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**Private Sector Competitiveness  
Enhancement Program**



# GREENHOUSE SECTOR ACTION PLAN

**MAY 2009**

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## SECTION I

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### Executive Summary

#### A. Overview

In early in 2009, the Private Sector Competitiveness Enhancement Program (PSCEP) conducted a Domestic Resource Cost (DRC) analysis to determine economic and financial profitability in over thirty sectors and sub-sectors of Azerbaijan's non-oil economy to identify those sectors where Azerbaijan has a comparative advantage and where program efforts will most effectively be focused. The study identified greenhouse tomato and cucumber production as highly profitable. This finding was confirmed by PSCEP's ongoing qualitative agribusiness sub-sector analysis. Accordingly, PSCEP chose greenhouse vegetable and fruit production as one of its sub-sectors.

Azerbaijan has three major greenhouse vegetable production areas: (1) the western part of the country, with an estimated 55% of production is centered in the Ganja and Shamkir region; (2) the central region, with 30% of production encompassing the Absheron peninsula; and (3) the southern region, with 15% of production in the Lankaran and Astara area. Across these three areas an estimated 200 hectares of commercial vegetable greenhouses are in cultivation.<sup>1</sup>

Greenhouse vegetable production is not a large sector. It generates approximately \$55-75 million Azerbaijani Manats (AZN) per year in annual sales. Nonetheless, it is a fast growing segment, with many new commercial greenhouse operations in recent years.

Constraints and weaknesses in operations are prevalent throughout the greenhouse value chain, including infrastructure, primitive production practices, weak human resources, and access to finance. Though infrastructure is the greatest bottleneck to increasing the quantity and quality of greenhouse product (including energy costs, market information, access to finance, cold transport, warehousing, packaging, laboratory testing, and access to quality inputs), human resources are particularly low and the lack of associative structures and activities diminishes the ability of the sector to adopt and disseminate best practices. These factors truncate the commercial promise of the sector, resulting in decreased product quantity and quality, limited value chain cohesion and attendant limitations in sales, jobs, and investment.

These constraints are not minor. The good news is that PSCEP believes that a targeted effort in the areas listed above will advance the sector and generate significant, two-fold increases in productivity and profitability within the sector over the life of the project.

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<sup>1</sup> Government authorities, donors, and multiple sources cite varying figures with some are as high as 2,000 ha. under greenhouse cultivation, although these larger estimates probably include backyard, noncommercial greenhouses which are prevalent in the regions.

## **B. Action Plan**

PSCEP's strategy consists of a five pronged approach to enhance sector competitiveness:

1. firm level assistance, especially of key “anchor” enterprises, in each region, focused on addressing key constraints to increasing sales, increasing investment, creating jobs, and enhancing productivity;
2. regional and national sector level assistance, especially select multi-stakeholder training opportunities that address sector-wide issues and constraints at the value chain level;
3. regional demonstration sites aimed at smaller, or “semi-commercial” operations, to expand PSCEP's outreach and overall impact;
4. access to investment and finance, including sustainable commercial bank lending, equity investments, and joint venture promotion to address specific areas such as greenhouse expansion and transportation logistics; and,
5. development of associative relationships.

These efforts will not be undertaken in isolation but rather, tap synergies from other sectors in which PSCEP is working. For example, PSCEP will strengthen warehousing and cold chain segments of the value chain, which will be highly beneficial to greenhouse operations. Through the cold chain action plan, PSCEP will forge joint ventures and expand investment in refrigerated transport.

PSCEP will support greenhouse enterprises in three leading areas of the country described above. Enterprise level activities will maximize sectoral impact through altering the core practices of key industry leaders across the three main regions of production. Firm level assistance will include, *inter alia*: operations planning, strategic planning, and greenhouse growing techniques, including the management of greenhouse environment, cultural methodologies for specific crops, and production scheduling.

It is crucial that these firm level activities bring disjointed value chain components together for greater progress and cohesion of the sector as a whole. Promotion of activities in soil, plant, and water testing, regional university collaboration, and market information systems, will be the foundation of our work within the sector. These activities involving a myriad of regional and national stakeholders will allow PSCEP a window of opportunity to help establish associative relationships, including a sector association, by utilizing anchor firms, regional universities, and trade associations.

## **C. Expected Impact**

Expected results from PSCEP's investment in the greenhouse sector include:

1. Sales and job percentage growth higher than 50% above the industry trend line. This implies sales increases in the range of 7 to 10 million AZN and over 450 full time job equivalents.
2. Direct investments of no less than \$10 million AZN.
3. Productivity increased by over 50% in enterprises assisted by PSCEP, with quantifiable multiplier or spillover impact on nearby enterprises.

4. Three regional associative relationships established among stakeholders, leading to the establishment of national association or other formal or informal body.
5. Over 30 stakeholders trained in competitive greenhouse management and operation practices.
6. One smaller demonstration greenhouse funded and established in each of the three main regions, with over 50 individuals participating in related trainings and workshops. Increases of no less than 35% in productivity demonstrated.

## SECTION II:

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### **Greenhouse Sector Assessment**

#### **A. The Greenhouse Value Chain**

The greenhouse sector in Azerbaijan is concentrated in three areas: the west near Ganja, the south near Lankaran, and the east throughout the Absheron peninsula. Of the 200 hectares of greenhouses in Azerbaijan, about 20 % are antiquated Soviet style greenhouses, many of which are currently being updated and refurbished by their owners. Most large operations consist of rebuilt glass houses which contain antiquated technology. These constitute some 50% of the greenhouses. New structures of Israeli, Dutch, Turkish and Italian companies have been built or are in the planning stages of construction. These make up about 30 % of greenhouses. In addition, upwards of 75 hectares of home built plastic greenhouses and tunnels exist in the regions.

The growing cycle of greenhouse tomatoes and cucumbers occurs in the fall and spring of each year. Tomatoes are the primary crop grown on an estimated 150 hectares of greenhouse, with the remaining hectares devoted to cucumbers, and a small number devoted to lettuce and greens. Some high value crops such as flowers are not produced because of informal and reportedly strictly enforced monopolies on their commercialization. Perhaps a third of the growers raise a crop of tomatoes in one season and cucumbers in the other season each year. Ancillary businesses exist in seedling production, greenhouse construction, chemical pesticides and fertilizers, as well as greenhouse equipment including glass production, and drip irrigation equipment<sup>2</sup>.

Transportation services are poor and cold storage is inadequate. In the west, exports are generally in straight bed, un-refrigerated trucks that are unloaded at the border and reloaded onto Russian trucks. In the south, tomatoes are packed green in wooden boxes betting against time that the produce will get to Russia before the tomatoes are overly damaged or otherwise deteriorated. Road conditions and the absence of refrigerated transportation capacity are two constraints which hamper these efforts.

Market information is limited. Progressive growers and traders create their own limited research for issues confronting their business and are highly reluctant to share that information in order to maintain the advantage of their research. Past market information systems in the region are either defunct or severely reduced, retarding the ability of producers to participate in the dialogue with the export markets regarding price, variety, packaging specifications, and timing of delivery.

Finance and investment is largely unavailable or scarce throughout the segments of the greenhouse value-chain. Input suppliers, equipment suppliers, greenhouse growers, cold transport, cold storage and market information systems are all in need of finance and investment.

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<sup>2</sup> For more information about growing practices in Azerbaijan please see Annex H

Although lead growers often have adequate financial resources and are established with financial institutions, or alternative capital sources, intermediate level growers have ongoing financial concerns be they cash flow, operations, or capital investment needs. Small growers believe they do not generate enough income to cover the costs of their greenhouse business operations and provide an acceptable income. Banks consider greenhouses to be high risk, though their risks are less than other agricultural sectors.

At the present time, no greenhouse vegetable grower associations exist in Azerbaijan and formal education and research institutions, such as the Ganja Agricultural University and Lankaran University, provide only limited benefits to the growers according to survey participants. Those services that are provided to the private sector are generally done so by NGO groups such as the Young Agrarians, Agro Meslahet, and the input dealers association, AKTIVTA. Across the board, human resources are limited and ancillary businesses including greenhouse construction, input supply, packaging, cold storage and cold transport are absent the necessary resources required (both financially and technically) to achieve economies of scale.

## **B. Greenhouse Sector Metrics**

Greenhouse tomato production ranges from about 144,000 kg per hectare to more than 288,000 per hectare, per crop. Extrapolating from information in the U.S. production areas, the cost of production is about 87% of gross revenue with net returns to the grower of some 13%.

If production is 144,000 kg per hectare, and the price averages 1 AZN per kg (both conservative estimates), then using the above percentages, the return to the grower is about 18,720 AZN per crop. If the estimate of 200 hectares of greenhouse vegetable production in Azerbaijan is correct, and if 150 hectares are devoted to tomato production, the returns to the growers for the 150 hectares of tomatoes would be 2.8 million AZN per crop or 5.6 million AZN per year.

Production of tomatoes seems to average around four kilograms per plant in the smaller greenhouse operations. This likely does not exceed the true cost of production, if all costs are taken into account. However, most growers believe they are profitable and can possibly sustain their operations at this level for some time because of their doggedness and creativeness. These growers need to be trained and brought up to speed to successfully compete in the industry or face failure (or remain unproductive and poor) as they are outpaced by developments in the commercial market.

More skilled growers are reaching eight or more kilograms production per plant, which can be profitable, with s management. The norm in the E.U. and U.S. is approximately 50% higher, or 12 kilograms, or more of fruit per plant. Cucumber harvest per plant is around 5 to 8 kg compared to 10 to 12 kg in other advanced production areas. These production levels can be raised to the benchmark averages, and likely exceeded with refinement of the production systems and training of growers.

Compared to available data of other countries in the region, Azerbaijan lags in all categories of greenhouse vegetable production. Tomato fruit production per plant ranges from four to eight kg with most production near the low end of that range. Cucumber fruit production per plant commercially, world wide, ranges from about 6 to more than 12 kg per plant. The majority of

commercial greenhouse tomato and cucumber farming in the EU, US and Mideast is in bags, hard containers, or sand culture with fertigation systems. In Azerbaijan, most production is in ground beds or troughs with drip irrigation and some fertigation. If fertigation is already in place, growers can convert to bag culture for an investment of less than five AZN per square meter. The increase in production should be evident in the demonstration greenhouses established in each region and will eliminate all objections of doubtful growers.

Grower organizations, in one form or another (cooperatives, associations, etc) exist in every Western society, with increasing numbers of such groups in Africa and the Middle East. Their purposes include marketing, purchasing input supplies, education, lobbying and socialization. That they do not exist in Azerbaijan in any meaningful sense is a constraint which will limit the success of the greenhouse sector structurally.

Water, soil, and plant tissue testing laboratories are the norm in the West with regard to agricultural production areas and vary from basic Nitrogen Phosphorus Potassium (NPK) analysis to more sophisticated labs with equipment capable of more intensive analysis. At the very minimum, basic laboratories are necessary for growers to upgrade and maintain production levels and quality.

The trend in the temperate climates is toward the use of high tunnel structures and greenhouses covered with polyethylene. In some countries, such as Holland, glass greenhouses are still preferred, but the trend is away from such structures, worldwide.

### **C. Value Chain Constraints**

While significant avenues exist for the cost-effective and timely advancement of the greenhouse sector in Azerbaijan, the sector is highly constrained. This section describes constraints throughout the value chain in inputs, production, post-harvest, transportation and warehouse, market information, support institutions, and access to finance<sup>3</sup>.

#### **C1. Inputs**

Obtaining appropriate inputs for greenhouse production needs in a timely manner and at economical prices is difficult in Azerbaijan. Fertilizers, seeds, packaging supplies, and specialized tools and equipment are of greatest concern here. There is limited selection of equipment and supplies. There is a lack of transparency about access to equipment or supplies in some cases, causing hesitancy on the part of the buyer. Domestic manufacturers of equipment and supplies are limited. There are quality issues and Government of Azerbaijan (GoAJ) activities, such as subsidized fertilizer programs or loan programs, seem to be a broadly ineffective if not a negative force for those who do not qualify, but lose interest in applying for a loan at market rates as a result.

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<sup>3</sup> For additional information on constraints see Annex C



## **C2. Production**

Production constraints are significant and multifaceted. Poor growing practices, greenhouse management, business management, weak human resources, and a dearth of testing services all combine to adversely affect production quality and quantity.

Because of variations in production methods and uncertainty regarding seed, fertilizer, and pesticide inputs, wide swings in production quantity and quality occur in individual ranges. This variability is increased due to a uniformly low level of specialized human resources and greenhouse management know-how. Inadequate records, analysis and planning exacerbate these difficulties as does the lack of availability of water, soil, and plant tissue analysis services so that in the end greenhouse growers may have a flawed idea of why they have- or have not- had a productive season.

The cost of electricity is high compared to neighboring countries and that limits the ability of greenhouses to begin production early in the winter months. Makeshift greenhouse design is not energy efficient in this regard, and even if there was a willingness to change greenhouse structures there is a present lack of interest in investment into the greenhouse sector for operations or expansion.<sup>4</sup>

## **C3. Post Harvest**

Throughout Azerbaijan and across multiple agricultural sectors, post harvest handling procedures including handling, sorting and grading are poor. Packaging techniques and packaging information are limited and in turn limit market access and reduce wholesale prices.

## **C4. Transportation/Warehouse**

Transportation expense is high and availability is inconsistent. Antiquated transportation without refrigeration capacity is used domestically, increasing transportation loss. Truck availability is low. For both transportation and storage, market information is not widely disseminated. Although Cold Storage projects are advancing in the areas of high greenhouse concentration, capacity as of yet is still insufficient.

## **C5. Marketing**

Market information for greenhouse production is highly limited. What little information does exist is created on a firm by firm basis and not shared such that market opportunities are frequently truncated rather than dealt with collaboratively with other growers. What market information does exist for public consumption is poor. As a result the supply chain is disorganized and vertical integration at the sectoral level is hampered due to poor communication paths downstream.

Labeling in general is substandard for all but the lowest tier of international markets. Product origination data is often missing. The lack of market information inhibits the grower from

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<sup>4</sup> For more information on greenhouse heating and cooling please refer to Annex I.

understanding the criteria for higher value production standards and the possible price increases that may accompany quality gains. As a result of these variables, capital investments for expansion become less of a strategic business decision and more of a gamble, hindering any investments.

## **C6. Support Institutions**

Formal education and research institutions, Ganja Agricultural University and Lankaran University, provide limited benefits to growers. Ministry of Economic Development or Ministry of Agriculture structures each have programs aimed at increasing access to finance but neither appears to be efficient in promoting greenhouse sector growth.

Extension services or similar structures are not active and training programs for supervisory, mid-management, or technical specialist personnel are not present or relevant according to greenhouse surveys conducted throughout the course of sectoral research. This lack of academic depth of knowledge in the sector limits research in greenhouse methodologies that could otherwise be responsible for better seed varieties and growing practices.

Most present services are provided by NGO groups such as the Young Agrarians, Agro Meslehet, and the input dealers association, AKTIVTA. Each of these organizations has consultants who serve a regional audience although their level of technical expertise is still substantially beneath the level of foreign experts.

## **C7. Access to Finance and Investment**

Loans to farmers by commercial banks are rare. There is a prevailing opinion that agriculture in general is too risky. The State run Agro Leasing Company does some agriculture facility leasing to provide agriculture supply outlets in some areas of Azerbaijan. One international financial organization observed that many of the smaller, private lending companies are finding it hard to compete with Agro Leasing. In addition to this, applicants to subsidized loan, lease, or input supply programs who are refused, frequently forego all other options that are available at free-market prices, thereby suspending their potential development rather than accelerating it.

Equity investment in Azerbaijan is mostly unheard of to greenhouse producers and there is fairly widespread reluctance to embracing the concept.

## **D. Greenhouse Value Chain Opportunities**

Immediate improvements in the greenhouse value chain will come through interventions to increase production, such as bag culture methodology; increase greenhouse financing for operations expansion and enhanced input supply; and the upgrade of semi-commercial operations. Promoting associations through concerted efforts with lead producers, input suppliers, universities, and business development service providers will help to sustain and extend these production changes to make positive changes through the development of testing facilities, demonstration greenhouses, and industry appropriate university programs.

The opportunity in the greenhouse sector is to make an impact in each of three geographic areas utilizing lead producers, input suppliers, universities and Business Development Service (BDS) Providers in order to bring disparate value chain segments together for the benefit of each. In the West, we will seek to involve the Ganja Agricultural Academy, just as in the South-we will involve Lankaran University. The creation of demonstration plots and soil testing at the regional level will advance sectoral cohesion and also allow producers a level of quality testing that will aid firms in accessing new markets and controlling their growing environments.

### D1. Firm Level Assistance

By engaging lead growers in each region and providing targeted technical assistance to meet their demand driven needs, new practices will be institutionalized in each region and disseminated as their results are proven through enhanced sales.

An extension of the growing season of two weeks at the beginning of the spring crop and at the end of the fall crop is achievable and, if followed, could result in as much as a 1 kg per plant per plant kg difference in production, or an estimated 25,000 kg per hectare in average commercial production in southern Azerbaijan. Widespread acceptance of this practice could result in as much as 4,000,000 Kg of additional production.

One key refinement in production methodology is the establishment of bag culture in the production of tomatoes and cucumbers. This technique involves growing the plants in either horizontal or upright bags (or other containers) to keep the roots out of contact with the natural soil and drastically minimizes problems associated with root nematodes and soil borne

Possible Greenhouse Production Enhancements	
1	Drip irrigation installation and maintenance
2	Fertigation system installation and management
3	Bag/container establishment and management
4	Greenhouse environmental management
5	Harvest and post harvest handling – packaging- grading
6	Greenhouse sanitation and food safety management
7	Inter cropping and succession cropping
8	Managing production cost control
9	Crop record keeping and analysis
10	Fertilizer needs assessment for specific crops

diseases. A well drained medium is used in the bags and maintained at an optimum fertility level throughout the crop life cycle. Combined with a drip/fertigation system, a 50 to 100% increase, or more, in production is expected. If tomato production, alone, would be increased by those percentages, it would amount to about 144,000 to more than 288,000 AZN of additional revenue per hectare. The calculated cost of installing a bag culture system with fertigation in an existing greenhouse is approximately 9.5 AZN per square meter.

Tomato and cucumber varieties are another aspect of production given insufficient attention by growers. In the past, appropriate greenhouse varieties were very difficult to obtain. The situation now has eased considerably, and growers can get proper hybrid seeds locally or by direct mail from international seed companies. Yet, some growers select cheaper outdoor varieties or save seed from hybrid plants to use in subsequent years, which leads to much lower levels of production and product quality.

## **D2. Sector Level Assistance**

Opportunities are present for regionally and nationally focused sector level assistance through collaborative arrangements with universities in the West and the South of Azerbaijan, through the promotion and expansion of market information services in Azerbaijan, and through increased access and know-how regarding plant, soil, and water testing facilities in each region. By engaging universities in a concerted effort to raise the level of human resources for lead producers there is an opportunity to tie education to on-the-ground market-led requirements of local growers, benefitting both the public and the private sector. In the promotion and expansion of market information services, producers in Azerbaijan will be able to better allocate resources, assess trends, and manage greenhouse harvest and seed varieties. By increasing access and know-how regarding plant, soil, and water testing greenhouse growers could have a heightened ability to understand the causes of variations in harvest volume and the required amendments to advance production quality, quantity, and food protection issues.

Because human capital is poorly trained in the greenhouse sector, and regional universities in the greenhouse areas do not have coursework suited to greenhouse vegetable production it is recommended that PSCEP promote development of curriculum or vegetable crop production programs, including greenhouse culture, through partnerships with these universities. The establishment of water, soil and plant testing laboratories at these universities could further strengthen ties within the sub-sector.

## **D3. Demonstration Plots for Semi-Commercial Growers**

While every commercial greenhouse could fine tune some facet of their physical plant, semi-commercial growers face prospects of large scale production gains from basic augmentation of their growing methodologies and greenhouse structures. Upgrading these facilities could easily double their production. There are an estimated 300 growers in this category operating on some 75 hectares of vegetable producing structures. Demonstration facilities are appropriate here. Annex E contains an example of the possible evolution stemming from the creation of these facilities.

Potential sites for demonstration greenhouses are located in each of the three principle greenhouse regions and include partnerships with universities, BDS organizations, and input suppliers. A grant to enable demonstration facilities and soil testing services would be self supporting and benefits would accrue quickly for semi-commercial growers involved in the program.

These activities would have a market led impact on human resources and, led by demand from within the value chain, they could be magnified through collaborations with universities in the Ganja and Lankaran area to develop horticultural curricula and related internship programs.

## **D4. Finance and Investment Promotion**

There are opportunities in finance throughout the greenhouse value chain. Existing producers need cash to be able to expand their operations, semi-commercial growers need financing to forge commercial operations, refrigerated trucks, cold storage, laboratory testing, and marketing

information systems are all opportunities for finance and investment in the greenhouse value chain.

The critical opportunity here is to work directly in between financial bodies and greenhouse operations in order to resolve financing issues on a case by case basis for lead producers. Basic training in financial modeling would serve as an aid to help businesses better manage their risk and allocate their resources while also allowing them to engage financial institutions in a more productive dialogue.

One example where finance and investment are critical to the growth of the greenhouse sector is refrigerated transport and cold storage. If traders had vehicles for transport in a quantity sufficient to serve their growers, the profit potential for each would strengthen. Financing of the vehicles would be necessary in most cases. There are a significant, but unknown number of traders who deal with greenhouse vegetable growers. These could be invited to not only participate in the PSCEP consortium groups for the purpose of unifying the value chain, but also to provide them with updated truck financing information and assistance through support of the PSCEP Access to Finance program. Since most of these traders also service field vegetable producers, the use of better trucks would also positively impact them. On the average, it is estimated that the improved quality (due to refrigeration), better condition and reduction of loss (due to better truck suspensions) would amount to some three percent increase in value of the produce handled.

The limited availability of produce warehouses and cold storage facilities for producers is another constraint to increased sales of greenhouse vegetables. If produce could be collected and/or brought to a central location and kept until sufficient volume is available to meet a buyers needs or until market prices increase, growers, traders, warehouse/cool storage owners and the buyers would all benefit. The financing of such large enterprises usually requires outside lending sources or investors. The cost would vary with the size and location. Estimated cost per square meter is about 900 AZN for a dry warehouse and 2,000 AZN for a cold storage facility. Each individual warehouse and/or cold storage facility would need to be unique to the locale.

## **D5. Association Development**

Associations offer a forum to disseminate new technology, to learn, and to bargain collectively for production inputs and highest market price. The presence of a cohesive community of growers also allows other support institutions to justify the increase of services that would increase and promote the resources of the group such as human resources development through local university curriculum development, or plant, soil, and water testing.

No formal active associations or other cooperative groups are known to operate among the greenhouse vegetable growers in the country. Several NGO agriculture consultant companies (Young Agrarians in Ganja, and Agro Meslehet near Lankaran) and the agricultural input dealers Association (AKTIVTA), headquartered in Baku, provide services to greenhouse owner/operators for a fee.

Previous attempts to form cooperatives or associations among vegetable growers have not succeeded. Reasons cited include past negative experiences under the Soviet system, the rugged

individualism of farmers, and the fear of loss of private information. Yet, many of the commercial growers indicated that a unified effort would have positive benefits in several aspects of their businesses, though they did not overtly volunteer to participate.

## **SECTION III:**

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### **Action Plan**

#### **A. Objective**

As the greenhouse sub-sector continues to develop into a significant component of commercial agriculture in Azerbaijan, major greenhouse producers must refine their business practices, and production technologies. In order to develop the industry to its full potential, these lead growers must evolve into a unified and organized associative community which can access and utilize technical information more effectively to increase productivity and link this technical information to financial information in order to readily access finance and investment. The level of human resources must be raised and supporting services, such as laboratory testing, must be developed in a way that distributes access and benefit across the sector while creating opportunities to work together for the individual benefit of each firm.

PSCEP will engage and unify lead players in the greenhouse sector through the interrelated activities of production enhancements, demonstration plots for semi-commercial growers, increased access to finance and investment, and association development.

The objective of this action plan is to create transformative change in the greenhouse sub-sector in the next three years. The basis of this change will come through five primary activities:

1. Firm level assistance, especially of key “anchor” enterprises, in each region, focused on addressing key constraints to increasing sales, increasing investment, creating jobs, and enhancing productivity;
2. Regionally and nationally focused sector level assistance, especially select multi-stakeholder training opportunities that address sector-wide issues and constraints;
3. Regionally focused demonstration sites aimed at smaller, or “semi-commercial” operations, to expand PSCEP’s outreach and overall impact;
4. Access to investment and finance, including sustainable commercial bank lending, equity investments, and joint venture and GDA promotion to address specific areas such as greenhouse expansion and transportation logistics;
5. Development of associative relationships.

#### **B. Firm-level Assistance**

PSCEP will work with a select group of greenhouse operators in the regions of Ganja / Shamkir and Lankaran / Astara. The purpose of this component is to maximize program impact in terms of sales, jobs, and investments, by leveraging the role of these firms as value chain leaders or “anchors” in their areas. Accordingly, this assistance will also impact other value chain stakeholders (suppliers, smaller greenhouse operations which may benefit from a demonstration affect, etc.). These firms will play a key role in many training activities (a separate but interrelated component), which PSCEP will design to effectively utilize these enterprises.

The criteria to select these firms will include: (1) potential to increase sales, employment and attract investments; (2) management’s commitment to changes that promote competitiveness; and (3) potential for impact beyond the firm to the value chain.

Firms selected to date in this sector include:

Initial Anchor Firms		
	Company	Region
1	Azertejhzat-M LLC	Zakatala
2	Janub Agro	Lankaran
3	Bitkiler Alemi	Lankaran
4	AzRusDosluq	Shemkir

Among the type of assistance that PSCEP will provide these enterprises are: (1) technology transfer (both individually to the enterprise and through joint training sessions with other companies); (2) management and cost analysis; and (3) new market development.

Technology in use in most commercial greenhouses in Azerbaijan today varies from current standard levels to that which is several decades old. In order for the sub-sector to maintain a competitive market position in the region, these key anchor firms (and subsequently, technology/production “followers” greenhouse production quality and quantity levels must be raised to a consistent high quality standard.<sup>5</sup>

### **B1. Technology Transfer and Productivity Enhancement**

While assistance will be customized to each enterprise, there are numerous common constraints and opportunities that PSCEP will address to maximize synergies. For example, as discussed in the previous section, PSCEP will work with selected greenhouses and other stakeholders in delivering joint and individual technical assistance to extend the growing season. PSCEP will also assist the enterprises in establishing bag culture in the production of tomatoes and cucumbers to significantly expand yields and increase productivity. The program will also work with operators to utilize the most appropriate varieties in their production – often not the case in Azerbaijan.

### **B2. Management and Cost Analysis**

Lead producers would not have become achieved their positions without some understanding of their business, yet few have an ability to articulate that understanding on paper. Moreover, numerous apparently successful greenhouses interviewed do not appear to have a full understanding of their cost structures. This constraint becomes a critical problem as producers seek to expand or further develop their business and require access to funding. By having a working business model, subsequent planning for these firms will be on a standard format, will be easier to analyze, and access to finance will be more transparent and efficient.

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<sup>5</sup> Please refer to Annex G for specific information on customized training programs.



PSCEP will provide management/financial training to firms individually and collectively, through regional workshops. These business models will incorporate key information for use in strategic business and enterprise planning, financial analysis and accessing finance. Each model will be customized to the operations of each lead producer and all information will remain confidential.

### **B3. Develop New Markets**

Where appropriate, PSCEP will work with enterprises to expand and secure new markets.

### **B4. Enterprise Level Train the Trainer Program created and implemented**

PSCEP will develop data collection, documentation, and reporting tools specifically for greenhouse vegetable crop enterprises. Workshop attendees will be trained as trainers to teach the key employees of each enterprise on the use of these tools for the better operational and financial management of their range.

## **C. Sector-level Assistance**

The objective of these activities is to conduct regionally and nationally focused sector level assistance through collaborative arrangements with universities in the West and the South of Azerbaijan through the promotion and expansion of the market information services.

### **C1. Improve Market Information Systems**

PSCEP will determine the extent of governmental and Agro Meslehet market reporting services and whether they can be internally expanded to serve the greenhouse sub-sector with daily and historic information for all markets served. If not, consideration should be given to establishing a BDS provider to conduct the service. This information is of sufficient importance that PSCEP should consider a seed grant for support. It may be possible to structure the service to serve a broader base than just the sub-sector and to charge a small subscription fee to cover annual costs. Further study is required.

### **C2. Establish a Partnership with the Ganja Agricultural University and the Lankaran University**

Arrange for greenhouse specialist to develop, cooperatively with University faculties, a program outline and appropriate courses for a horticultural program inclusive of internship opportunities with lead local producers. The impact of this is long term, but will add to the sustainability of this sub-sector by providing trained professionals in the field of horticulture and by bringing academia closer to present market and production trends.

## **D. Regionally-focused Demonstration Plots**

In addition to efforts with lead producers, there are some 300 growers we classify as semi-commercial in the principle greenhouse production areas of Azerbaijan. Many of them would be capable of managing a higher tech greenhouse and, in some cases, increasing their greenhouse

income by a factor of 10 or more to become true commercial greenhouse operators. In order to enable and enhance training in the program to serve these semi-commercial growers PSCEP will tap its Innovation Fund to provide grants for at least one demonstration plot in the geographic areas in which it will work.<sup>6</sup>

The grants will be provided on a competitive basis through a formal Request for Application. It is clear that there are numerous organizations capable of carrying out this work.

The grantees will be assisted to construct greenhouses using basic, but high tech production techniques. Once each demonstration greenhouse is constructed, annual cropping schedules should be established beginning with tomatoes and continuing with direct involvement of trainees in the production and maintenance of each greenhouse. Each greenhouse will be an ongoing operation and open to all growers to observe existing procedures and new innovations as they are implemented.

#### **E. Access to Investment and Finance**

The purpose of this component is to work with individual enterprises and banks (as well as collectively with banks and investment companies) to propose actions to enhance and expand value chain components through increased access to finance and investment. If greenhouse production increases as expected, these other value chain components will need to grow to provide the additional services which will be required.

While PSCEP will work at the enterprise level to enhance access to finance, it will also work at a macro level to achieve this objective. For example, PSCEP will work with six commercial banks and three investment companies in order to facilitate their better understanding of the greenhouse sector and its opportunities. PSCEP has already been successful in acquiring financing from Caspian International Investment Company (CIIC) for two Azerbaijani greenhouse businesses, AgroYurd and NAA Company, totaling 3 million AZN (1 million and 2 million AZN respectively). In July, PSCEP will hold separate presentations for commercial banks, equity funds and international financial institutions such as European Bank for Reconstruction and Development (EBRD) and International Finance Corp. (IFC) to promote and advance investment opportunities. Sector meetings with funds will be held in June, with banks, in July, and IFIs, in August.

#### **F. Development of Associative Relationships**

The purpose of this activity is to facilitate the development and organization of a unified consortium of progressive greenhouse vegetable owner/operators and to promote its sustainability.

The objectives of this action plan component are to coordinate regional professional greenhouse vegetable owner/operators groups in a functional format that would provide the following benefits:

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<sup>6</sup> Please refer to Annex E for further information on greenhouse production projections and earnings for semi-commercial growers utilizing new technology.

1. Better access to current market supply and price information;
2. More accurately and effectively access consumer preference information;
3. Opportunity for domestic and international networking;
4. Better access to domestic and international regulatory information; and
5. Access to accurate, current information on food safety issues.

The value of these benefits to the greenhouse vegetable sector in Azerbaijan will be more rapid growth and profitability estimated at 800,000 AZN over LOP.

Currently there is no greenhouse vegetable grower's organization in Azerbaijan. However, there are two universities, several NGO consultant organizations, BDS providers (The Young Agrarians, and Azerbaijan Agribusiness Center), AKTIVTA, a dealers' trade association, several prominent traders, business people, and several prominent greenhouse vegetable growers who could be approached to function as a host organization in each of the three key greenhouse intensive regions. PSCEP will also be bringing together numerous greenhouse operators and stakeholders in trainings, workshops, and other activities that will serve as basic first steps in movement towards more formal associative relationships such as regional clusters.

Experience world-wide has shown that this process cannot be "top down" enforced, but requires an incremental, but consistent series of steps to create trust and to make stakeholders clearly see the value of joining forces. In all activities, PSCEP will have this objective in mind, without discussing associations per se. We expect the process to be sufficiently mature so that by mid March/April 2010, clusters begin emerging in each region, supported by the program.

## **G. Expected Impact**

The expected impact of Action Plan implementation include:

1. Sales and job percentage growth higher than 50% above the industry trend line. This implies sales increases in the range of 5 to 10 million AZN and over 450 full time job equivalents.
2. Direct investments of no less than \$10 million AZN.
3. Productivity increased by over 50% in enterprises assisted by PSCEP, with quantifiable multiplier or spillover impact on nearby enterprises.
4. Three regional associative relationships established among stakeholders in each of the major regions, leading to the establishment of national association or other formal or informal body.
5. Over 30 stakeholders trained in competitive greenhouse management and operation practices.
6. One smaller demonstration greenhouse funded and established in each of the three main regions, with over 50 individuals participating in related trainings and workshops. Increases of no less than 35% in productivity demonstrated.

## H. Timeline

In October of 2010 PSCEP will evaluate progress to date, broaden those initiatives that have had greatest impact and plan for the next planting cycle in December. Training in business modeling will be extended and new developments with university and other stakeholder partnerships are expected. As the growers associations take hold in Ganja, Lankaran, and Absheron, grower's conferences will be planned for the spring of 2010. Our success in accessing financing for transportation, cold storage, and semi-commercial greenhouses will be measured and our resources reallocated in order to assure maximum impact. Likewise, our production enhancement measures will be evaluated for impact and follow-on measures initiated.

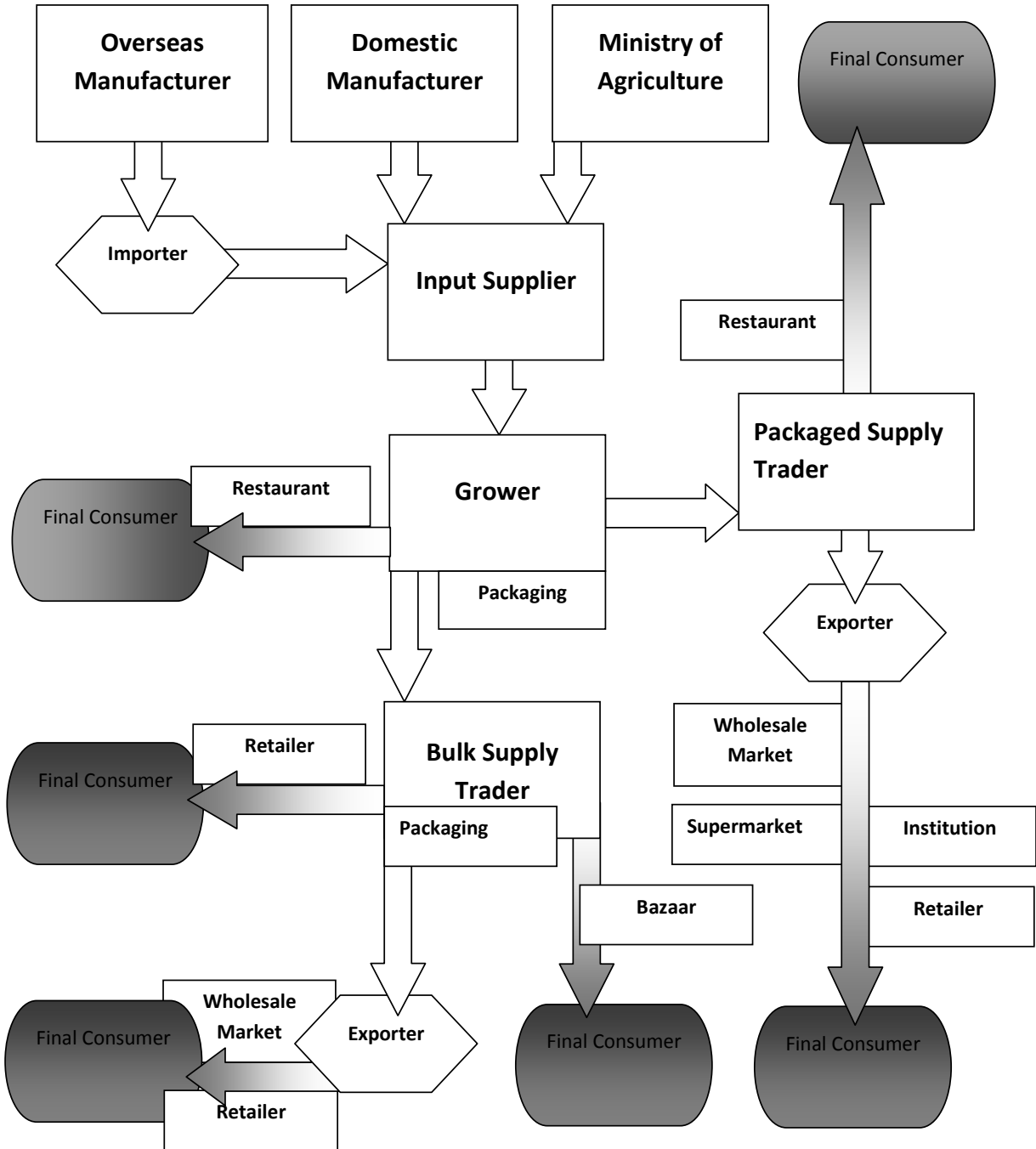
Key Activities in the second half of 2009 are detailed below:

Summary of Activities, Timetable, and Planning Chart: 2009				
ACTIVITY	MONTH	COUNTER-PART	PSCEP INPUT- SOW	PSCEP LOE
Directed Firm Level Support	Ongoing	PSCEP foreign technical specialist	PSCEP will provide firm level support	Ongoing
Conduct workshop to develop individual greenhouse business model in collaboration with BDS providers	September-October, 2009	PSCEP specialist, BDS provider, Lead Firms	PSCEP will provide specialist to develop individual greenhouse business models	3 weeks in-country
Enterprise level train the trainer program created and implemented	October-November, 2009	PSCEP technical specialist, BDS providers and lead firms	PSCEP will provide specialist to train the trainers	3 weeks in-country
Determine extent of existing market information system and support development of expansion	April-May, 2009	PSCEP VCS, BDS, Agro Meslehet, AAC	PSCEP BDS will chart the market information system and suggest development avenues	3 weeks in country
Establish a partnership with the Ganja Agricultural University and the Lankaran University	November, 2009	PSCEP, the Ganja University, Lankaran University	PSCEP VCS and BDS will complete a Memorandum of Understanding with the Ganja Agricultural University and the Lankaran University	No Cost to Project
Provide hands on experience in demonstration greenhouse	October-November, 2009	Foreign and local specialists, semi-commercial growers, and support organizations	PSCEP will provide a specialist to oversee construction of three demonstration greenhouses, one in Ganja, Lankaran, and Absheron, respectively	3 weeks in-country
Establish and conduct crop production on an annual basis	December, 2009	Regional Demoplot host and semi-commercial growers	PSCEP will provide a specialist to oversee crop production on an annual basis	3 weeks in-country
Commercial bank and equity investments	Ongoing	CIIC, AIC, KAIC, Commercial Banks	PSCEP finance VCS and regional VCS will work at the enterprise level to promote finance and investment among lead producers	No Cost to Project
Bring key regional firms and stakeholders together for the first seminar in promotion of regional greenhouse growers associations.	October, 2009	Ganja Agricultural University, Lankaran University, Aktivta, Lankaran Cilgaz Gayrma, NAA Company, Janub Agro, Agro Yurd, and BDS providers	PSCEP VCS and BDS will bring together key greenhouse sector stakeholders in promotion of three regional greenhouse growers associations	No Cost to Project
Conduct seminars in Ganja, Lankaran, and Absheron	November, 2009	Lead Producers, Input Suppliers Support Organizations	Conduct seminars in each of the three primary production regions to promote regional associations	3 Regional Stakeholder seminars

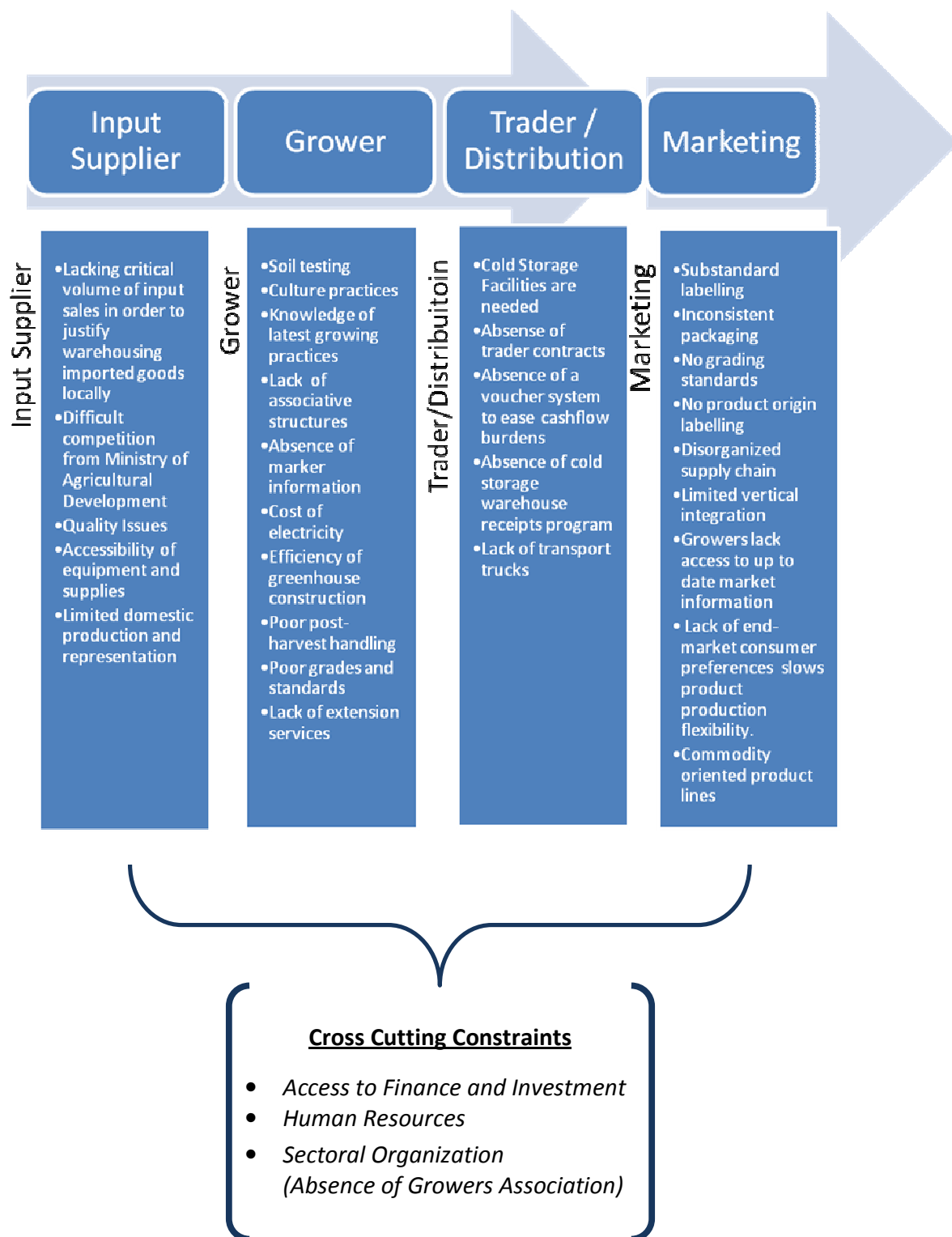
**ANNEX A: 2009 ACTION PLAN**

Chemonics		<i>PSCEP: 2009 Action Plan: Greenhouse Sector</i>											
<b>A</b>	<b>Increasing Greenhouse Productivity</b>	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
	Task A1. Directed Firm Level Support				>>								>
	Task A2. Conduct Workshop to develop individual greenhouse business model in collaboration with BDS providers							>>		<			
	Task A3. Enterprise level train-the-trainer program created and implemented									>>		<	
<b>B</b>	<b>Sector Development</b>	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
	Task B1. Determine extent of existing Market Information system and support development of expansion											>> x x <	
	Task B2. Establish a partnership with the Ganja Agricultural University and the Lankaran University								>>		<		
<b>C</b>	<b>Regional Demo Plots for Semi-Commercial Growers</b>	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
	Task C1. Provide hands on experience in demonstration greenhouse									>>	<		
	Task C2. Establish and conduct crop production on an annual basis												>> x x <
<b>D</b>	<b>Financing and Investment</b>	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
	Task D1. Commercial Bank and Equity Investments		>>										>
<b>E</b>	<b>Association Development</b>	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09
	Task E1. Bring Regional firms and stakeholders together for the first seminar in promotion of regional greenhouse growers associations										x x x		
	Task E2. Conduct Seminars in Ganja, Lankaran, and Absheron											x x x	

**ANNEX B: GREENHOUSE SECTOR VALUE CHAIN**



**ANNEX C: CONSTRAINTS MAP**



## **ANNEX D: GREENHOUSE SECTOR SWOT ANALYSIS**

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STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"><li>● High product demand</li><li>● Good environment for greenhouse culture</li><li>● Good export market</li><li>● work ethics</li><li>● Broad age range of people in the industry</li><li>● New appropriate greenhouse vegetable varieties available</li><li>● Good relations with Russian markets</li></ul>	<ul style="list-style-type: none"><li>● Lack of market information</li><li>● Few functional cold storage facilities</li><li>● Lack of vertical integration in value chain</li><li>● Limited, high interest, credit</li><li>● Weak government support policies</li><li>● Poor infrastructure</li><li>● Outdated cultural methods and equipment</li><li>● Lack of tech support services ( e.g. soil testing )</li></ul>
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"><li>● Higher tech training available</li><li>● Higher tech equipment available</li><li>● Increasing domestic and export demand</li><li>● Niche market crops</li><li>● Value added components for crops</li></ul>	<ul style="list-style-type: none"><li>● Economic crisis in region and world</li><li>● Fragmented marketing structure</li><li>● Iranian and Turkish greenhouse veg imports</li></ul>



## ANNEX E: BREAKDOWN OF ANNUAL COSTS AND REVENUE

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Item	Fixed Costs	Life Span	Annual Cost
Frame	2100	20yr	105
Polyethylene cover-double	500	3yr	166
Inflator fan	100	10yr	10
End Walls (local constr)	400	20yr	20
Vine Crop Support	1000	20yr	50
Monitoring meters (TDS,pH)	600	10yr	60
Fertigation system	800	10yr	80
Harvesting equipment	100	10yr	10
Replacement poly (800) (every 3+ years = 2400)	2400	16yr	150
<b>Consumable Costs</b>			
		<b>Life Span</b>	<b>Annual Cost</b>
Bags	410	3	137
Growing medium	410	3	137
Fertilizer	310	1	310
Misc	100	1	100
Packaging materials	400	1	400
Labor (self + part time help)	400	1	400
Marketing – Trader-Self	100	1	100
Plants (seeds and growing)	400	1	400
	8730		2635

### Production Projections and Earnings

Given a conservative average seasonal price of 1 AZN per kilogram of fruit the following illustration shows the estimated crop value at three production levels. Eight kg per plant should be readily achieved by a diligent grower and more expected with experience and greater skill. Note that two crops are produced each year. The cost above is calculated on a full year (two crops) of operation.

<u>Production</u>	<u>Returns – costs</u>	<u>Earnings</u>
4kg/plant = 1632 x 2 crops/yr = 3264	-2635 production costs =	629
6kg/plant = 2448 x 2 crops/yr = 4896	-2635 production costs =	2261
8kg/plant = 3264 x 2 crops/yr = 6528	- 2635 production costs =	3893

**ANNEX F: GREENHOUSE SECTOR VISITS AND CONTACTS**

Meeting and Contact Information			
	Name	Company	Contact
1	Samad Abasouliyev	Agro Yurd Greenhouse	Tel: (994) 0124974494 Mob: (994) 502104933 Email: <a href="mailto:samed@azevt.com">samed@azevt.com</a>
2	Mirsahab Mirzayev	Azerbaijan Agribusiness Center	Mob: (994) 502256308 Email: <a href="mailto:miri_mirzoyev@yahoo.com">miri_mirzoyev@yahoo.com</a>
3	Mamed Mamedov	Agrokima LLC	Tel: (994) 124303062
4	Farid Firadinov	AKTIVTA	Mob: (994) 503467917
5	Nizami Garayev	AKTIVTA	Mob: (994) 503575851 Email: <a href="mailto:nizami38@mail.ru">nizami38@mail.ru</a>
6	Mirazim Basiyov	Cenub Agro	Mob: (994) 0503246580
7	Ruhid Basiyov	Greenhouse	Mob: (070) 3384575
8	Yirshyl Bazaar	Market	Tel: (994) 124969360
9	Yasmoy Bazaar	Market	Tel: (994) 124752434
10	Adalat Nahinitov	Azerbaijan Business Assistance and Development Center	Tel: (994 )114 3 50 90 Mob: (994) 50 363 82 99 Email: <a href="mailto:jabc@mail.ru">jabc@mail.ru</a>
11	Ramiz Remihov	Cred Agro	Mob: (994) 50 342 93 77
12	Faid Nadirov	Agro Meslihet	Tel: (994) 12 497-81-88 Email: <a href="mailto:faig_agro@azeurotel.com">faig_agro@azeurotel.com</a>
13	Sahin Abbasov	GTZ	Mob: (994) 502358612
14	Elvin Aghayer	Save the Children	Mob: (994) 0503339574
15	Yunisou Shakir	Vugar LLC	Mob: (994) 502016689
16	Sabuhi Chabrailov	Young Agrarians NGO	Mob: (994) 502508354 Email: <a href="mailto:cahangirov@mail.ru">cahangirov@mail.ru</a>
17	Ahmed Alier	ADRA	Mob: (994) 502205675
18	Nureddin "Kivi"	GHSE- Nursery Plants	Mob: (994) 503127736
19	Anar Isayef	Transport Co. [25 trucks]	Mob: (994) 502256556
20	Haje Azizbala	Garden Shop, Baku, Seeds –retail and for Ghse growers	Tel: (994) 124938274
21	Abbasov Nadir	NAA Universal	Mob: (050) 2102672
22	Togru Kocharli,	CIIC (Regarding NAA Company)	Tel: (994) 124045061
23	Samin Taghiyev,	CIIC (Regarding NAA Company)	Tel: (994) 124045061
24	Mahmud Jafarov,	CIIC (Regarding NAA Company)	Tel: (994) 124045061

**Meeting and Contact Information**  
[continued]

Name		Company	Contact
25	Manfred Smotzok	DAI [formerly IFDC]	Tel: (994) 124967502 Mob: (994) 503798807 Email: <a href="mailto:manfred_smotzok@dai.com">manfred_smotzok@dai.com</a>
26	Salman Shiryev	Lankaran Cilgaz Gayrma company	Mob: (994) 70 347 6727
27	Zour Abiyev	Lankaran Cilgaz Gayrma company	Mob: (994) 503514307
28	Muhariz Basi	Trader	Mob: (994) 503399881

**Greenhouse Glass Sources**

Company Name		Location	Contact
1	Khazar JSC	Sumgayit, S Vurgun Str., 120	Tel: (99418) 6429911 Fax: (99418) 6459740
2	Qomel stekto, Balerussia	247045 Qomel city, 25 Qomelskaya Str.	Tel: (375-232) 711541 (375-232) 972358 Fax: (375-232) 711541 (375-232) 711538
3	Itner Glass	Baku, Azerbaijan	Tel: (012) 4470149
4	Kamenskiy Glass	Russia	Tel: (86365) 76250

**Russia Bazaars for Azeri Greenhouse Product**

Mnevnik Bazaar	Moskva city, 7 str, Mnevniky	Tel : +7 (495) 6484701
Sokolnikovskiy Bazaar	Tel: +7(4812) 555224; , 22 Sokolniskiy str,	
Slavanskiy Bazaar	Tel: 664043, Irkust city, Sverdlovskiy region, Berozovay rosha str.	Tel: 307245 (Administration)
Kuybisevskiy Bazaar/wholesale	664019 Kuybisevskiy region, 9 Barrikand str,	Tel : 705795
Rijskiy Bazaar	50 Rijskiy str ,	Tel: (8112) 440935
Pokrovskiy Bazaar	Irkust city, 38 Celabinskaya str.	

## ANNEX G: GREENHOUSE SECTOR TRAINING MODULE OUTLINES

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TRAINING MODULE TOPIC OUTLINES	
<b>1</b>	<b>Greenhouse Environment Management</b>
	Environmental factors
	Interaction of environmental factors
	Managing the environment to suit specific crop needs
	Adapting structures to suit crop needs
<b>2</b>	<b>Drip Irrigation Installation and Management</b>
	Concept
	Equipment
	Layout of system
	Water pressure management
	Filtration
	Application frequency
	System maintenance
<b>3</b>	<b>Fertigation</b>
	Concept
	Equipment
	Combining with drip system
	Fertilizer solubility
	Gravity systems
	Injector systems (water pressure)
	Injector systems (pump pressurized)
	Filtration
	System maintenance
<b>4</b>	<b>Bag Culture</b>
	Effective designs
	Matching with drip and fertigation systems
	Spacing
	Medium
	Drainage
	Extending life cycle
	Disease management
	Intercropping
	Succession cropping
	Off season crop scheduling
	Variety selection

**TRAINING MODULE TOPIC OUTLINES**  
[CONTINUED]

<b>5</b>	<b>Managing Production Costs</b>
	Enterprise record keeping
	Analyzing costs
	Alternative cultural practices
	Baseline measurements
<b>6</b>	<b>Greenhouse Sanitation and Food Safety Management</b>
	Purpose of greenhouse sanitation
	Purpose of food safety management
	Instituting greenhouse sanitation practices
	Instituting food safety practices
<b>7</b>	<b>Fertilizer Needs Assessment for Specific Crops</b>
	Determining specific crop requirements
	Sourcing appropriate fertilizer materials
	Measuring water quality
	Measuring growing medium fertility levels
	Measuring solution fertility levels
<b>8</b>	<b>Harvest and Post Harvest Handling – Packaging – Grading</b>
	Harvest methods for specific crops
	Post harvest handling of specific crops
	Mid term storage
	Long term storage
	Grading specific crops – standards
	Packaging – options
	Purpose
	Methods
	Financial records
	Analysis of information
	Utilization of analyzed information

## **ANNEX H: BASIC GREENHOUSE VEGETABLE PRODUCTION**

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Greenhouses come in various configurations, coverings and plant production system designs. All can usually be designed to grow crops effectively, though not with the same level efficiency. This structure style has been selected because it is easy to construct, inexpensive, and when outfitted with a bag culture, fertigation system, can be quite productive for a grower with limited skills. It is also a good structure to use for the demonstration of best management practices and for teaching.

Though not readily available in Azerbaijan, it can be imported for about the noted price or can be home built for less. The PSCEP value chain specialist is in discussion with a potential local manufacturer who may have these structures for sale in the near future.

Basically a high tunnel, or Hoop House, it can be used unheated with one layer of polyethylene sheeting in the southern region. It is most effective if set up with double layer polyethylene with an inflator to maintain a small amount of insulating air between the layers. This would require electric power; however, a Solar panel/battery system and 12 volt inflator fan could be purchased. If heat can be provided, it can function as a standard greenhouse. For hot weather ventilation, the side plastic can be rolled up or if electricity is available, exhaust fans can be used in the eaves.

The production of tomatoes or cucumbers could be done by the owner (or family) in a structure of this size for an estimated average of three hours per day (less time during the early stages and more during the harvest season). The labor cost budget reflects this approach. However, the crop must be monitored all day, every day.

The specifications in Annex E are for a structure 8 by 20 meters, by 4 meters tall. The length could be extended up to 30 meters. Beyond that length, it becomes difficult to ventilate unless exhaust fans are used. The width can be adjusted, though 8 meters has proven to be easy to manufacture.

Six rows are spaced 1.2 meters apart and one meter away from the sidewall lengthwise of the structure. The row ends are 1.5 meters away from each end to allow access to the rows. There is no room in the structure for storage, packing or other activities. This is simply a crop growing structure. Four plants per linear meter are planted in each row for a total of 408 plants per greenhouse.

## **ANNEX I: GREENHOUSE HEATING, COOLING, AND IRRIGATION CONSTRAINTS**

### **A. Greenhouse Heating and Cooling Constraints and Opportunities for Improvement**

Greenhouse heating and cooling are two major issues hindering growers in Azerbaijan. No absolute solutions are available and each facility must be assessed individually due to variations in design and past maintenance. The most economical approach is in energy conservation. Following are some suggestions for the grower to implement.

**Heating:** Glass greenhouses are notorious for leakage of air. Proper bedding of the glass is critical and re-bedding is necessary when the bedding compound dries and begins to crack. Bar caps have proven to help, as well and outside coverings of polyethylene sheeting in winter prevent air infiltration. Some growers have successfully used inside heat curtains, especially at night to keep heat close to the plants.

North walls of greenhouses can be insulated with little impact on light availability for plants, but care should be taken when insulating all side walls during winter so that light levels are maintained. Cleaning the roof glass before winter will increase winter light levels.

Poorly-constructed doors are usually the cause of great heat loss. Constructing entry ways or foyers with a second set of doors to serve as air traps helps considerably in winter, and can be an aid to limit insect access during warm weather.

Proper management of the heating and ventilating systems operations during cold periods will likely reduce costs without inhibiting the crop.

Polyethylene covered greenhouses have extreme heat loss if only one layer is used in a heated structure. Two layers, inflated by a small blower fan (could be solar powered), will more than double the insulating effect. Entry ways and north side insulation will help these structures as well.

In very cold locations, heat is lost through the soil at the bottom of the greenhouse walls. Installing insulation (Styrofoam or other) below the greenhouse walls to a depth of .5 to .75 meter will dramatically reduce the problem.

**Cooling:** A shading compound (commercial or diluted white latex paint) can be sprayed on to provide shade during the hot months when temperatures can be detrimental to plants. It will slowly degrade during the season, but may need to be washed off before the low light levels of winter arrive. Shade cloth is often used on smaller, single bay houses, is more expensive, but can last for 10 years.

Providing adequate air exchange is the key to cooling greenhouses. Hot air naturally rises, so roof ventilators are critical part of the ventilating system. Openings along the side and end walls of the structures allow the cooler air to enter to replace the hot air which exits through the roof vents. Growers who can manage such a natural air exchange and provide a total air exchange in

the structure every couple of minutes will do well at maintaining temperatures close to that of outdoors. Calculation of the opening sizes will require assistance of an engineer or greenhouse specialist. Some growers remove the plastic entirely during the hot months.

Exhaust fans can also be used, as well as evaporative coolers, but the cost in electricity would be prohibitive for vegetable growers.

Permanent improvements in heating and cooling systems can be done by considering applications such as hydrothermal, appropriate greenhouse design and crop scheduling. Perhaps the most relevant recommendation is to select the proper structure for the crop to be grown. For example, it would not be cost effective to use an expensive glass greenhouse, fully heated, to grow spinach. That can be grown in simple cold frames year around.

**B. Irrigation:** Irrigation methods in Azerbaijani greenhouses have been significantly upgraded in recent years. Overhead irrigation has been all but eliminated in leaf disease susceptible crops. Flood irrigation is also rarely used in greenhouses. Both of these methods are wasteful of water and promote numerous other cultural problems.

Most growers have, or are adding drip irrigation systems, which when combined with some form of bag or container culture and the application of soluble appropriate fertilizers through the drip irrigation system will improve production quality and quantity significantly.

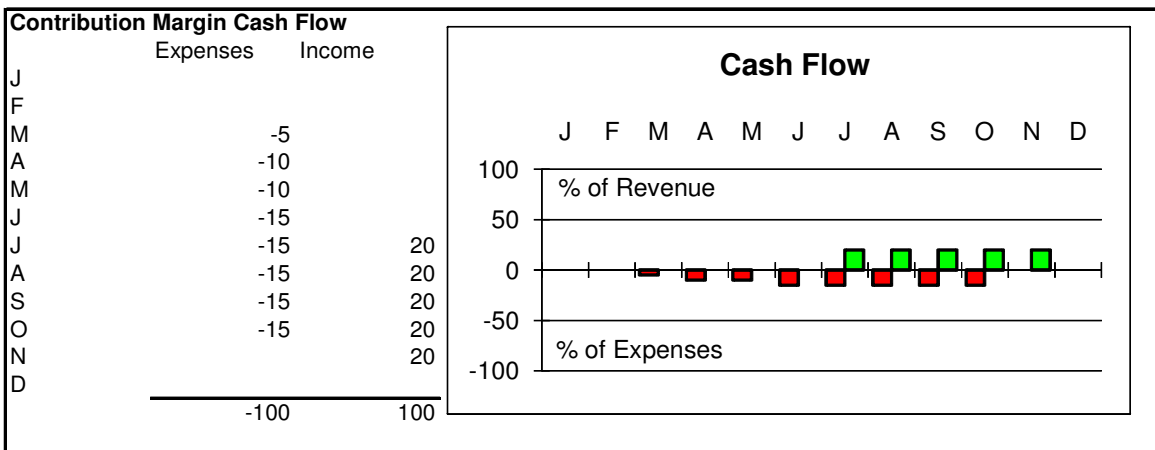
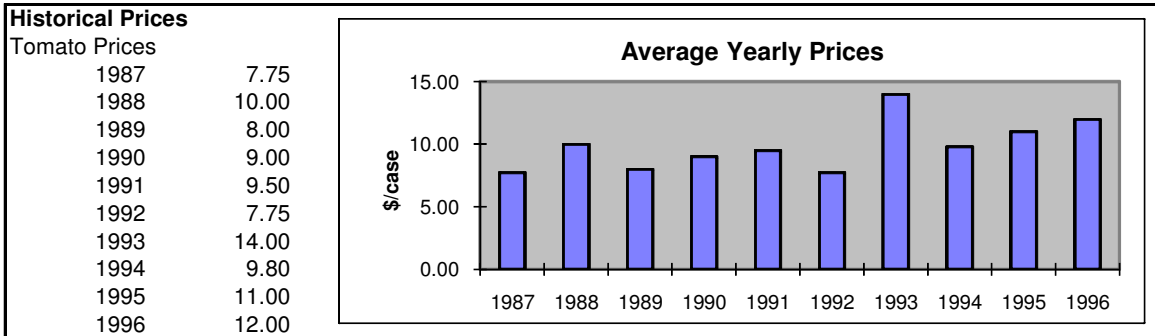
Management and attention must be factored in, but growers moving from soil culture in ground beds and overhead or flood irrigation to the system described above can expect to double their production and returns.



## ANNEX J: GREENHOUSE MODELING TEMPLATE

Tomato/Cucumber Template		AREA	5	Acres	Per Acre	Total Income
<b>INCOME</b>		<b>YIELD</b>	<b>PRICE</b>	<b>INCOME</b>		
		case/Acre	\$/case	\$/Acre		
Grade #1		750	8.81	6,609.00		
<b>Total Income</b>		750	8.812	6609	<b>6,609</b>	<b>33,045</b>
<b>DIRECT EXPENSES</b>		<b>INPUT</b>	<b>PRICE</b>	<b>EXPENSE</b>	Per Acre	Total Expense
	Units	UNITS/Acre	\$/UNIT	\$/Acre		
<b>Seeds</b>						
Seed	1,000	92	0.85	78.20		
					<b>78</b>	<b>391</b>
<b>Fertilizers</b>						
13-16-10	kg	180	0.38	68.40		
Calcium Nitrate	kg	45	0.43	19.35		
Lime	MT	0.5	59.00	29.50		
Manure	yard	25	2.00	50.00		
					<b>167</b>	<b>836</b>
<b>Herbicide &amp; Pest Control</b>						
CIPC	litre	1.9	34.90	66.31		
Gramoxone	litre	2.2	21.60	47.52		
Cygon (2X)	litre	0.3	15.23	9.00		
Disyston	litre	0.6	23.00	13.80		
Lannate	g	340	0.07	25.00		
Monitor	litre	0.9	32.00	28.80		
Zineb	kg	1.1	11.49	12.64		
Pirimor	kg	0.2	90.90	18.18		
IPM	case	750	0.03	22.50		
					<b>244</b>	<b>1,219</b>
<b>Machinery Operation</b>						
Fuel, Oil, Lubrication				113.00		
Machinery Repair & Maintenance				125.00		
					<b>238</b>	<b>1,190</b>
<b>Hired Labour</b>						
<b>Marketing</b>						
Co-op Charges		750	1.11	828.75		
Cartons		750	1.25	936.75		
					<b>1,766</b>	<b>8,828</b>
<b>Contracts &amp; Custom Work</b>						
Contract Labour	hour	251.5	8.00	2012.00		
					<b>2,012</b>	<b>10,060</b>
<b>Equipment Rentals</b>						
<b>Other Supplies &amp; Services</b>						
Irrigation Power & Water				45.00		
					<b>45</b>	<b>225</b>
<b>Total Direct Expenses</b>					<b>4,550</b>	<b>22,748</b>
					<b>2,059</b>	
					<b>3</b>	
						<b>10,297</b>

<b>Rules of Thumb</b> Investment \$7,000 - \$8,000 / acre Contract Labour 40 hours/acre Direct Expense % of Income 20% - 30%	<b>Target</b> Quantity: ____ per Hectar Price: __ AZN - __ AZN per Kg
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**Contribution Margin Sensitivity Analysis**  
 The table below lists the changes to gross margin as the quantity of yield and price received changes.

Price \$/unit	Yield - cases per Acre			
	650	700	750	800
8.00	650	1050	1450	1850
8.81	1177	1617	2058	2498
9.50	1625	2100	2575	3050
10.00	1950	2450	2950	3450
10.50	2275	2800	3325	3850

**Capital Investment**  
**Building and Machinery Replacement Cost**  
**Total Farm Size - 60 Acres**

Buildings	\$60,000	
Power Machinery	99,000	Note: Costs associated with these capital items may be spread across other farm enterprises.
Field Machinery	78,500	
Product Handling Equipment	37,500	
Irrigation and Drainage	81,000	
Vehicles	43,000	
<b>Total</b>	<b>\$399,000</b>	