Name of the initiative:

Egyptian greenhouse cultivation at a higher level with Dutch technology

Number of initiative given by T & U

399

Project number by PPS:

Contributes to innovation theme

'More with Less', sub-theme Sustainable Production, and supports the implementation of Foreign Policy.

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Consortium members

Name	Company	Further information
Yassin Lahiani	Koppert Biological Systems	Berkel en Rodenrijs
Arjen Janmaat	HortiMax	Pijnacker
Mahmoud Zaki	BioEgypt	Cairo, Egypt
Hussein Hassan	AllGreen	Cairo, Egypt
Anne Elings	Wageningen UR Greenhouse Horticulture	Wageningen

Summary

The project realizes through the use of Dutch technology a higher sustainability of Egyptian protected cultivation, especially in the areas of water, which has absolute priority in Egypt, and crop protection. The Egyptian horticultural sector is in dire need of an innovative approach that increases its sustainability. Dutch technology is offered as an integrated and optimized package for Egyptian conditions. In particular, this concerns the import and application of water technology and of biological control agents, which are currently not permitted on the Egyptian market. With regards to water technology, the project want to demonstrate the effects of high-quality water technology on the water use efficiency and crop production. With regards to biological control agents, the project wants to open a dialogue with the Egyptian Government to realize a new legislation. The ambition is to import biological agents from The Netherlands, either under a new legislation, or on the basis of a waiver. In a demonstration trial, the effects of better water management and more biological control of pests and diseases on sustainability in Egyptian greenhouse horticulture will be shown. Knowledge on local conditions is gathered to optimize the greenhouse management strategies. The project realizes under practical conditions a platform where knowledge can be shared and that forms the nucleus for scaling up to other horticultural companies. This leads to follow-up business. The project wants to seize commercial opportunities in Egypt.

Project details

Knowledge institute: Wageningen UR Greenhouse Horticulture (PPO/PRI); Dr. Anne Elings
Contact person at Ministry of Economic Affairs: Jan van Vliet
Project duration: 1/1/2013 – 31/12/2016
Other project partners:

- Early up-scaling is anticipated. Other Egyptian farms will then join the project, however, not necessarily become a project member.
- A local University may be requested to participate, e.g., through the involvement of a student to assist in data acquisition and analysis.
- The Netherlands Embassy will be requested to facilitate contacts with Egyptian governmental representatives.

Project description

Goal
The goal of the project is to raise protected cultivation in Egypt to a higher level through the use of Dutch technology, in particular in the field of water, which has absolute priority in Egypt, and in that of crop protection where the use of chemicals still prevails. The project results in a transition to a more advanced and sustainable production system in protected horticulture, limiting the use of water, increasing the water use efficiency ('More Crop Per Drop'), making maximum use of natural enemies and soil enhancers, and minimal use of chemicals. This, in turn, leads to a greater market share of the Dutch horticultural supply sector.

Background
The Egyptian horticultural sector can be divided in two broad areas, viz. small to medium-scale producers that serve the national supply chains, and medium to large-scale producers that serve the export market. The first group uses basic fertigation equipment and operates in a market with little food safety regulation, resulting in high levels of chemical use and risks for both farm workers and consumers. The second group is variable in terms of water technology and complies with international certification standards – as they would otherwise not be in a position to export -, but can nevertheless substantially improve their cultivation system.

Water availability and quality are major issues in Egypt in general, and in agri- and horticulture in particular. Water resources are declining, quality is problematic, and the use of fossil water resources is not sustainable. Critical for Egypt is also the fact that import of biological control agents (bca's; of which predators are the best-known example, but which also includes soil enhancers) is not permitted. These issues seriously hamper a sustainable development of the industry. Egypt is not in the position to continue the business-as-usual approach, and has to act in a variety of ways to deal with a number of sustainability and food supply/safety issues. As the resource-use efficiency in protected cultivation is higher than in open-field cultivation, a move towards more protected cultivation fits in this strategy.

Scope
The project concentrates on the demonstration of water management and the use of biological control in greenhouse horticulture in Egypt. The actual demonstrations are located at two locations, and should result in up-scaling to other farms in Egypt. The project engages in awareness raising and knowledge transfer.
The project has no activities beyond Egypt, and is not engaged in demonstration activities beyond those at the farm (for example, the supply chain is excluded).

Relevance for project partners
A successful project will provide Dutch business with a relevant new and growing market. Egypt is an important producer of horticultural products, certainly in the Arab region. New market prospects will therefore also develop in other countries in the region.

The project provides the knowledge institutions with greater expertise regarding protected cultivation under North African conditions, which fits in the internationalization agenda of Wageningen UR as a whole, and of its Business Unit Greenhouse Horticulture. The Middle East has been selected as one of its focal areas.

The project is successful if the import of water technology and biological control agents has been made possible, and if the use of water technology and bca's is spreading over Egypt.

The project builds on a number of earlier initiatives by the project partners, namely:
- Long-standing Netherlands involvement with the Egyptian water sector;
- HortiMaX is a global market leader in greenhouse technology and developer of advanced water management and fertigation equipment. Together with our local partner AllGreen, we promote the use of advanced irrigation automation in Egypt to improve efficiency and save water and nutrients. In 2011, HortiMaX realized the first demonstration greenhouse project together with AllGreen.
- Koppert been trying for a decade access to the Egyptian market to obtain for its products, the project will through mediation and demonstration accomplish this.
- Workshop greenhouses, Ghiza, 2011;
- IPM workshop in December 2010 in Sharm El Sheikh, Egypt;
- Triple-P project (People, Planet, Profit) conducted by WUR, where a chain approach was defined to realize innovations in horticulture.

Relevance for the sector

The project is important for the sector due to the fact that Egypt is a major horticultural producer for The Netherlands, Europe and of course the growing domestic market for quality horticultural products. The Egyptian horticultural sector will not only develop for the water technology and crop protection supply industry but in its slipstream also a variety of other suppliers. One technical innovation stimulates further technical innovations. Also for other technologies, Egypt plays a regional example role.
The project reflects the ambition of the top sector T & U to stimulate sustainability internationally. This is very relevant for Egypt with major problems in the field of water pollution, land use and urban development (especially Cairo).

Added value
The economic value lies in the increased turnover of the Dutch supply sector in Egypt, and the regional example. In the future, Dutch logistics can play a role in the increased exports from Egypt to Europe. There are also links with the Dutch water sector, which is very active in Egypt.
The social added value lies in better working conditions for farm workers, the better quality of the drain water and therefore that of the surface water in the Nile delta, and delivering products with less chemical residues, which adds to the food safety.
The scientific value lies in increasing the expertise of integrating Dutch technology in the Egyptian technology level, which strengthens the knowledge base relative to other exporting countries for horticulture.
The project contributes to the international position of the Dutch supply sector, especially in the Arab world.
The Human Capital Agenda is served by exporting Dutch knowledge and on-site training of horticultural staff, and by for example organizing open days.

Knowledge and Innovation

The project makes available and improves knowledge and systems that are available in Dutch horticulture, but not yet in Egyptian horticulture. For Egypt, this is an innovation, bringing protected horticulture to a new technological level and introducing new approaches and forms of collaboration.

The project knows three major elements, viz.
1) introduce advanced water management systems and knowledge in Egyptian horticulture;
2) enable the import of biological control agents into Egypt, and stimulate the use of biological soil enhancers;
3) integrate advanced water management and biological control in the management systems of Egyptian horticulture.

The Netherlands possesses high-quality water management technology that can be adapted to local conditions. It concerns for example appropriate decision rules operated by a software system, high-

quality fertigation equipment, disinfection of the incoming water, recirculation with disinfection of the recirculated water, minimization of drain to the outside environment.
Enabling the import of biological control agents is a mixture of a dialogue with all relevant stakeholders, in particular the Egyptian Government represented by the Ministry of Agriculture, the exchange of knowledge regarding the safety and risks to import and use biological control agents in a certain country, and experimentation under controlled conditions. Such a process, resulting in legislation that regulates the import of bca's has been held in different countries. Understanding the political context, identifying key decision points, supply of relevant arguments, and discussing rules and legislation, are some of the process steps.
Stimulating the use of soil enhancers in particular involves the demonstration of their efficacy under local circumstances.
This work is a set of valorisation activities.

Good water management and integration of biological control agents and biological soil enhancers in the management systems of Egyptian horticulture requires the acquisition of knowledge under Egyptian conditions. Whereas the strategy of good water management and the efficacy of different bca's is known in a general sense, the optimization of the local cultivation system as a whole is not known. Knowledge for local conditions has to be gathered with regards to the interaction between water management, crop protection, climate management, and other crop management strategies. For water, it implies the close monitoring of various water flows and nutrient concentrations, and for crop protection it implies monitoring the survival rates of the predators, the use of other pest and disease management options, and the ultimate efficacy of the bca's. As indicated, much knowledge is available from similar crop protection systems in other places, but nevertheless, this knowledge can not be directly transplanted to Egypt. For biological soil enhancers, it implies the careful evaluation of their capacity under local, often sub-optimal conditions.
The project goal is to achieve up-scaling of the water management and crop protection system in terms of pests and diseases, crop and acreage. Each step of up-scaling requires careful collection of information and system optimization.
This work is a mixture of applied research and valorisation activities.

More specifically, with regards to knowledge:
- Optimum water application strategy to reduce water needs and increase water use efficiency.
- Optimum nutrient application strategy.
- Effects of Egyptian climate (which can be very hot and dry) and climate management on bca's.
- Effects of crop and water management, and other crop protection measures on bca's.
- Effects of improved water management and integrated pest management on production, product quality, and farm profitability (including possible lengthening of the cultivation season).
- Effects of biological soil enhancers on crop productivity.
- A business case that specifies the benefits, costs and pay-back time of the new management system.

More specifically, with regards to innovation:
- Transition to a more advanced and sustainable greenhouse system that meets the following Egyptian priorities: less water use, higher water use efficiency, less chemicals, healthier products for consumers, more international trade, a better working environment.
- A national system of knowledge transfer
- Better market integration

Approach and time path

Time sheet of activities

	Year	**1**				**2**				**3**				**4**			
	Quarter	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	Inception																
2	Technical design																
3	Realization of demonstration																
4a	1st crop, cultivation & monitoring																
4b	2nd crop, cultivation & monitoring																
4c	3rd crop, cultivation & monitoring																
5	Evaluation and system adjustment																
6	Evaluation of biological soil enhancers																
7	Admission of bca's																
8	first introduction of bca's																
9	Knowledge transfer, awareness raising, communication																
10	Up-scaling																
11	Reporting																
12	Co-ordination																

Explanation of the activities:

Phase 1. Inception.
The project has been started with an inception mission to Egypt, with the aims to meet with the Egyptian project partners and the Netherlands Embassy. Upon return in The Netherlands, results of the discussions held were used to develop this final project plan.
The results of this phase are:

- A concrete project plan
- Project organization and partner responsibilities.
- Communication protocols

Phase 2. General inspection and design of the demonstration facilities.
The farms of AllGreen (high-tech) and BioEgypt (mid-tech) are available for demonstration purposes. AllGreen will focus on water and crop management, and BioEgypt will focus on biological soil enhancers. However, biological control agents and water technology may be demonstrated at both farms.
Remote guidance (see phase 3) can only be provided if the demonstration facilities are well-known to WUR experts and if possible major shortcomings are removed before commencing the demonstrations. A short mission by a WUR expert on water and substrate issues, and by a WUR expert on crop cultivation will take place shortly early in the project. The WUR experts will acquire intimate knowledge on the production systems, and will be able to recommend first improvements in the production systems.
The system of data recording, processing and storage will be agreed upon. An automated system is preferred, and standardization is necessary.
The results of this phase are:

- A general description of the demonstration centres (the greenhouse, its installation, crop protection strategies, other management strategies).
- A general description of management strategies and tactics that can be improved upon.
- Agreement on the design of the demonstrations.

Phase 3. Realization of the demonstration centre.

The design that was agreed upon in Phase 2 is realized at AllGreen: installation components (hardware and software), data management, etc. The sanitation is brought to highest possible standards. The system is tested and improved where necessary (fertigation, recirculation, crop protection schemes, data flows, working protocols).
At BioEgypt, an evaluation system of biological soil enhancers is put in place, including enhancer-crop combinations to be tested, growing medium, fertigation schemes, etc.
If possible, water technology is also demonstrated at BioEgypt, just as biological soil enhancers and predators may be demonstrated at AllGreen.
The results of this phase are:

- A working fertigation system and operational crop protection in the demonstration greenhouse.
- En evaluation system of biological soil enhancers.
- Working protocols.

Phase 4. Crop cycles, growth advice and monitoring
A crop cycle in Egypt last approximately 10 months. No crop is cultivated during the very hot summer months.
Every 2 weeks, electronic contact will be established between WUR experts in The Netherlands and Egypt, and any relevant aspect of the cultivation cycle will be discussed. The main goal of these discussions is to optimize strategic and operational crop management, in order to maximize production and profit. Without maintaining the broad picture, optimization of water and nutrient application is not fully effective. Access to the local computer system is granted, and visuals (photos, webcam) are made available. Each time, a brief report is written.
This intensive guidance will in any case be provided for the first year, after which the frequency may be reduced as the focus should shift to support the up-scaling (such as open field days and seminars).
To actually be able to demonstrate that more sustainable water use and crop protection is possible, careful observations are necessary. All available data are used to develop a business case in which the profitability of the system is demonstrated. Where possible the data collection happens automatically. It concerns the following:
- Crop growth
- Production and product quality
- water flows (irrigation, drain, recirculation)
- nutrient use
- Use of biological and chemical control agents
- Fixed and variable costs, and product prices.

The results of this phase are:

- Well growing healthy crops that translate the positive effects of a good fertigation and crop protection in a high yield and good product quality.
- Detailed knowledge on the above.
- A business case, with pay-back time

Phase 5. Evaluation and system adjustment.
After each cropping season, the results are evaluated and used, if necessary, to adjust the system. This could include an improved method of crop management, fertigation, another biological control, etc. Naturally, improvements will also be implemented during the cultivation period if there is reason to.
The results of this phase are:

- A continuously, motivated improvement of the system.

Phase 6. Evaluation of biological soil enhancers.
Phase 6 starts parallel to phase 4.
Biological soil enhancers are evaluated at BioEgypt for their impact on crop growth and production. Wageningen UR provides, in close consultation with BioEgypt, a detailed experimental design and a working protocol, and is responsible for data analysis. It is likely that first experiments will be conducted in pots, as this for example enables easier randomization. Later validation experiments can be in the ground.

The biological soil enhancers are supplied by both Koppert and BioEgypt, and are admitted to the Egyptian market.
The results of this phase are:

- Quantified effects of biological soil enhancers on crop growth and productivity.

Phase 7. Import of biological control agents.
A workshop on the (legislation regarding) import of biological control agents will be organized. This can be organized as a follow-up to the IPM meeting that was held in December 2010 in Sharm El Sheikh. The current Egyptian legislations currently does not allow for the import of predators (although it does for humble bees), which hampers the sustainability of Egyptian horticulture. Attendees: Egyptian government, Egyptian researchers, Egyptian growers, WUR, EPO, Koppert, BioEgypt, AllGreen, the Netherlands Embassy, others.
This high-level workshop can be organized only after the political situation in Egypt has stabilized. It is not useful to open discussion with lower-rank officials without decisive authority. Give the current situation (April 2013) this is foreseen for the 2nd half of 2013.
After half a year, a follow-up workshop will be organized for further discussions and to bring forward the implementation of legislation.
As an alternative to the political process, it will be attempted to import bca's for experimental purposes, and in this manner enable phase 8 of the project.
The results of this phase are:

- Clear arguments for the import of import of biological control agents.
- Revised legislation on the import of biological control agents. A guarantee for achieving this result can unfortunately not be given.
- As an alternative, import of bca's for experimental purposes.

In case the revised legislation can not be achieved, none of the project partners will be considered defaulting.

Phase 8. First introduction of biological control agents.
The aim is to start integrated pest management (IPM) with the first crop. In any case, pollination with bumblebees is possible because their import has been allowed recently. The greenhouse must be properly monitored for residues of hazardous chemicals.
While starting the first demonstrations, the Egyptian government must be involved as closely as possible. Therefore, the project partners are most willing to have parallel demonstrations at farms designated and made available by the Egyptian government. To that end, the dialogue started in phase 6 will be continued.
The results of this phase are:

- Integrated pest management, the use of predators as a first option.
- A lower use of chemicals.

Phase 9. Knowledge transfer, awareness and communication
Greenhouse horticulture is knowledge-intensive by nature, and even more so when the technology level is increased. The introduction of advanced water management and integrated pest management requires advanced knowledge levels. The grower will, therefore, be guided in the use of the new system. The guidance will be provided primarily by the supervisors of Koppert, Hortimax, BioEgypt and AllGreen. It will consist of the transfer of background and operational knowledge. The frequency will be relatively high. Where possible, WUR will add knowledge. The goal is not only to transfer facts and cooking book recipes, but rather the transfer of understanding of the entire cultivation system, increasing the awareness of the complexity and operation of the cultivation system. Once this is achieved, independent decision making becoming easier.
Before the technology can be scaled up to the outside world, other growers have to be convinced of its usefulness. This implies an intensive communication of the results to the sector in Egypt, by inviting other growers to the demo. Growers must 'see to believe'. Not only growers will be invited, but also other key stakeholders, such as government officials, researchers, bank representatives, traders, caterers, etc. The entire national and international value chain is the target. The detailed business case

is an important part of the communication.
Concrete communication means are: open days, journal articles, 1-on-1 conversations, website, etc.
The results of this phase are:

- Informed growers.
- Trained greenhouse staff, from management to workers.
- Informed other stakeholders, such as researchers, decision makers, etc.

Phase 10. Up-scaling.
There are three types of up-scaling in the project:

a. Up-scaling to other crops
b. Up-scaling up to other pests
c. Up-scaling up to other greenhouses, and realizing a larger acreage in Egypt with improved water management and biological control. The ambition is national implementation.

Up-scaling up to other crops and pests may occur within the demo and other growers who are convinced of the possibilities offered by the system. Up-scaling up to other farms is a tailor-made activity in which the Dutch suppliers are closely involved, and in which the results of the demo form an important guideline.
The results of this phase are:

- Application of the system to several crops.
- Application of the system to multiple pests.
- Application of the system by multiple farms.

Phase 11. Reporting
A progress report will be produced every six months and will account for project progress, and achievement of objectives and finances.
The results of this phase are:

- Periodic reports.

Phase 12. Coordination.
Project coordination comprises all activities that are related to project progress, such as monitoring project activities, facilitating communication and exchange of demonstration results, organization of workshops, maintaining contacts with the Egyptian government and Netherlands Embassy, etc.
The results of this phase are:

- A well-coordinated projects in which planning and promises are kept, and adjustments are well motivated, and well communicated.

Overview of activities in year 1
The first year has a focus on a new legislation with regards to the import of biological control agents, their first introductions, and knowledge transfer, awareness raising and communication. The following activities will be employed in the first year:
Quarter 1

- Inception mission to Egypt, to identify and meet with all relevant stakeholders.
- Development of the final plan.

Quarter 2

- Design of water technology demonstration at AllGreen.
- Design of crop protection trials at BioEgypt.
- Agreed work protocols, including system of data flows.
- Start of water technology demonstration, including providing growth advice by WUR.

Quarter 3

- Continuation of water technology demonstration.
- Evaluation of biological soil enhancers.
- If possible, experimental evaluation of predators.

Quarter 4

- Workshop on (legislation regarding) the import of biological control agents. Attendees: Egyptian government, Egyptian researchers, Egyptian growers, WUR, EPO, Koppert, HortiMax, BioEgypt, AllGreen, the Netherlands Embassy, others.
- Communication of workshop results.
- Open days at the demonstration site: awareness raising & knowledge transfer.
- Continuation of water technology demonstration.
- Continuation of evaluation of biological soil enhancers.
- Communication of first demonstration results.

Organisation

Role of project partners

The private project partner Koppert supplies packages of biological control agents, biological soil enhancers and knowledge, and participates in workshops in which the results of the demonstration trials are evaluated, and in which up-scaling to other growers is discussed. In addition, periodic consultancy visits to Egypt are paid to guide the demonstration trial and consult with other interested growers. The overall purpose of their visits are awareness raising and spread of knowledge and technology over Egypt.
Koppert is involved through its sales manager for the Middle East.

The private company HortiMaX is supplier of advanced greenhouse management systems and will participate in workshops and training sessions to educate growers on the benefits of advanced water management.
HortiMaX is involved through its sales manager for the Middle East.

The private partner BioEgypt is present at workshops on biological control (see above) and is active, through consultancies, in the spread of knowledge and crop protection technology over Egypt. BioEgypt, being a local company, will have an important role in the dialogue with the Egyptian Government. The evaluation of biological soil enhancers takes place at, and with close involvement of, this company.
BioEgypt is involved through its managing director and greenhouse staff.

The private partner AllGreen is a grower of high quality fresh fruits and vegetables for export. The company will provide greenhouse facilities with greenhouse management, and be run the first responsible for executing the demonstrations. AllGreen will participate in communication and knowledge transfer.
AllGreen is involved through its managing director and greenhouse staff.

Wageningen UR Greenhouse Horticulture is involved because of its experience with innovative horticultural projects and international experience. Wageningen UR has an important role in the dialogue with the Egyptian government regarding the (legislation to) import biological control agents. Additionally, Wageningen UR will assist in designing and improving the systems of water management, crop protection, and crop management in general. Also, Wageningen UR will be involved in data analysis, organize and be present at workshops, and be responsible for overall project coordination and for reporting.
Wageningen UR Greenhouse Horticulture will participate with scientists in the fields of water technology, crop management, crop protection, and international projects.

A local university or research institute may be requested to be involved with data acquisition (e.g., a student).

The Netherland Embassy in Cairo will be requested to facilitate in the dialogue with the Egyptian government.

Cooperation and project management

Leading in the project are the commercial interests of the private project partners, although there is also a strong public agenda in terms of legislation, sustainability and food supply. The group of project partners is small, who are well-known to each other, and who share a similar agenda and cooperate intensively by default in the project activities. For this reason, a project committee and an explicit structure to facilitate the cooperation are not considered appropriate. However, if the need arises, senior managers will be involved.
Internal quality control, process management and strategic decision is managed through an annual revision by the project team of project achievements, project plans.

Communication

Communication of the project results is at the core of the project. To stimulate up-scaling of water technology and biological control, its advantages must be widely known among the Egyptian growers, wholesalers, researchers, governmental representatives, etc. Without this, the project does not meet its commercial potential. A number of means are employed:

- The demonstration sites established at AllGreen and BioEgypt are open to the Egyptian horticultural stakeholders, e.g., through open days or private visits.
- Workshops will be organized on a regular basis, which stimulate an on-going dialogue with stakeholders.
- A quarterly newsletter can be sent a broad audience.
- Specific visits are brought by project partners to interested growers that are interested in adopting biological control agents and water technology, providing them tailor-made advice.
- Interested growers are invited to training sessions by the project members.

The communication should support the successful spread of the biological control to other growers, and an improvement of the sustainability of Egyptian protected horticulture.

Relevant documents (summary of work plan, progress reports with results) are made available through 'Kennisonline'.

Budget and financial commitment

Table 1 Budget en financial commitment project

In k€		**2013**	**2014**	**2015**	**2016**	**Total**
Costs						
Researchers	DLO	87.3	72.7	76	71	307
Materials	DLO					
Hardware	DLO					
Others (travel, workshops)	DLO	28.7	27.9	27	27.8	111.4
Total Costs		116	100.6	103	98.8	418.4
Financing						
	Private sector in kind - total	150	148	143	145	586
	Koppert	18.5	18.5	18.5	18.5	74
	Products	6	6	6	6	24
	Personnel	12.5	12.5	12.5	12.5	50
	HortiMaX	17	15	10	12	54
	Products	5	3	2	0	10
	Personnel	12	12	8	12	44
	AllGreen	73	73	73	73	292
	Greenhouse*	50	50	50	50	200
	Personnel***	13	13	13	13	52
	Inputs	10	10	10	10	40
	BioEgypt	41.5	41.5	41.5	41.5	166
	Greenhouse**	24	24	24	24	96
	Personnel***	12.5	12.5	12.5	12.5	50
	Inputs	5	5	5	5	20

	Government DLO	116	100.6	103	98.8	418.4
Total Financing		266	248.6	246	243.8	1004.4

* 250 kEuro depreciated over 5 years

** 249 kEuro depreciated over 10 years

*** 30% administrative costs included