Strengthening of Protected Vegetable Production

Abstract

In order to counterbalance the impact of climate change, agricultural production under protected circumstances (i.e., shade houses or semi-open greenhouses) will be an important solution. At the same time, the technology also helps to secure a more equal supply of vegetables year-round. 'Protected agriculture' technology is still relatively new to Surinam and requires a substantial amount of testing and finding out what works best and is most cost-efficient under Surinamese conditions.

Project research activities will include a research study on the management of environmental factors in greenhouses in a cost-effective way (output 1), a research study on the year-round production of tomatoes and lettuce under alternative greenhouse conditions and using different technologies (output 2), a testing of heat-tolerant vegetable varieties (output 3), and a marketing study on the potential of greenhouse vegetables (output 4). Activities focusing on technology transfer will include the organization of a National Horticulture Congress (output 5), the development of production manuals specifically for greenhouse production (output 6), training of farmers and extension officers in greenhouse production practices and post-harvest quality management (output 7), and information dissemination by using modern media (output 8).

Introduction

Total vegetable production in Suriname reached 24,569 tons in 2014, with a total value of approximately US$ 30.3 million (LVV).[1] Area under production constituted some 1436 ha (LVV), of which only a very small part (3.3 ha) was under protected structures, of which 1.8 ha shade houses (i.e., only providing a roof) and 1.5 ha greenhouses (i.e., semi-closed structures).[2] However, the volume of production under protected conditions can, for example in the case of paprika, be a factor 6-24 higher per square meter (depending on the growing medium and the technology used) than under open-field conditions.

At the same time, production costs per square meter of protected agriculture are also many times higher and it is not automatic that protected agriculture is also more cost-efficient compared to open-field production. However, as climate change is predicted to cause heavier rains and more unstable weather conditions in Surinam, it is expected that also in Surinam protected agriculture will be one of the solutions to secure the food supply in the future. Moreover, protected agriculture technology allows farmers to grow good-quality vegetables year-round, which helps to dampen the seasonality of supply and hence improve the overall food situation of the population and reduce out-of-season import of vegetables. Food security is an important policy objective of the Ministry of Agriculture, Animal Husbandry and Fisheries (LVV) and hence its commitment to promoting protected agriculture.

Protected agriculture is still a relatively new technology to Surinam. To support the development of this new method of production it is important to conduct research and provide protected agriculture practitioners with relevant information and knowledge that has been validated under Surinamese conditions.

Background

Nowadays, there is increased interest in Suriname in the production of vegetables under protected conditions. Simple open shade houses have been in use in Surinam for decades. Tannia leaves, for example, are mostly grown under structures covered with shade mesh to protect them from the high light intensity of the sun and to some extent also from the impact of heavy rainfall. It was only around 2005 that semi-enclosed structures covered with polyethylene (i.e., greenhouses) were introduced in Surinam together with hydroponic technology for the production of mainly lettuce and tomatoes. This has become the main production technology for lettuce, enabling production in even the urban areas of Paramaribo. Other crops such as cucumbers, sweet peppers, celery, species of Chinese cabbage and herbs are also being grown in Surinam under greenhouse conditions.

Over the past decade, the construction of semi-closed greenhouses has been far faster than that of open shade houses – between 2012 and 2015, for example, the area under greenhouses in the districts Paramaribo, Wanica, Commewijne and Saramacca increased with 59%. Many new greenhouses are currently under construction. It is expected that greenhouses will soon become the dominant 'protected' agricultural technology. Although still rather small in area at the moment, the total area under greenhouse production is expected to increase at least 10-fold over the next five years, if not considerably more if affordable financing can be secured. This according to the

[1] LVV. 2016. Agricultural Production Statistics 2009-2014. Paramaribo: LVV.

[2] Zweevel, Mayra. 2016. 'De rentabiliteitsstudie van paprika en het karteren van de beschermde teeltstructuren in Commewijne, Paramaribo, Saramacca en Wanica anno 2015.' Student thesis, International Agribusiness, PTC. The COMCEC paper provides a similar estimate, which is believed to be a lower estimate as not everybody surveyed responded.

participants of the stakeholder meeting held at LVV on July, 11th, 2016. In that sense protected agriculture is a highly dynamic part of the vegetable industry, which may change the outlook of the industry quite dramatically over the next few years as it has the potential to deliver better quality vegetables, at competitive prices, year-round.

Greenhouse production is rather capital-intensive, but can give high returns as: (a) it can produce year-round, (b) capture good prices during the off-season; and (c) is substantially less affected by weather conditions. Moreover, it allows for a more controlled use of pesticides, which saves costs as well as avoids negative externalities such as pollution of the environment and exceeding maximum residue levels set by food safety standards. There is, therefore, considerable merit to extending the area under protected agriculture, for the benefit of both producers and consumers.

Despite this upbeat outlook, there are quite a number of challenges to be overcome. Most importantly, most imported as well as locally-designed greenhouses have turned out to be suboptimal for vegetable production in Surinam. The main problem is that the temperature in nearly all greenhouses is getting too high (above 30 to 35 ^{0}C) if no measures are taken (such as ventilation, shading, misting, etc.) and hence placing a constraint on production. To date, no research has been conducted into what would be an optimal greenhouse structure in combination with climate control measures under Surinamese conditions. For example, passive ventilation may work well in one place, but not in another depending on the exposure to wind. Providing better information about how to select/construct the right greenhouse structure in combination with climate control measures is very crucial to the ultimate success of the enterprise. Another possible answer to relatively high temperatures is the use of vegetable varieties that are relatively heat-tolerant. Again this requires research to identify suitable varieties that will do well in the market.[3]

Protected vegetable production requires more advanced (and to Surinam relatively new) production techniques such as using alternative growing media, irrigation and misting, and precision agriculture. There is a great demand for information and a better understanding of the different greenhouse production techniques and their cost implications. In particular there is much demand for low-cost solutions that are durable and efficient, and are adapted to Surinamese circumstances.

The greenhouse production value chain is still very much in its early stages of development. Both the pre- and post-harvest parts of the chain are also very much underdeveloped and the linkages between the different stakeholders rather weak. For example, post-harvest quality management of fresh produce is still very much problematic. This is a problem that also affects open-field vegetables.

The application of technology for the production of vegetables seems to stimulate interest in the agricultural sector even among the young population. The ministry and some of the privately owned enterprises get often visits of groups of students and this area is often selected for educational projects. With ageing of farmers and the loss of interest in agriculture being considered as a global issue, protected cultivation is a mean to encourage the predominantly young population of Suriname to develop the agricultural sector.

[3] For example, the introduction of cauliflower and broccoli varieties that are heat resistant may be an opportunity to substitute imported products for locally grown.

Project justification

The Government of Suriname promotes vegetable production under protected conditions in order to:

- counterbalance the impact of climate change;
- raise productivity and product quality;
- realize a more equal supply of vegetables throughout the year;
- substitute for some import of expensive, high-quality vegetables; and
- open up export opportunities.

Setting up vegetable production under protected conditions is knowledge and capital intensive, but also risky. This project aims to stimulate the uptake of protected agriculture technology by reducing those risks. It will do so by making sure that farmers have access to good-quality knowledge and information by:

- developing knowledge and information on optimal protected structures in combination with climate control measures;
- developing knowledge and information on protected agriculture production techniques and their cost implications;
- identifying alternative, low-cost solutions that fit Surinamese circumstances;
- Identifying heat-tolerant varieties; and
- sharing this information and knowledge as widely as possible through modern media, training and on-farm demonstrations.

Beneficiaries of the project will be vegetable producers with the capacity to absorb and exploit new knowledge about more advanced production technologies, who have access to capital, and who have an entrepreneurial attitude.

Interventions to date

To support the growth of the protected agriculture subsector, the ministry of LVV has undertaken several interventions, such as:

- The establishment of simple protected structures (shade houses), the well-known “Surisombra” to show the benefits of protected cultivation in plant development.
- Several initiatives to build capacity of staff and growers in collaboration with International partners such as Wageningen UR and Applied Plant Research (PPO)
- Motivation of existing to get organized as a group; emerging of the Suriname Greenhouse Association is a result of that.
- Applied research for performance of main crops is different systems
- Set up of demo structures at different LVV locations
- Provide different educational institutions with structures to gain experience with this type of production and to disseminate knowledge
- COMCEC project: development of a general manual for protected production in the tropics, overview report of protected agriculture
- Demonstration tours for interested individuals within the structures of the ministry and technical support for starting and existing growers.

Interventions from the Caribbean which we can learn from:

- Promotion of protected agricultural technology to increase yields, control pest and diseases, improve quality and productivity in several project throughout the region.
- Research and development done by CARDI as part of their protected agricultural program spread throughout the different member states.
- Ongoing research at the University of the West Indies to assist in improving existing structures, to develop a model structure for demonstration and low cost technology for cooling of structures.

Project objectives

Main objective (i.e., goal): Strengthening of vegetable production under protected conditions

Intermediate objectives (i.e., outcome):

1. Increased area under protected vegetable production; and
2. Better quality vegetables adhering to food safety and GAP standards.

Project outputs and activities

Project activities and outputs are summarized in table 1 below.

Table 1: Projects outputs and activities

Outputs	**Activities**
1. Criteria developed for cost effective "Model structure" with the ability to effectively manage climatic conditions of Suriname.	1.1 Evaluation of protected structures and production practices at the beginning and the end of the project[4] 1.2 Contract research on the management of environmental factors in greenhouses in a cost-effective way and to develop "Model structure" for Suriname 1.3 Disseminate results of study, including a simple guideline of criteria to be considered when buying and/or setting up a greenhouse
2. Year-round production of tomatoes and lettuce evaluated in 'new model greenhouse' and 'old model greenhouse' using different technology packages	2.1 Set up of model structure at LVV's headquarters 2.2 Evaluation of climatic factors (T, RH) 2.3 Evaluation of the performance of lettuce year-round in new and old model greenhouse under the following technologies: hydroponic (NFT and deep water culture) and in the soil with drip irrigation 2.4 Evaluation of the performance of tomatoes year-round in new and old model greenhouse under the following technologies: hydroponic (NFT and coco coir substrate culture) and in the soil with drip irrigation 2.5 Economic analysis of production 2.6 Dissemination of results and recommendations
3. Performance of selected heat-tolerant varieties of lettuce, tomatoes, sweet pepper, cauliflower, and broccoli tested	3.1 Selection of heat tolerant varieties of lettuce, tomatoes, sweet pepper, cauliflower, broccoli 3.2 Import of seed of heat tolerant varieties of selected crops

[4] Include in the survey questions regarding GAP, as GAP certification is one of the outcome indicators. We may not be able to record GAP certification as such (that all hinges on the establishment of a certification agency), but we could document to what extent farmers are familiar with GAP and adhere to it.

Outputs	Activities
	3.2 Evaluation of the performance of heat tolerant varieties of crops in 'new model greenhouse' and 'old model greenhouse' 3.3 Economic analysis of production 3.4 Dissemination of results and recommendations
4. Better insight into market opportunities	4.1 Contract research on market opportunities for selected greenhouse crops on the local market
5. Linkages between the different stakeholders of the value chain strengthened.	5.1 National Protected Horticulture Congress with all stakeholders including existing and emerging growers, suppliers of equipment and other inputs, buyers, retailers, national, regional and international experts, researchers and extension officers, to share knowledge, experience and information on protected horticulture and to provide inputs for further developments in this area. 5.2 Establishment of an "Innovation platform for protected agriculture"
6. Production manuals developed for the five most important vegetables grown under protected agriculture conditions and disseminated to farmers	6.1 Literature review and consultation with regional experts, with a specific emphasis on ICM, GAP, IPM, environmental control, operation management, cost and returns. 6.2 Regional Study tour to 2 countries in the region with mayor developments in protected agriculture production and research (Dominican Republic and Trinidad and Tobago) 6.3 Drafting of the production manual 6.4 Production of the manual (text, layout, etc.) both in printed form as well as electronically 6.5 Promotion campaign among farmers
7. Capacity building of key staff and growers in best practices for protected vegetable production and postharvest quality management	7.1 National Training course on best practices for protected production for existing and emerging growers. 7.2 National Training course on postharvest quality management of selected crops
8. Modern-media-based information products on protected horticulture production developed and distributed	8.1 Production of instruction videos to highlight specific good practices 8.2 Dissemination of videos through television, You Tube and DVD's 8.3 Use of social media and text messaging technologies to reach out to farmers

Project results

See results matrix below.

Results matrix

Project objective	To strengthen vegetable production under protected conditions							
Outcome indicators	**Base**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Target**	**Means of verification**
Area under greenhouse production increased								
Indicator 1: Surface under greenhouse production	1.5 ha	3 ha	6 ha	9 ha	12 ha	15 ha	40 ha	1. Survey by project (see activity 1.1) Comment: Greenhouse production requires considerable investment in infrastructure. Hence the lack of credit can be a crucial bottleneck in the expansion of greenhouse production.
Better quality vegetables throughout the year								
Indicator 1: Share (area under) greenhouse vegetable production GAP certified	0%	0%	0%	5%	10%	15%	75%	1. Data provided by the local GAP certification agency or collected by project survey (see above) Comment: Local GAP standards are in the process of being developed. Not clear yet who will do the certification.
Output indicators	**Base**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Target**	**Means of verification**
Criteria developed for cost effective "Model structure" with the ability to effectively manage climatic conditions of Suriname								
Indicator 1: Research report and guidelines released	0	1					1	1. Research report and guidelines
Year-round production of tomatoes and lettuce evaluated in 'new model greenhouse' and 'old model greenhouse' using different technology packages								
Indicator 1: Research report	0				2	2	2	1. Research reports Comments: For each vegetable a preliminary report in year 4 and a definitive report in year 5.
Heat-tolerant varieties tested								
Indicator 1: Test results and economic analysis released	0		1	2	1	1	5	1.Research reports Comment: Year 2: Broccoli; Year 3: Tomatoes and lettuce; Year 4: Cauliflower; and Year 5: Sweet peppers
Better insight into market opportunities								
Indicator 1: Research report	0		1				1	1. Research report

Linkages between the different stakeholders of the value chain strengthened.								
Indicator 1: Protected agriculture innovation platform meets regularly	0	0	1	1	1	1	1	1. At least once a year a meeting as of year 2
Production manuals for five greenhouse vegetables produced and promoted								
Indicator 1: Production manuals released	0	1	1	1	1	1	5	1. Production manuals released (printed as well as electronically)
Indicator 2: Production manuals distributed	0	50	100	100	100	100	500	1. Stock figures
Indicator 3: Production manuals downloaded from Internet	0	100	200	200	200	200	800	1. Website statistics
Vegetable growers trained in best practices for protected vegetable production and postharvest quality management								
Indicator 1: Number of greenhouse farmers trained in best practices	0	40		40	0	40	120	1. List of farmers attending the training; 2. Training evaluation forms; and 3. Training materials
Indicator 2: Number of farmers trained in post-harvest quality management	0	0	40	0	40	0	80	1. List of farmers attending the training; 2. Training evaluation forms; and 3. Training materials
Modern-media-based information products on protected horticulture production developed and distributed								
Indicator 1: Five YouTube videos uploaded	0	0	2	3	0	0	5	1. YouTube videos
Indicator 2: Number of times YouTube videos viewed	0	0	300	500	500	500	1800	1. Website statistics
Indicator 3: Percentage of farmers practicing protected agriculture that can be reached through social media, email or text messaging	0%	10%	20%	30%	40%	50%	75%	1. Contact database

Project implementation

The project will be implemented by the protected agriculture specialists of ODLOAV in collaboration with other ODLOAV staff and staff of ODL – statistics, extension and modern media. The head of the vegetable division will be the project manager and responsible for the implementation of the project. One-day a week has been budgeted for this task.

The time table below (table 2) provides an overview of how the different activities will be implemented through time.

Table 2: Time table

Activity	1-i	1-ii	1-iii	1-iv	2-i	2-ii	2-iii	2-iv	3	4	5
1. Criteria developed for cost effective "Model structure" with the ability to effectively manage climatic conditions of Suriname											
1.1 Evaluation of existing protective structures at the beginning and end of the project											
1.2 Contract research on the management of environmental factors in greenhouses in a cost-effective way											
1.3 Disseminate and promote results of study											
2. Year-round production of tomatoes and lettuce evaluated in 'new model greenhouse' and 'old model greenhouse' using different technology packages											
2.1 Set up of model structure at research department of Ministry											
2.2 Evaluation of climatic factors											
2.3 Evaluation of the performance of lettuce year round											
2.4 Evaluation of the performance of tomatoes year round											
2.5 Economic analysis of production of lettuce and tomatoes											
2.6 Dissemination of results and recommendations											
3. Heat tolerant varieties tested											
3.1 Selection of heat tolerant varieties of lettuce, tomatoes, sweet pepper, cauliflower, broccoli											
3.2 Import of seed of heat tolerant varieties of selected crops											
3.3 Evaluation of the performance of heat tolerant varieties of crops in 'new model greenhouse' and 'old model greenhouse'											
3.4 Economic analysis of production											
3.5 Dissemination of results and recommendations											
4. Better insight into market opportunities											
4.1 Research on market opportunities											
5. Linkages between the different stakeholders of the value chain strengthened.											
5.1 National Protected Horticulture Congress											
5.2 Establishment of an 'Innovation platform' for protected agriculture											
6. Production manuals developed for the five most important vegetables grown under protected agriculture conditions and disseminated to farmers											
6.1 Literature review											
6.2 Regional Study tour to 2 countries in the region with mayor developments in protected agriculture production and research											
6.3 Drafting of the 5 manuals											
6.4 Production of the 5 manuals											
6.5 Promotion campaign											
7. Capacity building of growers in best practices for protected vegetable production and postharvest quality management											

Activity	1-i	1-ii	1-iii	1-iv	2-i	2-ii	2-iii	2-iv	3	4	5
7.1 Capacity building of growers in best practices for protected vegetable production (5 days, 40 participants each year)											
7.2 Training course on postharvest quality management of selected crops (5 days, 40 participants each year)											
8. Multimedia on protected horticulture production developed and made available for growers											
8.1 Production of 5 instruction videos											
8.2 Dissemination of videos on the Internet and as DVDs											
8.3 Use of social media and text messaging to reach out to farmers											

Project partners

The project will seek partnership with the Caribbean Agricultural and Development Institute (CARDI) as the main international partner for this project. In addition, a study tour to Trinidad & Tobago and the Dominican Republic will help to establish links with counterparts in these countries.

Other partners could be the Wageningen University Research (WUR) and Applied Plant Research (PPO) in the Netherlands.

The Suriname Greenhouse Growers Association and the Cooperative 'Hydroponic Suriname' are organizations in which some of the growers are already organized, but both organizations are still in development. The project team will work closely together with them.

Project budget

Table 3 provides a summary of the budget per output. Overall project budget is close to US$ 633,000, of which roughly US$ 370,000 will be financed by the IDB loan and US$ 260,000 by LVV (mostly salaries). Moreover, LVV will pick up the bill for electricity, water, telephone, office space, etc., which have not been accounted for in the current budget. Detailed budget tables are available in Excel form and will be made available as an annex.

Table 3: Project budget summary

Output	Funding	Year 1	Year 2	Year 3	Year 4	Year 5	Total
		(US dollars)					
1. Criteria developed for cost effective "Model structure" with the ability to effectively manage climatic conditions of Suriname.	IDB	101,750	0	0	0	750	102,500
	LVV	9,988	0	0	0	4,288	14,275
2.Year-round production of tomatoes and lettuce evaluated in 'new model greenhouse' and 'old model greenhouse' using different technology packages	IDB	60,000	45,000	12,000	12,000	13,000	142,000
	LVV	1,850	28,850	26,450	26,450	28,050	111,650
3. Performance of selected heat-tolerant varieties of lettuce, tomatoes, sweet pepper, cauliflower, and broccoli tested	IDB	10,000	5,000	4,000	4,000	4,000	27,000
	LVV	800	17,975	17,975	17,975	17,975	72,700
4. Better insight into market opportunities	IDB	11,000	0	0	0	0	11,000
	LVV	3,100	0	0	0	0	3,100
5. Linkages between the different stakeholders of the value chain strengthened.	IDB	0	7,500	500	500	500	9,000
	LVV	0	2,900	0	0	0	2,900
6. Production manuals developed for the five most important vegetables grown under protected agriculture conditions and disseminated to farmers	IDB	12,700	3,700	3,700	3,700	3,700	27,500
	LVV	6,365	2,890	2,890	2,890	2,890	17,925
7. Capacity building of key staff and growers in best practices for protected vegetable production and postharvest quality management	IDB	2,700	2,700	2,700	2,700	2,700	13,500
	LVV	1,590	1,590	340	340	340	4,200
8. Modern-media-based information products on protected horticulture production developed and distributed	IDB	0	700	1,050	0	0	1,750
	LVV	400	2,625	3,738	400	400	7,563
General project costs	IDB	7,750	5,250	2,750	2,750	2,750	21,250
	LVV	2,600	2,600	2,600	2,600	2,600	13,000
Subtotal	**IDB**	**205,900**	**69,850**	**26,700**	**25,650**	**27,400**	**355,500**
	LVV	**26,693**	**59,430**	**53,993**	**50,655**	**56,543**	**247,313**
Contingency 5%	IDB	10,295	3,493	1,335	1,283	1,370	17,775
	LVV	1,335	2,972	2,700	2,533	2,827	12,366
Total	**IDB**	**216,195**	**73,343**	**28,035**	**26,933**	**28,770**	**373,275**
	LVV	**28,027**	**62,402**	**56,692**	**53,188**	**59,370**	**259,678**
	Total	**244,222**	**135,744**	**84,727**	**80,120**	**88,140**	**632,953**

Human resources

The human resources that have been budgeted to implement the various project activities have been summarized below (see table 4). In its peak year (year 2), this project will command inputs from various researchers, adding up to some 636 days.

In addition, the project will contract out: (i) a research study on 'the management of environmental factors in greenhouses in a cost-effective way'; (ii) an economic analysis of lettuce and tomato production; and (iii) research on market opportunities.

Table 4: Human resources involved in the implementation of the project

Staff	Year 1	Year 2	Year 3	Year 4	Year 5	Total
	(days)					
Research staff – HL	387	636	546	531	576	2,674
Research staff – ML	104	489	449	449	444	1,933
Research staff – LL	5	390	390	390	395	1,570
Extension staff – HL	15	0	0	0	15	30
Extension staff – ML	15	20	10	10	35	90
Extension staff – LL	0	0	0	0	0	0
Modern media staff – HL	5	30	43	5	5	88
Modern media staff – ML	0	10	15	0	0	25
Modern media staff – LL	0	10	15	0	0	25
Statistical staff-HL	20	0	0	0	20	40
Lawyer- HL	5	0	0	0	0	5

Capital items

Table 5 summarizes the main capital items that will be purchased for the execution of the project. Most of them are lump sums that need to be further detailed what it entails.

Table 5: Capital items that will be acquired for the project

			Date of acquisition				
Activity	**Cost items**	**Cost**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Activity 2.1	Contract greenhouse	40,000	1				
Activity 2.2	Equipment for measuring and managing Temp and RH	20,000	1				
Activity 2.3	Lettuce production system	10,000		1			
	Crop management equipment	5,000		1			
Activity 2.4	Tomatoes production system	10,000		1			
	Crop management equipment	5,000		1			
Activity 3.3	Crop management equipment	1,000		1			
General project costs	Laptop	1,000	2	1			
	Desktop	1,500	2	1			

Service contracts

Table 6 provides an overview of the services that will be contracted as part of the implementation of the project. Indicative terms for consultants to be hired by the project are provided in Annex A.

Table 6: Service contracts

			Date of acquisition				
Activity	**Cost item**	**Cost**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Activity 1.2	International study	100,000	1				
Activity 2.5	Economist	5,000		1			
Activity 3.2	Import of heat tolerant seeds	10,000	1				
Activity 4.1	Marketing study	10,000	1				
Activity 5.1	International speaker(s)	4,000		1			
Overall project	Cleaning contract polyethylene cover of greenhouse	750	1	1	1	1	1

Annex A: Indicative Terms for Consultants to be Hired by the Project

1.2 Contract research on the management of environmental factors in greenhouses in a cost-effective way

Input needed from a foreign research team to study how best to manage environmental factors in greenhouses in a cost-effective way under Surinamese conditions. The consultancy contract comprises some 180-200 working days in total.

TOR

The development of the TOR for this study has been budgeted as part of the project.

Activity 2.5: Economic analysis of the production of lettuce and tomatoes under greenhouse conditions

Input needed from a local economist for about 20 days in analysing the cost of production of lettuce and tomatoes under greenhouse conditions in the 'old' and 'new' greenhouse at LVV's premises.

TOR

Working under the direct supervision of the project leader, the economist will:

1. Organize during the trials the collection of data specifically needed for the economic analysis, such as the use and costs of inputs (including labour), off-farm sales prices, etc.;
2. Based on this data and the technical parameters provided by the technical counterpart (such as environmental variables, yield data, technologies used, etc.) make a cost-benefit analysis of tomato and lettuce production under different greenhouse conditions and using different technology packages; and
3. Make a recommendation how best to optimize the profit of tomato and lettuce production under greenhouse conditions.

Activity 4.1: Research on market opportunities

Input needed from one or more experts to conduct a study on market opportunities for vegetables grown under greenhouse conditions in Surinam.

TOR

The development of the TOR for this study has been budgeted as part of the project.

Activity 5.1: National Protected Horticulture Congress

Input needed from one or more international speakers as keynote speakers at the conference.

TOR

Working under the direct supervision of the project leader, the speakers will:

1. Deliver a keynote speech of 30-45 minutes on a topic that has been mutually agreed in advance;
2. Submit an electronic version of the speech to be included in the Congress proceedings; and
3. Actively participate in the discussions at the Congress (e.g., participate in a panel discussion)