Technology Fact Sheet for Adaptation

E. Integrate Production and Protection (IPP) of Greenhouse Crops [i]

Sector : Agriculture	
Subsector : Greenhouse crops (i.e. tomato)	
Technology characteristics	
Introduction	IPP is a modern concept or agriculture system that deals with the production in a holistic approach combining the planting system, good agriculture practices to integrated pest management, and other inputs management of crop production at farm level. In this factsheet we focus only on protected cultivation under greenhouses. In other words, this technology integrates a sequence of hard and soft technologies starting from the adaptation of the greenhouse structure and material to the harvesting of the crop.
Technology characteristics/highlights	- IPP is considered a high cost technology (initial capital) when compared to open field cultivation or even to traditional protected cultivation - IPP uses combined soft and hard technologies with variable costs: ✓ Adapted greenhouse structure and plastic cover for isolation, insulation and aeration and for capturing condensate water from plastic cover ✓ Insect-proof nets ✓ Appropriate plant material with selected rootstocks and varieties tolerant to climatic and soil problems (drought, salinity, nematodes, fungi diseases) ✓ Suitable planting density for optimal yield and aeration ✓ Increasing planting season: better yields, longer season of production and more resilient to environmental and market risks. ✓ Management of the climatic environment of the greenhouse (heating/cooling/aeration/water drainage) ✓ Insect pollination: increased fruit set without chemical use ✓ Integrated pest management: preserved product quality with minimum chemical use ✓ Fertigation system: high efficient use of water and fertilizers.
Institutional and organizational requirements	IPP requires a long term capacity building for farmers through joined efforts of the Ministry of Agriculture, the private sector (service providers) and donors. An initiative through a pilot project was implemented by FAO/MOA between 2001 and 2004. Such initiative should be disseminated and generalized. Protected crop growers are grouped in small fragile associations that could be the target beneficiaries. They could be empowered if linked with potential service providers.
Operation and maintenance	The installation of the system requires professional enterprises. Maintenance is minimal as most structures are renewed at the end of their shelf live (plastic cover, nets, irrigation system…) .

Endorsement by experts	IPP is recognized worldwide especially in Mediterranean countries. The Ministry of Agriculture as well as the experts and scientists dealing with protected cultivation and IPP have all endorsed this technology.
Adequacy for current climate	Since protected cultivation is based on protecting the crops from climatic adverse, IPP is adequate for both current and expected climate in the future.
Scale/Size of beneficiaries group	The surface area (4800ha) of protected crop cultivation constitutes 2% of the total cultivated area in 2007, and has been increasing since the last decade. Greenhouses are distributed as follow: 70% on coastal areas up to 300m, 15% between 300 and 1200m, 5% above 1200m and 10% in the Bekaa.
Disadvantages	IPP requires sophisticated materials, professionalism and expertise. Although these are found on the local market and at service providers' level, farmers require capacity building and financial incentives and facilities to enable them adopting IPP. Another disadvantage is that IPP is an intensive agriculture system which requires the use of many synthesized products produced from GHG emitting industries.
Capital costs	
Cost to implement adaptation technology	The modernized greenhouse structure and plastic cover, fertigation system, nets and other accessories cost between 10 and 15$/m^2 add to this selected grafted plant material (i.e. 0.6$/m^2 for tomato).
Additional cost to implement adaptation technology, compared to "business as usual"	Traditional protected cultivation would require between 3 and 6$/m^2 and non grafted plants around 0.35$/m^2 for tomato production. Hence the additional cost ranges between 4.25 and 12.25$/m^2 when compared to business as usual. However, such expenditure is partially compensated by the reduced annual costs for soil disinfection and pest management by a minimum of 0.4$/m^2 per season for tomato production.
Long term cost (i.e. 10, 30, or 50 years) without adaptation	The average cost for the supply and installation of traditional greenhouse tunnels is 9$/m2 including galvanized steel, wires, plastic film, irrigation network and installation.
Long term cost (i.e. 10, 30, or 50 years) with adaptation	The average cost for the supply and installation of IPM adapted greenhouse uni-spans is 17$/m2 including galvanized steel, wires, plastic film, irrigation network, SAS door, side ventilation, insect net and installation.
Development impacts, direct and indirect benefits	
Direct benefits	- Increase the production and quality of the cultivated crops. Increase food security through a lasting production off-season. The benefit can increase at least by 1.4$/m^2 just by improving fruit quality and reducing the cost of production. - IPP reduces the cost of production by i) increasing yield, ii) upgrading crop quality and iii) reducing the amount and cost of inputs (plant material, water, fertilizers and pesticides) with variable proportions. Unfortunately, it is difficult to assess the benefit between traditional protected cultivation and IPP in Lebanon.
Reduction of vulnerability to climate change, indirect	- IPP avoids direct impacts of climate extremes on protected crops (i.e. fruit set can be inhibited by high temperatures) and pest outbreaks (i.e.

	fungi diseases due to higher temperature and higher relative humidity). - In some crops like tomato, using grafted seedlings enables reducing plant density by 50% which would result either by reducing water consumption by the same amount, or profiting from the spared space to practice intercropping (i.e. lettuce between tomatoes) when compared to traditional protected cultivation. - Most rootstocks are also tolerant to drought and soil salinity which are likely to increase under future climate scenarios.
Economic benefits, indirect Employment Growth & Investment	 Job opportunities would increase especially at the technical level within the service providers' enterprises, labor force, as well as within the public extension services and post-harvest market opportunities (transport, packaging…) Capital requirements are essential at both service provider and farmer's level. An increased production is reflected in an increased economic growth.
Social benefits, indirect Income Education Health	The income of farmers increases. Farmers' capacity to manage their production and adapt to climate change (resilience) through training is higher. IPP enables farmers to avoid exposures to hazardous health problems due to pesticide use, and the lower pesticide residues in the products preserve consumers' health.
Environmental benefits, indirect	Reduction in Methyl-Bromide emission, reduction in chemical pollutants (fertilizers and pesticides) leaching to soil and groundwater
Local context	
Opportunities and Barriers	IPP is an opportunity to sustain vegetables production on small agriculture properties surrounding the cities and on coastal areas. IPP is more resilient to climate change namely, due to water shortage, water and soil salinity and pest outbreaks. It is also an opportunity to use greenhouses tops for water harvesting or to adopt soilless cultivation (see these technologies for water sector). IPP has also an opportunity to develop in higher altitudes with future climatic conditions, since higher temperature will reduce the need for heating in cooler areas. IPP will be almost the only agriculture subsector to sustain higher land prices on the coastal areas and around the cities. The higher initial cost to develop these technologies and the absence of a sound crediting system for farmers, are the major barriers for their development.
Market potential	The actual figures show that protected cultivation is mainly on coastal areas; however an increasing trend is registered in the Bekaa. Under future climate, the trend will keep increasing in mountainous areas on higher altitudes.
Status	IPP has been introduced by an FAO project in collaboration with the ministry of agriculture and the private sector in 2003. Nevertheless, the dissemination of the technology from pilot projects to the farmers was difficult due to the unstable situation between 2005 and 2007. Starting

	2008, few farmers adopted partially some of the technologies under IPP (i.e. alternatives to Methyl-Bromide including grafted plants, integrated pest management, fertigation…). Currently, LRF is funding the deployment of modern greenhouses in Akkar.
Timeframe	Short to Medium Term.
Acceptability to local stakeholders	Farmers are unable to adopt IPP if left alone due to socio-economical constraints. Besides the cost of implantation, in some areas (i.e. Mount Lebanon) the urbanization and the high land prices are more attractive for investing; this doesn't allow farmers renting lands to take the risk of deploying technologies that would require years to ensure financial returns, while the sustainability of their exploitation is not guaranteed.

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment Reports For Climate Change Adaptation – Lebanon. You can access the complete report from the TNA project website http://tech-action.org/**