Green Farming
Demonstration Project

Sustainable and efficient water management in Kenyan horticulture

Green Farming
Partners for perfect solutions

65% less water use, 20% more production

How to improve results by water management

Project results January 1st - June 30th 2013

The link between Dutch and East African horticulture

Green Farming
Partners for perfect solutions

Green Farming is a Dutch programme that unites horticultural networks in the Netherlands, Kenya and Ethiopia. This is achieved by setting up joint activities, projects and co-operations in the areas of research, development and production.

All Green Farming activities are related to one or more of the five main themes of the programme:

- Water management
- Crop management
- Climate and energy
- Post-harvest and logistics
- Research and knowledge exchange

Who is involved?
The Green Farming consortium consists of over 25 leading Dutch companies in horticulture technology. Wageningen University and Research Centre supports the programme and is actively involved at the level of research and knowledge exchange.

Green Farming is coordinated by AVAG, the representative of joint Dutch horticultural suppliers, and by DLV Plant, active as an advisory company in the international agribusiness. The Dutch Ministry for International Trade and Development Cooperation supports the programme in close cooperation with the Dutch Embassies in Nairobi and Addis Ababa.

What are the activities?
Green Farming organizes a broad spectrum of activities, both at business-to-business and government-to-government levels.
The business-to-business activities include:

- Market studies and sector reviews
- Exhibition visits and participation
- Trade missions
- Matchmaking
- Seminars
- Demonstration projects

Green Farming sets up various demonstration projects together with local businesses and knowledge institutions to show which technologies, products, knowledge and services are available and how these can be applied to the local situation. The results in terms of production levels, efficiency of input use, production costs and revenues are shared with the sector via open days, professional journals and reports.

Green Farming demonstration project:

Best water management in practice

The demonstration project 'Water management in Kenyan horticulture' was put into practice at rose production farm Van den Berg Roses in Naivasha in July 2012.

Over a period of two years this project is providing the Kenyan sector and Dutch partners with information on the impact of water-saving technologies on production results, water use and resulting financial implications.

Goals of the project
The project will demonstrate the effect of the implementation of proper technology and management in protected horticultural production systems. At the same time water and nutrient use can be reduced and production quantity and quality can be increased. It will result in a well-founded payback time calculation.

Implementation
All relevant technologies and services relating to greenhouse water management that are applicable to the East African cultivation conditions are demonstrated at the project site.
In the existing greenhouse of Van den Berg Roses, 1.6 hectares of roses of the Upper Class variety has been planted on a hydroponic cultivation system, with coco-peat as the growing medium. The use of water and fertilizers, and production results of the hydroponic system, are compared with a soil reference.
The hydroponic growing system of the project consists of water storage, water treatment with reverse osmosis, water recycling, optimization of supply of water and fertilizers, and optimization of crop cultivation techniques.
Savings in water and fertilizers are made through collection of drain water from the hydroponic system, mixing it with water that is treated with reverse osmosis and re-using it in the soil.
All water management processes are optimized and controlled by computer.

Expected results
The expected results:
- Reduction of the use of irrigation water by at least 30%.
- Reduction of the amount of fertilizer by more than 30%.
- Reduction in running costs.
- Maintenance or improvement of product quality.
- Maintenance or improvement of product quantity.
- Increase in level of production system sustainability.

"Thanks to the lower input of water and fertilizers and higher production levels, the running costs remain low while the return increases."

Expected output
All inputs and outputs are registered. A year-round profile of input needs, production results and required running costs is made available every year. Ultimately, the project will result in a report on water savings linked to production results and a detailed financial business plan.

Thanks to the lower input of water and fertilizers and higher production levels, the running costs remain low while the return increases. Calculating the eventual payback time for technology in this situation is an important aspect of the project.

Project partners
The project is an initiative of Green Farming member C & J Bosman, in cooperation with Green Farming members Hoogendoorn Growth Management, Van der Knaap Groep, Wageningen UR Greenhouse Horticulture, Genap, Hatenboer-Water, DLV Plant and JB Hydroponics.

Wageningen UR Greenhouse Horticulture and DLV Plant are cooperating with Van den Berg Roses and Jomo Kenyatta University of Agriculture and Technology (JKUAT) in data recording, processing and data analysis. JKUAT, located near Nairobi, is one of the public universities in Kenya. The Department of Horticulture at JKUAT trains graduates for the horticulture subsector at B.Sc. level and M.Sc. level. There are also Ph.D programmes. The University is keen on collaboration and strategic partnerships in the execution of its mandate of training, research and innovation.

First results: 65% less water use, 20% more production

This brochure presents the results of the demonstration project 'Water management in Kenyan horticulture' for the period January 1st to June 30th 2013; six months' information gathered from a full-grown crop.

The data show that with the hydroponic system:

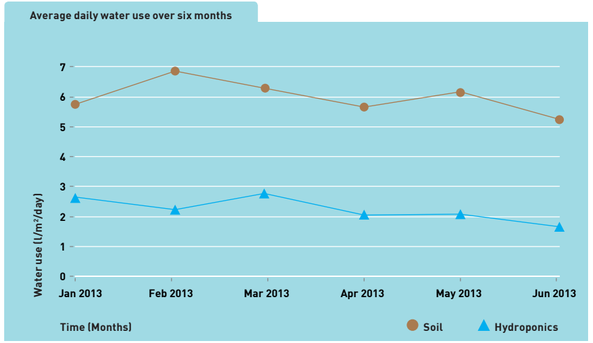
- Impressive amounts of water can be saved.
- Savings can be made in fertilizer use.
- The production results are better than for roses grown in the soil.

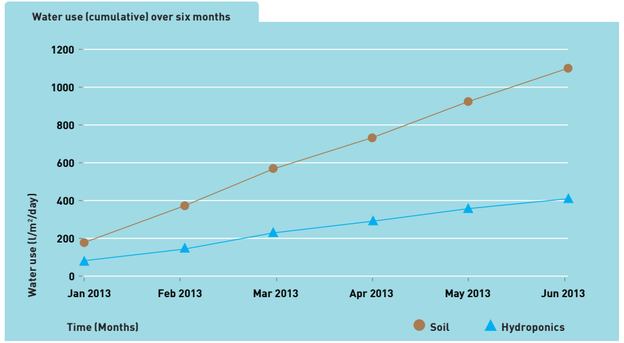
The actual results surpass the expected results.

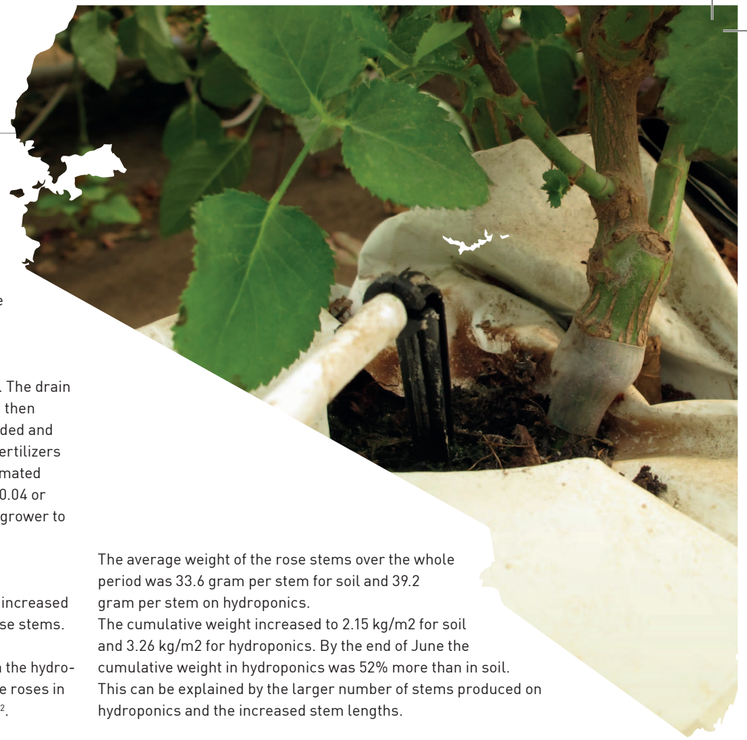
Result 1. 65% less water use

The average daily water use (litre/m²), was 2.23 for hydroponics and 5.97 for soil. Minima and maxima ranged between 0.5 to 5.7 for hydro and 3.0 to 8.1 for soil. Water use on hydroponics was calculated as the supplied irrigation water minus the drain water that was re-used in the soil.
The average irrigation water supplied to the hydroponic system was 6.5 litre/m² per day at an average drain percentage of 65.4%.

Over the total six-month period, the water use for hydroponics was 411 l/m², for soil it was 1.098 l/m². The difference in water use between the two systems increased to 687 l/m² in favour of the hydroponic system. This is due to the reuse of drainage water in soil cultivation.
A reduction of the use of irrigation water by at least 30% was expected. The actual water saving of hydroponics compared to soil over 6 months was 65%.







During the six-month period, the average temperature inside the greenhouse was 18.7 °C, the radiation 20.0 MJ/m²/day and de RH 82%.

Result 2. Less fertilizer

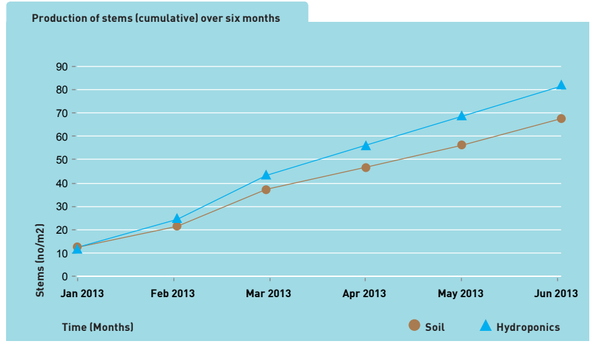
Together with reusing the water, fertilizers could also be reused. The drain water of the hydroponics was mixed with reverse osmosis water, then mixed with fresh water, after which necessary minerals were added and the water was reused in the soil. Over the six-month period the fertilizers drained from the hydroponic system per m2 represented an estimated value of € 1.04 or 115 KES . On a weekly basis this translates to € 0.04 or 4.43 KES per m2. The soil-based cultivation system enabled the grower to reuse these fertilizers.

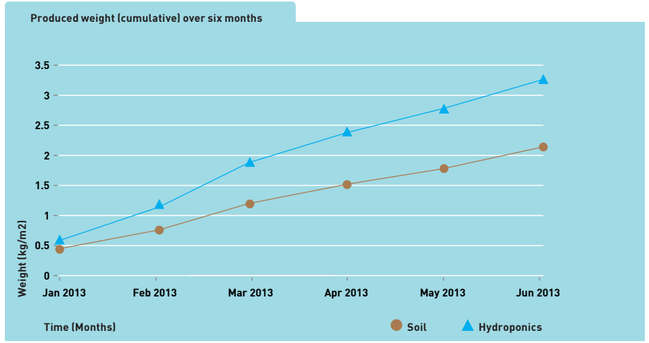
Result 3. Far more stems, weight and length

The large saving in water and fertilizer use was accompanied by increased production numbers and weights, and increased length of the rose stems.

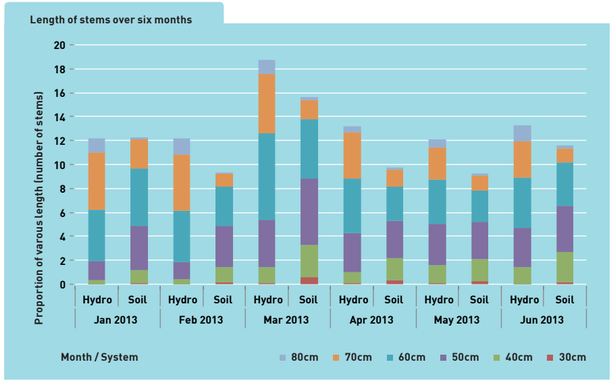
After the six-month period the total number of produced stems on the hydroponic system was 20% higher than for soil. By the end of June the roses in soil had produced 67.7 stems/m2 and on substrate 81.7 stems/m².

The average weight of the rose stems over the whole period was 33.6 gram per stem for soil and 39.2 gram per stem on hydroponics.
The cumulative weight increased to 2.15 kg/m2 for soil and 3.26 kg/m2 for hydroponics. By the end of June the cumulative weight in hydroponics was 52% more than in soil. This can be explained by the larger number of stems produced on hydroponics and the increased stem lengths.





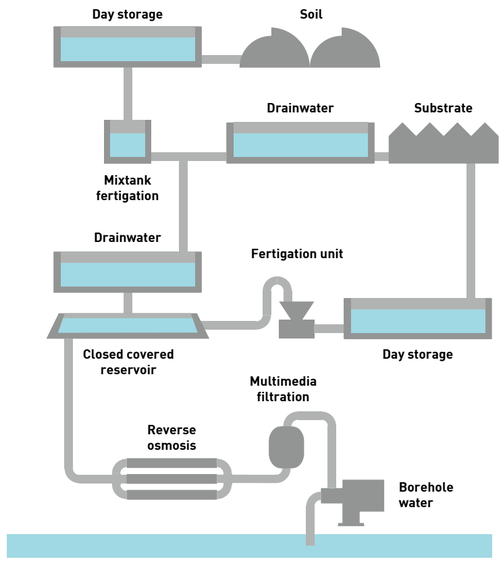
The crop growing on hydroponics produced more longer stems. 64.1% of the stems had length 60 and 70, while this percentage was 46.0% for the crop growing in the soil.



Result 4: Higher turnover
In the post-harvest phase 7.5% of the roses from soil and 9.8% from hydroponics were rejected during grading. Based on average price information of the Dutch auction for the Upper Class rose variety, the turnover from hydroponics was still 28% higher over the six-month period, equalling an increase in turnover of € 3.15 or 345 KES per square meter. This is due to the much higher number of stems and greater lengths that were harvested.

Conclusion
The expected results have been achieved and even surpass expectations. The reduction in irrigation water use of 65% is much higher than the forecasted minimum saving of 30%. This fits with the results of a case study for two rose farms done by Wageningen UR in 2009. Using a water streams computer model Wageningen UR predicted that a combination of all included technologies could lead to water use reductions up to 60%.
By implementing the hydroponic system the output to the environment has been significantly lowered and will become close to zero when drainage water is being reused in the hydroponic system. Because of the savings on fertilizer application in the soil-based cultivation, the running costs are strongly reduced. Production amount and quality has increased in terms of increased volumes and stem lengths, resulting in increased revenues.

Process



"Production amount and quality has increased in terms of increased volumes and stem lengths."

Prognosis

The presented data shows good results in water saving and production levels after the first year of the crop. Data collection will continue into the second crop year to establish the impact of the system on the longer term.

By including a longer time period, several factors can be checked, including the impact of build up of pests and diseases in the soil, maturing of the crop and quality status of the coco-peat.
The expectation is that water savings on a hydroponic system will remain at a comparable level. At the moment the amount of water that is supplied to the hydroponic system is relatively high. Large volumes of drain water are being reused in the soil, so water use in general is low, but the water has to be available to enable the higher supply.
Once fertigation management is even more optimized drain levels could be lowered without risking accumulation of salts, it is also possible that less water will be supplied to the hydroponic system. Water reuse in the hydroponic system would be a next step.

The water use in the systems has been fully analysed but the fertilizer use and costs have to be elaborated on in more detail. The long-term differences in pests and disease development in the crop and impact of nematodes in the soil will also have to be established. In the end, the full overview of differences in costs and revenues between the two systems will be calculated. The same applies to the payback time on the hardware.

Meaning for Kenyan horticulture

Hydroponic systems are not common in Kenyan horticulture and water management can often be greatly optimized. Therefore there is much to gain. The differences between growing in soil and in a controlled hydroponic system are huge.

This project shows the Kenyan sector how farms can be more productive at lower running costs. In addition, this project shows how Kenyan horticultural businesses can become more sustainable so that less water and fertilizers are wasted in the production process and spilt into the environment.
The set up of good water management requires more investments in the farm. Yet the project proves that it is possible with this equipment to pin down the financial demands during production and to realize sustainable production at a higher level of quantity and quality.

Green Farming partners in the water management project

Bosman

Bosman is a business-to-business turnkey solutions provider. With more than 90 years of experience, Bosman is active in the horticulture and agriculture industries, providing solutions through design and construction for commercial greenhouses, installation technologies and even solar solutions. In East Africa Bosman focuses on providing water technology solutions as an answer to market demands. To ensure quality support and service in the region, Bosman has established an office in Kenya.

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Hatenboer-Water

Hatenboer-Water has been a specialist in the field of water treatment since 1906. For the horticultural sector, Hatenboer-Water delivers worldwide solutions for irrigation and post-harvest water. As water is a many-sided product, the treatment of the different sorts of water demands different techniques and products. Solutions can vary from desalination of brackish well water with reverse osmosis (RO) to disinfection of drain water with compact UV systems.

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Genap

With over 60 years of experience, Genap is a specialized, professional and innovative partner in the field of plastic foil applications, including high-quality storage systems for liquids, in particular water. Genap's assortiment includes silos, reservoirs, closed systems, anti-algae covers and offers both standard products and bespoke solutions. Besides holding a leading position in the domestic market, export activities around the globe have become increasingly dominant.

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DLV Plant

DLV Plant is a leading, independent international advisory and research partner for the agricultural and horticultural sectors. Its activities are aimed at advice, research and projects in the Netherlands and abroad. DLV Plant has more than 175 knowledge-driven consultants working worldwide, with offices in Africa, Latin America and Europe, and has a strong network within the agricultural, horticultural and affiliated sectors.

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Hoogendoorn Growth Management

Hoogendoorn is known as the most innovative supplier of process automation in the horticultural industry. The company has worldwide experience in automation greenhouse projects. Our user-friendly irrigation, climate and energy software is customized for farms and open field projects in East Africa. Energy and water saving combined with optimum climate are easy to achieve with Hoogendoorn's products. To guarantee 24-hour service, maintenance and spare-parts, Hoogendoorn works together with local partners in Ethiopia, Kenya and South Africa.

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Wageningen UR Greenhouse Horticulture

Wageningen UR Greenhouse Horticulture is the leading research institute in the international greenhouse horticulture. In East African horticulture they specialize in sector assessment, farm assessment, supporting the transition towards more sustainable production systems that utilize appropriate technology, and transfer of knowledge that is relevant for the local situation.

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Van der Knaap Group

Van der Knaap is a group of companies that specializes in developing high-quality, organic solutions for rooting and growing of plants based on peat moss and coco-peat. The products Van der Knaap Group supplies in East Africa are coco-peat and substrates, coco plugs and discs, and Forteco coco slabs.

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JB Hydroponics

JB Hydroponics is specialized in the development and production of hydroponic systems and substrates. JB Hydroponics designs, develops and produces all possible gutter systems, such as steel gutter systems and container systems, for slabs and loose substrates to grow cut flowers and vegetables. In East Africa, the company has been active since 2002 through sister company African Hydroponics.

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