Occasionally reusable plastic totes are used for harvesting, packing and shipping.

Negative aspects:
There is no product cooling to remove field heat after harvest and little if any cold storage of post-harvest products. Without pre-cooling, metabolic processes are actively running and breaking the fresh produce down internally.

Recommendations:
Encourage the use of post-harvest vacuum cooling and product cold storage. Storage at 2° C slows the metabolic breakdown of tissue and extends produce shelf life. Rapid cooling and cold storage are important links in the cold chain for extended fresh vegetable storage and shelf life; Locate small volume vacuum cooling chamber for grower's use.

B. Specific assessment of post-harvest product handling within six sites:

Although each site was visited and post-harvest product handling was observed within each site, the general assessment above mentions what each of the six growers do in terms of post-harvest product handling.

7. Greenhouse technology

A. General assessment of greenhouse technology:

Positive aspects:
All growers visited had metal frame greenhouses covered with plastic. All these are easily ventilated at the ends and sides for temperature control.

Negative aspects:
All growers visited also had traditional wooden pole frame greenhouses covered with plastic. Most of these structures are inadequately ventilated.

Recommendations:
Improve greenhouse ventilation systems.

B. Specific assessment of greenhouse technology in six sites:

Peja - The grower has two types of greenhouses. The first is the traditional wooden pole frame structure covered with plastic. The second type is a Swiss made metal frame with a single gable roof that can be ventilated at the sides, top and ends for efficient air movement.

Pristina - This grower also has two types of greenhouses. The first is the traditional wooden pole frame with plastic cover. The second is metal frame with plastic cover from Bosnia Herzegovina and one from a local manufacturer. Both are designed to be opened for ventilation.

Gjilan - The grower has metal frame structures with plastic covers that can be opened for side and top ventilation.

Mitrovica - The grower has metal frame structures with plastic covers that can be opened for side ventilation.

Near Mamusha - The grower has several wooden pole frame greenhouses covered with plastic that can only be ventilated from the ends. There is one plastic covered metal frame greenhouse with four connected gables that can be ventilated from the sides and ends.

Mamusha - The grower has ten traditional wooden pole frame greenhouses covered with plastic that are only ventilated from the ends. There is a Swiss metal frame greenhouse with four connected gables that was purchased for €6000.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTIVITY

A. General issues and concerns within each of the seven growing systems:

1. Transplant Production

Some growers use no fertilizer for transplant production or only apply fertilizer when the plants show nitrogen deficiency (leaves are yellow); In general, seedling roots are not uniformly distributed through the growing medium.

2. Ground Preparation for Transplanting

Some growers use no fertilizer for transplant production or only apply fertilizer when the plants show nitrogen deficiency (leaves are yellow); In general seedling roots are not uniformly distributed through the growing medium.

3. Irrigation Method

At one location, drip irrigation tape was wrapped around a small diameter stick for storage. The tape tends to twist and break the internal emitters; Surface flood irrigation contributes to several problems. When manure or composted manure is used for fertilizer, surface flooding can spread human pathogens in the manure to the lettuce. Flood irrigation also washes surface soil into the leaves of the crop.

Chemical and or biological contamination of open water sources increases the risk to human health. Chemical contamination can occur from improper cleaning of application equipment and/or disposal of pesticides. Biological contamination of open water sources can occur from unregulated movement of wild and domestic animals. Leaching from public and private waste disposal sites can also contaminate water sources.

4. Pest Control

Insects such as aphids, thrips and leafminers can introduce viruses into greenhouse or open field crops. It is important to monitor the growing crops for the presence of insects.

Although no lettuce diseases were observed, open field crops should be monitored because many native weed species can harbor crop diseases.

5. Harvest: Open Field and Greenhouse

The lettuce heads are generally small, which is probably the result of harvesting at 21 to 30 days. Lettuce is generally a minimum 90 day crop.

6. Post-harvest Product Handling

There is no product cooling to remove field heat after harvest and little if any cold storage of post-harvest products. Without pre-cooling, metabolic processes are actively running and breaking the fresh produce down internally. Storage at 2° C slows the metabolic breakdown of tissue and extends produce shelf life. Rapid cooling and cold storage are important links in the cold chain for extended fresh vegetable storage and shelf life.

7. Greenhouse Technology

All growers visited had traditional wooden pole frame greenhouses covered with plastic. Most of these structures are inadequately ventilated.

B. Opportunities:

There are opportunities for at least five high value lettuce products for the Kosovo market. The first three are individually wrapped iceberg, Romaine and leaf lettuce. The fourth is Romaine hearts in a plastic bag. The final product is bulk baby lettuce salad mix to be offered for sale in a refrigerated supermarket case.

An assessment of potential value added for production of these products is presented in Annex III.

Year round open field and greenhouse lettuce production is possible using the iceberg and Romaine lettuce varieties identified below. The following lettuce types have been identified for open field and greenhouse production in each of the growing areas visited:

- Four iceberg lettuce types with characteristics for summer production
- Four Romaine types with characteristics for summer production
- Six baby leaf lettuces for salad mix products

The baby lettuces were selected for color (red, green and golden), small leaf size and shape/texture (oak leaf, pointed and deeply cut spiral). The lettuces can be grown on a bed with one or two rows of each variety.

The procedure for baby lettuce production is as follows:

- Pre-plant ground preparation with 20Kg N/ha using 15-15-15, 20-20-20 or 11-44- 11.
- One or 2 rows of each variety is seeded on the bed. Up to 12 seeded rows can be established per bed.
- Irrigate for germination and growth.
- No additional fertilizer required.
- Harvest with hand sickle at 15-20 days when leaves 2.5-6 cm in length.
- Wash in cold water (potable/drinkable).
- Wash leaves and place in plastic bag in carton/tote and close bag.
- The baby lettuce should be pre-mixed in the harvest and washing process.
- Product should be stored in a cold room for delivery to supermarket.
- Product should be displayed in a refrigerated case at super market.

ANNEXES

Annex I: Seedling Transplant and Harvest Schedule through 2012

Annex II: Lettuce Inputs by Production Site Location

Annex III: Potential Value Added for Lettuce Production using Current Data

Supplement I: Chicory Production Background

ANNEX I – Seeding, Transplant and Harvest Schedule through 2012

2011	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Greenhouse									
Seed for transplant	X						X		
Transplant		X						X	
Harvest			X						X

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Open Field											
Seed for transplant	X							X			
Transplant		X								X	
Harvest			X								X

2012	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Greenhouse									
Seed for transplant	X						X		
Transplant		X						X	
Harvest			X						X

For 2011

Add greenhouse production in Mamusha

Work with selected growers in each area to install commercial injectors for fertilizer distribution on transplants and greenhouse production

For 2012

Add growers in Mamusha and Gjilan for open field production

Work with selected growers in each area to install commercial injectors for fertilizer distribution on transplants and open field production

ANNEX II: Lettuce Inputs by Production Site Location

Lettuce Inputs by Production Site Location						
Inputs	**Peja**	**Pristina**	**Gjilan**	**Mitrovica**	**Near Mamusha**	**Mamusha**
Soil Nutrition	Composted cow manure 300 Kg/ha 15 15 15 50 Kg/ha Urea 50 Kg/ha $Ca(N0_3)_2$ Plastic mulch	29 Kg/m^2 15 15 15 1 Kg/liter 20 20 20 Plastic mulch (3 year life) €2.7/Kg	400 Kg/ha 15 15 15 Autumn 0.1% 11 44 11 One application 30 Kg/ha 20 20 20 Plastic mulch (€50/ 1100m^2)	No rates 11 44 11 $Ca(N0_3)_2$	700 Kg/ha 15 15 15 Starter 1 g/plant 11 44 11 One application 1-2 g/plant 20 20 20 20 plants/m^2 Enough residual fertilizer from tomatoes and cucumber crops	Composted cow manure only Rely on residual nutrients from tomato and cucumber crops
Water	Covered well	Canal water from 15th June (€100/ha – no limit)	Open well in greenhouse and adjacent to greenhouse	Open well in greenhouse		
Greenhouse Technology	Old style Swiss made (one gable)	Locally made Bosnia-Herzegovina made	Metal frame (multiple-gable)	Metal frame	Old style Gutter connected Metal frame	Old style 1 Swiss metal frame 4 gable house
Production		5,000 transplants every 2 weeks (2,500/week) Winter: 15,000 plants/week	120,000 heads/year			
Additional Notes			Soil test (approximately €20/sample)			Greenhouse production only
	The growers visited had some degree of ventilation control for the old style greenhouses. The metal frame houses had side and in some cases end ventilation capability.					

ANNEX III: Potential Value Added for Lettuce Production Using Current Data

Carton Lettuce (Commodity)	Value Added (VA) Lettuce (iceberg, leaf and butter)
Assume – 700 m²/week X 20 heads/m² = 14,000 heads/week	Assume – 25% of weekly production goes to value added products 14,000 heads/week X 0.25 Value Added = 3,500 heads/week VA VA price €0.70/head (quite modest price when iceberg reported at €3.09/head at local super market)
Commodity price €0.25/head X 14,000 heads/week = €3,500/week	VA price €0.70/head X 3,500 heads/week VA = €2,450/week
14,000 heads/we ek total – 3,500 heads/week VA = 10,500 heads/week commodity	
10,500 heads commodity/week X €0.25 = €2,625/week 3,500 heads VA/week X €0.70/head = €2,450/week **TOTAL** **€5,075/WEEK**	
Commodity only €3,500/week Commodity + VA €5,075/week a 45% increase/week	

SUPPLEMENT I: Chicory Production Background[2]

Witloof Chicory (Belgian Endive)[3]
Cichorium intybus L. var. folosum

This information deals with the production of the forced Witloof chicory for chicons (4-6 inch, spindle-shaped heads or buds).
"Chicory" and "endive" are frequently interchanged because the "forced" product of Witloof chicory has been erroneously named French or Belgian endive. Other synonyms are White Endive and Dutch chicory.

SOIL

Witloof chicory must be planted in friable soils suitable for carrot production. Raised beds greatly improve root quality for forcing. Soils should provide good water holding capacity, good internal drainage and a pH of 6.5 and above. The roots of Witloof are harvested in the fall and soils should be chosen that allow harvest in rainy conditions.

SEED

Seed numbers - approximately 25,000 per ounce.
Seeding rate – 2.8 Kf/ha
Plant will be dictated by soil and moisture conditions.

SPACING

Witloof performs best under cool temperatures and requires 110 to 130 frost free days in order to produce roots of desirable size for forcing. Varieties are planted beginning in April, ending in May. March plantings would need to be covered with plastic to prevent premature bolting (seed stalk development). Establish plants at 19-20 plants/m^2. Roots are harvested from August through October for forcing.

FERTILIZER

Fertilize similar to open field lettuce production.

IRRIGATION

Irrigate similar to open field lettuce.

HARVESTING FOR FORCING

Witloof chicory is harvested after about 130-150 days, when roots are of adequate size. Roots may be dug for forcing from September until before the first frost. With the onset of freezing

[2] Requested by NOA Chief of Party Martin Wood

[3] Source – Oregon State University, Corvallis, Oregon

temperatures the plants will begin to produce flower initials and will not produce harvestable chicons. Vernalization temperatures prior to forcing affect chicon quality (sugars and shape), with greater vernalization producing longer chicons.

When a white section about the size of a little finger is present just below the crown section, the root is ready for harvest and forcing. If this white tissue is smaller than a little finger, the roots are immature and will not produce tight chicons. When larger than the little finger, numerous unmarketable chicons may form. Roots should be 3.5 – 6.5 cm diameter.

Harvest as follows:

1. Undercut and loosen roots with a bar blade, and allow roots to cure in the field for 3 or 4 days. Do not allow roots to be exposed to sunlight.
2. Cut tops 1.5 – 3.0 cm above the shoulders of the roots. Remove as much of the top as possible without injuring the growing point. Failure to remove enough of the tops can result in decay during forcing.
3. After loosening roots hand harvest or dig with potato equipment after the tops are removed.
4. Sort roots by diameter. Roots about 4.0 – 6.5 cm in diameter are ideal.

FORCING - HARVEST AND HANDLING

Roots are cut to a length of 15 – 23 cm and packed upright, tightly, in bins that are about 30 - 38 cm deep, with soil or a hydroponic solution. Both circulating and non-circulating hydroponic systems are used. Roots are forced in darkness in cellars or forcing rooms. Temperatures of 0 – 2° C is used for holding and 10 – 15° C is used for forcing. Ideally, air temperature should be 2° C cooler than the root temperature during forcing. Forcing rooms should be kept at 90% or more relative humidity. At the proper temperature 3-4 weeks are necessary for proper chicon development.

Chicons are cut or snapped from the roots and any loose outer leaves removed. They should be 15 – 17 cm in length, compact and spindle-shaped. Chicons 56.8 – 85.2 g each and free of green color.. They must be handled carefully to avoid abrasion and mechanical damage. From each 45.4 Kg of roots being forced, about 6.8 – 9.1 Kg of Witloof chicons may be expected.

STORAGE

Cool product as quickly as possible. Witloof should not be wetted. Store cartons in a cold, room at 0 – 2 **C** and 95-98% relative humidity.
This bullet-shaped salad vegetable should keep 2 to 4 weeks at 0 – 2 **C** with high relative humidity. Compact chicons 10 – 13 cm in length are most desired. Over-wrapping with perforated plastic film is beneficial. Blue paraffin paper may be used for protection against light and moisture loss. Leaves should be white with slightly yellow tips.

PACKAGING

These crops are packaged in cartons containing 4.5 – 9.08 Kg, depending on the item. Package Witloof chicons in cartons lined with blue moisture proof paper to exclude light and retain moisture.