AGRICULTURAL DEMONSRATION PLOTS: TECHNICAL CHOICES AND EFFICIENCY

USAID/GEORGIA RESTORING EFFICIENCY TO AGRICULTURAL PRODUCTION

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Restoring Efficiency to Agriculture Production

AGRICULTURAL DEMONSTRATION PLOTS: TECHNICAL CHOICES AND EFFICIENCY

USAID/GEORGIA RESTORING EFFICIENCY TO AGRI CULTURE PRODUCTION

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ABBREVIATIONS

REAP	Restoring Efficiency to Agriculture Production Activity in Georgia
FSC	Farm Service Center
GOG	Government of Georgia
MSC	Mechanization Service Center
SOW	Scope of Work
MOA	Ministry of Agriculture
BA	Business Association
KSA	Knowledge, Skills, Abilities

BACKGROUND

The objective of this assignment is to conduct an assessment of options to develop a sustainable private sector demonstration plot system that could be used to showcase agricultural products, techniques, best practices and access to new information to small-holder and emerging commercial farmers. Analysis and recommendations will support the development of a demonstration plot system contributing to improved quality of smallholder produce, increased smallholder sales and incomes, and expanded markets and reach of FSCs/MSCs in the Georgian agricultural sector.

The stated deliverable under this assignment is a final report which includes assessment results, analysis, and recommendations on a sustainable model that will be introduced by REAP and implemented over the five year life of the project. This report is prepared for USAID's Restoring Efficiency to Agriculture Production (REAP) activity.

CURRENT MARKET SITUATION

This report assesses and proposes viable models for demonstrations of superior technology for the Georgian agricultural sector and the USAID/REAP project in particular. Using existing systems and commonly available machinery, we provide recommendations to increase yields and quality in a wide diversity of crops and systems. Some of these recommendations involve introducing new crop genetics, techniques for accelerating plant production and different methods to use existing resources for crop and agricultural systems field demonstrations in ways that create synergies for agricultural producers.

Agriculture in Georgia is characterized by small holdings and incomplete property rights that make agglomeration of large scale farms difficult for most crops. Since there are many holdings with different owners, plans for each farm which may only be a few thousand square meters, should be developed and coordinated with others to actually produce a viable crop. It is difficult to manage a very small plot of beans, maize, squash, or any crop when neighbors are growing different crops and sometimes working at cross-purposes. Machinery, pesticides, and planting/harvest timing differ greatly between crops and make individual efforts expensive and unjustifiable in many cases when different functions are required.

Moreover, smallholders have little incentive to invest in land improvements such as soil chemistry corrections, rotational crops, or irrigation systems when the absolute area of the crop is fixed and expansion is not possible. In the case of long-term tree and vine crops, the inherent value of existing production can be high or low, depending on the perspective of the observer. For example, a smallholder with an unimproved apple orchard would be reluctant to remove producing trees to rent his property for a large commercial potato operation.

It was commonly found in discussions with growers that informal arrangements are often made to overcome the land tenure problems with some growers accepting more risk than others.

This is likely to continue until the policy framework for land rights and markets for land come into place and are transparent and enforceable. Clustering of specific crops comes naturally to smallholders and it is expected to see adjacent plots of the same or similar crops or varieties in most cases. Standalone operations are expensive and holders of similar resources generally use them in similar ways and cooperate when possible making terms that are mutually acceptable. Other times the strongest producer in a set of smallholders will rent or acquire adjacent plots and expand operations to their financial ability and the constraints of the existing agricultural system.

Large input suppliers such as seeds and pesticides distributors have a vested interest in running demonstration plots to attract new customers and sell more of their seed and chemicals. Fertilizer companies have a minor interest, and would supply advice and perhaps some product. It is unlikely that a pure fertilizer demo plot would be financed by a fertilizer producer or distributor except in rare cases where the deficiency is well known and dramatic results are highly visible. Individual farmers often participate in demo plots underwritten by retailers of agricultural inputs. If the demo plot is located on the grower's land, and as long as costs are covered, it may be possible for farmers to more effectively participate. This provides an opportunity to engage the growers in many areas and encourage consensual solutions to problems of land usage, crop production and timing, and acting together to increase their economic effectiveness.

Demonstration plots are an efficient way to introduce new genetics, new technologies, and new production management methods. Individuals must have access to and focus their efforts on understanding and learning prior to a heavy investment in unknown technology. Many times failures of understanding create significant inertia in the production system when failures increase perceived risk, and transactional friction increases, raising prices and reducing development speed.

STATEMENT OF PROBLEM

The private sector actively invests in demo plots and is usually subsidized in this by the manufacturers of seed, pesticides, machinery, irrigation, etc. in the hope of generating sales. The seller invites growers and investors to see the product in action, usually at a time when it is functioning well and the crop shows superior growth and development under the influence of the demonstrated input, technology, or machine. This generally occurs at field days which are held at various times of the growing season so that participants can better visualize the yield and quality of the crop after the demo intervention. This is called the demonstration effect. Sometimes demos are made to show off a primary tillage tool, cover crop, mid-term tillage, fertilizer application, or spraying technology. This means that demo plots can be used much of the year if the willingness and need is apparent.

Demonstration farm plots are a proven method to disseminate technology to large numbers of farmers. The methods and techniques used in demonstrations generally reflect the actual conditions for local conditions and crops with a view towards promoting a new advance in science and technology. These advances can include superior genetics in the form of new varieties or improved varieties, improved fertilizer placement and use, crop density manipulation, irrigation and fertigation or chemigation, and any technique that can be introduced to address specific problems in specific crops.

For example, making sure maize is properly planted at the correct depth and the correct spacing is a function of calibrating the planter. To enhance this technology, it is many times valuable to apply a measured amount of di-ammonium phosphate or other ammoniated phosphate as a band below and to the side of the planted seed. This ensures that the seedling has a ready supply of nitrogen and phosphorus to grow quickly and take advantage of early growing conditions. Much of the potential yield in maize is realized by early growth. The first three weeks of growth in young maize determine the yield potential of the crop under normal conditions. Georgia produces ammoniated phosphate fertilizers and this can be used to greatly influence the performance of many crops, especially those planted from seeds or young transplants.

Although many areas require focus to increase efficiency towards making Georgia a modern agricultural producer of desirable goods, the most urgent efforts we investigated were:

- Genetics and new crops
- Irrigation
- Modern tillage and mechanization
- Obvious economic possibilities to extract profits

It is a common practice to charge overhead that contains short term credit, reflects licensing for brands, patents, distributorship fees, cross-border trade costs, salaries and generally running the business. To attempt to charge farmers as a line item has only worked in rare cases such as crop scouting for serious disease or infestation in sophisticated production areas. Seed, ag chemical and pesticide dealers commonly use excess profit and manufacturer's subsidies to install and maintain demonstration plots showcasing a specific technology, variety or type of crop protection. The basic way to train people is to produce a good demonstration and have knowledgeable people present to answer questions that growers may have. The demo plot should address a specific constraint that farmers face. It does not necessarily solve their problems, but may provide an alternative method, variety, or practice to avoid problems in the first place.

Demonstration plots must be relevant to the production area. If wheat producers abound, they will have problems with soils, irrigation, and wheat production in the first instance. However, the bigger problem is that they should not waste their time and valuable soils, water, and resources on wheat; alternative crops would be the focus in a demo plot for this region. Another way is much more involved and is more like a vocational school with large demo plots that grow practical amounts of the relevant crops.

The existing demo plot systems underwritten by entrepreneurs and their multinational sponsors are sustainable as long as farmers buy their supplies and equipment. This is a totally normal state of affairs and these demo plots are very common in agricultural production areas of the world. There is scope to help the entrepreneurs learn new techniques faster by assessing their operations and supplying recommendations on new technologies, varieties, and practices. Some are more advanced than others and require no help. Smaller firms can improve significantly with regular visits, assessments, introductions to new materials, methods, suppliers, and markets.

This provides a place where farmers can be trained on many aspects of farming, from accounting to machinery calibration and actual work in the fields usually with higher precision equipment and new technologies. This is hugely expensive and is more properly a state run scheme since it requires full time instructors and researchers. It is advisable to have a wide diversity and redundancy of demo plots since there are always a finite number of operations that can be demonstrated in a practical way. Once a tree has been pruned, no further pruning is possible until the following season; when fertilizer is applied and once seed has been planted, there is little use in re-planting. This limits the participants just as a traditional field day and demo plot does, making multiple demo plots at different elevations, areas, and micro-climates desirable.

The demo plots for the 2014 cropping season are essentially done. Any demonstration utilizing new machinery, novel technology, different timing, different hybrids, etc. is over for the main summer crop. However, rotational crops for the fall soil building, preparation for soil chemistry corrections, internal drainage corrections, fall tillage, cover crop species selection, and cover crop management for forage and feed can be planned.

At this time, the effectiveness of existing Farm Service Centers (FSCs) are satisfactory. More diversity could be introduced in terms of fertilizers and more modern pesticides, but seed and genetics in general are current and for the most part, supplies are adequate. It was observed that all demo plots are negatively affected by the problem of land fragmentation and usufruct rights rather than a formal land market.

Extrapolating from observations and assessing multiple "what if" scenarios allows us to gain a rapid understanding of the forces that compel the Georgian agriculture to different conclusions. We find that there are many opportunities and much of the problem is inexperience that only time and sustained effort can overcome.

METHODOLOGY

To perform this assessment, the consultant conducted interviews with experts, local growers and organizations engaged in this field as well as visited demo plots operated by REAP beneficiaries and stakeholders to analyze the real impacts of demonstration plots, and develop an environmental scanning appraisal of natural resources by examining soils, geography, geology and soils morphogenesis, area vegetation, and native species and topography.

While undertaking this assessment, the consultant utilized the following methods:

- Desk Review (See Annex 1- Resources Used)
    - Available reports and assessments on extension services/demo plots

- Published and online data
- Business proposals of REAP's grant recipients

▪ In-depth interviews with local and international industry experts, Government of Georgia (GOG), and other relevant stakeholders (See Annex 2- A List of Interviews)

  - Representatives of Georgian Ministry of Agriculture
  - Representatives of local NGOs and international organizations engaged in demo plot development/operations
  - Representatives of FSCs/MSCs and primary producers
  - Representatives of vocational colleges
  - Representatives of suppliers of agricultural inputs

▪ Site visits to demo plots

  - Demo plots operated by FSCs in Kakheti and Samtskhe-Javakheti Regions
  - Demo plots and nurseries operating in Shida Kartli Region

FINDINGS

The gaps and challenges to sustainable competiveness of demo plots are summarized below in accordance with key tasks specified in the SOW:

VIABILITY OF PARTNERSHIP BETWEEN INPUT SUPPLIERS, FSC/MSC, AND INDIVIDUAL FARMERS TO ESTABLISH DEMO PLOTS:

The large input suppliers of seeds and pesticides have a viable interest in running demonstration plots to attract new customers and sell more of their seed and chemicals. Fertilizer companies have a minor interest, and would supply advice and perhaps some product. It is unlikely that a pure fertilizer demo plot would be financed by a fertilizer producer/distributor except in rare cases where the deficiency is well known and dramatic results are highly visible. Individual farmers often participate in demo plots underwritten by retailers of agricultural inputs. Most individuals would not be especially open to altruistically creating a demo plot for the benefit of others unless the farmer planned to consolidate with others and gain market power. If the demo plot is located on the grower's land, and as long as others covered the costs, it may be possible for farmers to more effectively participate.

The concept of farmers teaming with input suppliers of different kinds is plausible although it is difficult to envision that the farmer would contribute more than land and in-kind labor in exchange for the products of the demonstration plot. A common arrangement have farmers who are recognized as experienced growers and who may be interested in new crops, better plant protection techniques or simple curiosity allowing input suppliers the use of land, equipment, and some labor in exchange for new seed, pesticides, fertilizers and in some cases, new mechanization technology. Most times the supplier will exhibit the demonstration plot at the end of the season and allow area growers to examine the crop and see the yields and quality first-hand. The land owner or grower has a powerful incentive to allow the demonstration plot as the end product traditionally is granted to the grower for sale or trade. The input supplier benefits from a farm level comparison of their methods that can be seen to be superior or not by others. If they are significantly superior increases in sales and customer loyalty generally follow.

ASSESSMENT OF EFFECTIVENESS OF EXISTING DEMOSTRATION PLOTS OPERATED BY FSCS/MSCS:

The demonstration plots we observed serviced by small, medium and large input suppliers and FSC firms were satisfactory in terms of management and how to achieve the desired demonstration effect. For example, several Pioneer Seed company (DuPont-USA) sellers were actively demonstrating many different varieties of maize potentially suitable for Georgian growing conditions and seasonality. Other demonstrations were focused on fruit tree rootstocks and grafting techniques with the aim of selling improved rootstocks and grafted trees to area growers. In all the cases we observed, the type of demonstration and how the operator intended to achieve the expected results were reasonable and likely to succeed. More diversity could be introduced in terms of fertilizers and more modern pesticides, but seed and genetics in general are current and for the most part, supplies are adequate. It would not be problematic to grow almost any crop under existing conditions and supplies are sufficient for most needs. However, it would be good to see more soluble fertilizers, other sources of Nitrogen fertilizers than Urea and perhaps supplies and spreading services for gypsum in some areas where salt affected soils are found and internal drainage is impeded. All demo plots are somewhat negatively affected by the problem of land fragmentation and usufruct rights or traditions rather than a formal land market since many crops require a certain scale to be profitable.

ASSESSMENT OF SUSTAINABILITY OF ESTABLISHEMENT OF DEMOSTRATION PLOTS BY NEW FSCS/MSCS, AND INPUT SUPPLIERS:

A new service provider could encounter much difficulty due to established firms with better access to public resources. For example, in Gori there are many different crops grown and there are dozens of small input suppliers and businesses to service farmers. The market is crowded even with crops requiring differentiation of product and specific techniques such as proper micro-irrigation and large scale irrigation. Encouragement to the sector to diversify supplies and consolidate crops to gain economies of scale is necessary for the next step forward in the evolution of the agriculture sector. There are opportunities to form demo plots showcasing specific techniques and as a practice area for trying out new technologies. Examples of these are the application of calcium nitrate on apples in the fall to build trunk carbohydrate reserves and contribute to a larger and higher quality subsequent apple crop. Minimum tillage, no-tillage, crop rotations and enhancing the micro-biome of the soil are badly needed. Soils we have seen so far are sometimes mismanaged and plowing as a standard practice should be discouraged unless absolutely necessary. This is simply an artifact of tradition and new tillage methods can be taught to growers via demonstration plots. Specifically, the planting of no-till soybeans after wheat looks very promising and can be introduced very rapidly. New seeds, inoculation of N fixing bacteria, and specialized machines (planter) will be required to do this.

More demonstration plots developed by anyone in the input supply business would be welcomed since there are a great many different climatic zones and crop potentials throughout Georgia. Although multiple maize trials might seem superfluous in a growing area, the heterogeneity of Georgian soils and microclimates makes redundancy a necessary requirement to validate the utility of superior genetics and growing techniques. Some areas have changed very little since Soviet times in terms of agricultural techniques. Multiple demonstration plots should be established to provide an opportunity for growers to assess the possibilities and extrapolate the results to their specific situation. In these areas, there is scope to experiment with new crops and devices as well as trying new things that can improve productivity without risking the main crop. As a general practice, input suppliers or firms that wish to sell farm services should vigorously promote their products and provide real examples that can be visited often and shown to produce superior results. However, since all demonstration plots incur high transaction costs, there is a natural limit to the extent and size of demonstration any specific firm can justify. Moreover, it is likely that firms with large business interests in specific brands or types of inputs will promote those products without acknowledging the contribution of the system or technology of production as a whole. Although many times a dramatic effect can be observed from an improved genotype or application, environmental effects are such that the effect may not be a sustainably reproducible across all areas.

RECOMMENDATIONS

PARTNERSHIP WITH MOA, INPUT SUPPLIERS, BAS, AND EDUCATIONAL INSTITUTIONS TO CONDUCT DEMOSTRATIONS

Partnership with MOA, input suppliers, business associations (BA) and educational institutions can be hugely complex and it is unlikely that the private sector would be interested in working with any government entity as an equal partner since there is little incentive to do so other than to utilize the new equipment controlled by the MSC. However, a vocational level school would certainly help matters with young people learning core fundamentals of plant growth, soil science, and practical applications of science. The difficulty would be establishing the operational model of who pays and what would have priority. Input suppliers have different motives than educational facilities and may not have the patience or financial capability to absorb the considerable transaction costs associated with a government entity. For example, a vocational school may have large amounts of good land, but lack the resources to develop and maintain a proper demonstration plot. Input suppliers may be frustrated by the inflexibility of government entities and uncertain decision making during a short-term crop schedule and prefer a private grower. A long-term agreement with a major multinational firm doing business in Georgia and supporting a vocational school with general research and practice as well as enhancements to the existing curricula would be possible. However, this requires continued buy-in between business interests and a range of other stakeholders.

DIFFERENT FEE-BASED MODELS OF PRIVATE SECTOR DEMOSTRATION PLOTS

The fee-based model is inherent in the demonstration plot; it simply is not priced very transparently. When input suppliers sell seeds, fertilizers, pesticides, etc., they build in and charge overhead that contains short-term credit, reflects licensing for brands, patents, distributorship fees, cross-border trade costs, salaries and generally running the business into the price of everything they sell. The demonstration plot consumes resources from the input supplier's profits just as advertising does but ultimately the grower pays often slightly higher prices often on unrelated products than are used for the demonstration plot. To attempt to charge farmers a fee for a demonstration plot as a line item has only worked in rare cases such as crop scouting for serious disease or infestation in sophisticated production areas. The idea of a fee-based model to support a demonstration plot does not appear viable.

TRAINING CAPACITY OF FSCS/MSCS OPERATING DEMO PLOTS

The basic way to train people is to produce a good demo plot and have knowledgeable people present to answer questions that growers may have. The demo plot should address a specific constraint that farmers face. It does not necessarily solve their problems, but may provide an alternative method, variety, or practice to avoid problems in the first place. Demo plots should be relevant to the production area. If wheat producers abound, they will have problems with soils, irrigation, and wheat production in the first instance. However, the bigger problem is that they should not waste their time and valuable soils, water, and resources on wheat; alternative crops would be the focus in a demo plot for this region if change is desirable. In other words, creativity is necessary to confront agricultural problems in specific areas and demonstrate ways or methods that can be used to solve or avoid the problem.

The most important aspect of any demonstration plot is the capability to train others, assuming the demonstration is valuable. This can be problematic since many of the so-called demonstration plots are actually experimental plots that still require validation which may or may not work out. If growers are trained in methods that cannot work or have flaws that limit their usefulness, the credibility of the demonstration effect is diminished. Evidence based demonstration plots are much more likely to provide a positive effect, but can take years to develop and disseminate. Another way is much more involved and is more like a vocational school with large demo plots that grow practical amounts of relevant crops. This provides a place where farmers can be trained on many aspects of farming, from accounting to machinery calibration and actual work in the fields usually with higher precision equipment and new technologies. This is expensive and is more properly a state run scheme since it requires full time instructors and researchers. There are always a finite number of operations that can be demonstrated in hands on way in any demonstration plot. Once a tree has been pruned, no further pruning is possible; when fertilizer is applied and once seed has been planted, there is little use in re-planting. This limits the participants to traditional field days and demo plot training during the season.

DEVELOPMENT OF GUIDELINES AND INSTRUCTIONS FOR ESTABLISHMENT AND OPERATIONS OF DEMO PLOTS OPERATED BY FSCS/MSCS

A model of demonstration plot establishment could proceed as follows:

Step 1 - Survey the surrounding area of a proposed demonstration plot and identify the main focus of what could or should be demonstrated. In some areas, this may be as simple as addition or placement of appropriate fertilizers to gain efficiency and increased yields. In others the level of sophistication should concur with the KSA of the proponents and instructors who will train interested growers. This could be as complex as demonstrating new grafting techniques, rotation crops for multiple uses (fodder, soil improvement, bio-fumigation, nitrogen fixing, and plow-pan fragmentation), and new mechanized technology.

Step 2 - Compile a materials list to develop the costs to be incurred in the demonstration plot. Separate resources to be supplied by each participant. For example, the interested grower may supply land, water and some labor; an input supplier may supply seeds, pesticides, fertilizers and mechanization. Technical services and training personnel may be supplied by REAP. The point is that each input has a cost and should be accounted for in the model.

Step 3 - During the plot preparation, there are opportunities for training interested people in improved techniques. Rather than simply using local methods and adding a singular input or piece, the demonstration would ideally have a holistic design that accounts for improvements to all the parts that make up the production system. Better ways of soil chemistry corrections with lime, gypsum and sulfates, integration of biomass and the required nitrogen to accelerate decomposition by soil bacteria, maintaining soil structure and attaining good tilth and a myriad of other improved practices can be used, demonstrated, and disseminated to area growers. However, in practice it is usually necessary to limit the inputs to discern significant effects of specific practices. Multiple demonstration plots using the same crop with different inputs to account for differences in soils, climate or growing conditions will be valuable and make the technology that subsequently develops as a local practice to be more robust and resistant to environmental effects.

Step 4 - During the vegetative stage of growth until harvest, there are obvious opportunities for training growers in pest control, recognition of problems before they manifest as crop failures, proper fertilizer use and placement, mineral fertility deficiencies and inherent deficiencies, crop scouting, correction of simple problems during crop growth, and many other areas that are germane to the production system in the area.

Training consists of 5 basic elements:

1. Identification and documentation of the problem
2. Development of training materials in text, visual aids, specimens, data, etc.
3. Schedule training days around crop timing for maximum participation
4. Delivery of training on the demo plot with hands-on practice when possible
5. Follow-up with distribution of high quality photos, practice plans or compendiums.

The diversity of the Georgian agriculture may itself be a constraint due to small plot sizes, but also an opportunity. Traditional crops such as wheat may make little sense when wheat producers abound in the region except in terms of food security concerns. With favorable terms of trade, the small size and different microclimates of Georgia lend themselves to intensity and specialization. Since there is reportedly a large part of the population in rural areas with few employment opportunities except agriculture, specialization can make a dramatic impact.

Specialized agriculture requires special skills and manual labor that is difficult to mechanize. Good examples are small fruits such as strawberries and raspberries. There are no mechanized harvesters for these crops that produce fruit fit for fresh markets and in these cases, even fruit for processing requires much manual labor.

In agronomic crop production areas, a shift from wheat followed by a forage crop for winter grazing and fallow works well when implemented. However, the introduction of soybeans that yield well immediately after wheat crops may be a good choice. New technology must be introduced, but this is available in all sizes and is relatively simple to master. Soybeans yield valuable oil for human consumption and very high protein meal when the oil is expressed, standardized at 44% protein and quoted on world markets (currently $1250 USD/MT). In this case, much of the productive potential is wasted if a wheat crop is harvested and much time, energy, and costs are used to traditionally plow, disc, and prepare a fine seedbed. Over the last 40 years, we have found such traditional practices unnecessary and actually harmful to the environment, reducing the probability of the grower receiving a profit from farming. If and when possible, it is recommended that no-till methodologies be promoted.

The MSC installations we visited were full of excellent quality machinery that fit well with current practices. These are practices that should be changed to increase agricultural efficiency and the FSC/MSC are not prepared to introduce new machinery and technologies (save irrigation) because they have a large inventory of new, modern, and functional equipment that works well under their production systems.

One specific area where assistance may be profitable is irrigation. There is much confusion among growers about irrigation in general. Micro-irrigation, drip irrigation, overhead sprinklers, center pivot systems, and traveling guns are useful tools under the correct circumstances. However, from our observations, there is some chaos and poor understanding of what irrigation systems do, how they are managed, how they are calibrated to best practices, and how to manage irrigation in an actively growing crop. Improper installation of irrigation components can cause failure of the system, the crop, and the ultimate failure of the grower if the system is not rectified.

REAP does have opportunities to demonstrate the benefits of proper irrigation showing benefits of this technology to farmers. For example, one grower was visited that had a very good pome fruit genetics improvement business and is expanding; this is one of the farms where land has not been the limiting factor to expansion. However, it is necessary to assist this grower (grantee) by doing an engineering check on the irrigation components to see if they are compatible and adequate. This only takes a few minutes, but can mean the difference between successes or a compound failure. This is where the technical services committee may require more bolstering. Although a person can be educated in general agriculture, there is no possible substitution for actual experience post-education. Unfortunately, in the centrally planned model of Georgia in years past, little attention was given to broad experiential learning and critical thinking.

Good analysis and forward thinking or incorporation of recent knowledge in their current activities is critical to success in demonstrating viable agricultural technologies. In another case in the south of Georgia, advanced growers are becoming agriculture advisers and applying their KSA to local practices. They clearly understood the requirement for a complete system to function, but the fine techniques of managing the system requires experience that can only be obtained over time. In these cases, the trainers need training to reach through the veil of rote learning and grasp critical thinking and the elements of modern agronomic science and crop production. Although too late in the planting season for 2014 to do more than adequate planning for the spring of 2015, some fall tillage where, and if, available and rotation crops can be introduced, implemented, and models can be made more precise. Some new technology can probably be introduced for the 2014 season for specific areas such as precise applications for pesticides, some mid-season tillage equipment, and harvest and post-harvest equipment and methods.

Given the proximity of Georgia to EU markets and the mild climate, small fruits including strawberry, blackberry, raspberry, and blueberry may be good choices for the continuing development of the Ag sector. With high levels of labor available, production could be competitive with Spain and Portugal for early season berry fruits. Channeling the labor force into agriculture may be the simplest way to increase rural employment. However, to adequately service EU markets, technology must keep abreast making manual labor a stopgap measure to be replaced by future technology and skills development. The demonstration plots planned for high value horticultural crops which include short term, medium term, and long term crops must be selective in what they demonstrate to retain the interest of growers. They should show practical techniques that can be easily replicated whilst providing increased incomes for the demonstration plot operator and increased incomes in future for the target audience. Some suggestions are:

1. *Improved plants (genetics) for small fruits*. This can include strawberries, blueberries in some areas, raspberries and blackberries, as well as red currants. There are sufficient

micro-climates in Georgia to produce these crops on a rotational basis and to produce the necessary planting material with proper licensing. Tissue culture plants of excellent varieties can be imported and grown in greenhouses for multiplication and exposure to chilling to stimulate growth and development of further materials for commercial planting.

2. *Irrigation*. Irrigation should be a large portion of the improved technology associated with REAP and its emphasis on enhancing agricultural efficiency. However, one size does not fit all and so far, 100% of the systems we observed were improperly installed, poorly engineered, or managed very poorly. Additionally, costs can be shared if the manufacturers donate use of equipment, provide seed, fertilizers and inputs and the FSC/MSC entity manages the crop and holds the field day at harvest to disseminate true yields and quality straight from the harvester.
3. *Soybeans*. Where possible, soybeans can be considered to be one of the most desirable crops to grow, especially in a corn-soybean rotation system. Soy provides edible oil and protein for animal feed which is currently imported. Soybeans are an excellent beginner crop for understanding minimum tillage systems and how to properly manipulate newer machinery ranging from tillage, planting, and precision agriculture to crop drying and storage. It is also possible to use on-farm corn and soy for the grow-out phase of swine production where hogs are grown from 25 to 100 kilos with little or no processing. Other crops have been also suggested and include grass crops, legumes, mixtures, brassicas, and oilseed radish.

Local agronomists are not yet sufficiently prepared to help entrepreneurs engage global markets and devise solutions and specific differentiations that will grow their businesses and assist the farm sector to evolve properly and sustainably. Creative thinking and a strong exposure to market elements that drive demand and quality parameters is lacking in Georgia. This unfortunately cannot be rushed. To become an agricultural expert with 20 years' experience in crop production, quality selection, probing markets, sorting, packing, and using post-harvest technology takes 20 years. It cannot be compressed very readily.

REAP can use STTA to generate ideas that illustrate this sort of expertise and apply it to local conditions in order that the people being assisted do not have to suffer painful and expensive trial and error methods. Small businesses have difficulties with operating capital and are hard-pressed to invest in incrementally better technology such as new machinery or tools that might simply gather dust on their shelves and contribute to excess inventory.

The businesses we have spoken with tend to be knowledgeable about the improved techniques but cannot afford to be distracted from their day to day work due to high levels of competition from other distributors and newish dealers with cheap inputs from India and China. Although, disparaged due to their origin, there is no absolute difference in a brand such as Syngenta and a generic formulation from India if the chemical constituents are the same. This may not be possible to verify in Georgia without advanced lab facilities and technologies.

Even where competition is high in differentiation of product and specific techniques such as proper micro-irrigation and large scale irrigation, there is vigorous competition. Encouragements to the sector to diversify supplies and consolidate crops to gain economies of scale are necessary for the next step forward in the evolution of the agriculture sector. There are opportunities to form demo plots showcasing specific techniques and as a practice area for trying out new technologies. Examples of these are the application of calcium nitrate on apples in the fall to build trunk carbohydrate reserves and contribute to a larger and higher quality subsequent apple crop. Minimum tillage and no-tillage techniques where the terrain allows, crop rotations, and enhancing the micro-biome of the soil using cover crops could be applied, where possible. Plows should be discouraged unless absolutely necessary as a mixing tool. This over-use of plowing is simply an artifact of tradition and new tillage methods can be taught to growers via demo plots. Specifically, the planting of no-till soybeans or no till forage/cover crops after wheat looks very promising and can be introduced and introduced very rapidly.

In summary, there appears to be great potential in multiple areas of agronomic and horticultural investment in Georgia. There are some gaps in market knowledge and demand-driven investments are not considered as often as they could. Growers in Georgia have a local market mindset, which is completely understandable given the uncertainty of land tenure and the heavy investments required for international exports of agricultural goods.

Crop inputs are widely available and easily purchased, although many are obsolete and largely ineffective. There is low understanding of pesticide applications and their impacts. This problem generally eases as growers begin to use highly effective next generation pesticides with extremely low application rates.

Current pesticides are applied as kilos or liters per hectare; modern pesticides are generally limited to grams per hectare. Irrigation is a valuable tool and is one of the best investments in agriculture as it removes the risk of drought and reduces costs when mineral fertility can be managed via the irrigation network. Coupled with appropriate genetics of crop varieties and good management of efforts, it is difficult to see where crop failure would be a problem in the areas we surveyed.

Moreover, as growers become more aware of markets and as new crops develop, Georgia has a multiplicity of elevation changes and fine soil resources that would allow producers to focus on the highest value products. Some are currently grown in a very small scale, and others will require a complete updating of variety and technology, but the potential is clear. Agronomic crops in general are important for food security and animal forage. Even with such crops there is a large scope to improve methods and efficiencies with double-cropping, minimal tillage, rotational crops and clever additions to existing systems such as adding a legume crop to a grass crop for cattle forage, increasing protein and palatability. However, the real remunerative potential of Georgian agriculture lies in high value horticulture and exports to the EU. Proximity to Europe, moderated climates, and diversity of growing conditions make the country well suited to supply exotic and high value products to lucrative markets. Regular outside technical assistance should follow this project and ensure it focuses on core technologies of agronomy and new crops for export. Georgia represents a tremendous opportunity to build a powerhouse of high value horticulture and exports very efficiently. Introduction of properly managed demonstration plots will help Georgia to better understand and realize its agricultural potential.

ADDITIONAL DATA

ANNEX 1: RESOURCES USED

1. Full business proposals of REAP's grant recipients of Round 1, namely of :
    - I/E Giorgi Tediashvili
    - I/E Davit Omanashvili
    - Alva, LTD
    - Lukagro, LTD
    - Agrokartli, LLC

2. USAID's Analytical Foundation Assessment - Agriculture (Rural Productivity) Sector Report, 2011

3. USAID/SEAS (Strengthening Extension and Advisory Services in Georgia) Report on Existing Extension Services in Georgia, 2014

4. Assessment of Farm and Machinery Service Centers in Georgia (developed by USAID/EPI Project, author – Gerald Bahensky), 2011

5. USAID/EPI Year 2 work plan, where the rational for the knowledge plots is given in details, 2011-2012

ANNEX 2: LIST OF INTERVIEWS

Organization	Representatives	Location	Contact info
Agriculture Research Center (under the Ministry of Agriculture)	Levan Ujmajuridze, Director	Tbilisi	595 222217
USAID/SEAS Project (Strengthening Extension and Advisory Services in Georgia)	Roland Smith, COP; Liza Basishvili, Project Manager	Tbilisi	577 471046
EU/Capacity Building of the Ministry of Agriculture Project	Lasha Dolidze, Deputy Team Leader	Tbilisi	595 759955
USAID/Economic Prosperity Initiative	Vincent Morabito, Agriculture Sector Component Lead	Tbilisi	577 418812
Union Agroservice	Inga Lagoshvili, Director	Tbilisi	599 72 89 80
Akhaltsikhe Vocational College "Opizari"	Bela Avalishvili, Director	Akhaltsikhe	577 200730
Elkana (Biological Farms Association)	Irakli Javakhishvili, Marketing Director	Tbilisi	599 969014
Kartlis, G & A (Dupon& Pioneer representative)	Robert Revia, Director	Tbilisi	599 564712
Agronovacia (Seminis & Metzerplas representative)	Levan Kometiani, Director	Tbilisi	
Netafim (greenhouse and irrigation systems)	Vakhtang Gogaladze Director	Tbilisi	

Borani Sophkimia	Gia Kordzadze, Executive Director	Tbilisi	215 75 75
Luk-Agro Ltd	Tamaz Naskidashvili, Owner	Kakheti, Tsnori	599 999929
Kartlis Ltd	Ambrosi Macharashvili, Manager	Kakheti , Lagodekhi	599 508076
I/E Giorgi Tediashvili	Giorgi Tediashvili, Owner	Kareli, Breti	599 925036
I/E Ivanidze	David Ivanidze, Owner	Kareli, Bebnisi	599 925036
I/E Makhare Matsukatovi	Makhare Matsukatovi, Director	Akhalkalaki	596 577788
Rural Advisory Service Ltd	Guram Jinchveladze, Owner	Akhaltsikhe	599 517891
Georgian Business Zone Ltd	Beso Babunashvili, Owner	Akhatsikhe, Tsnisi	599 557464

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