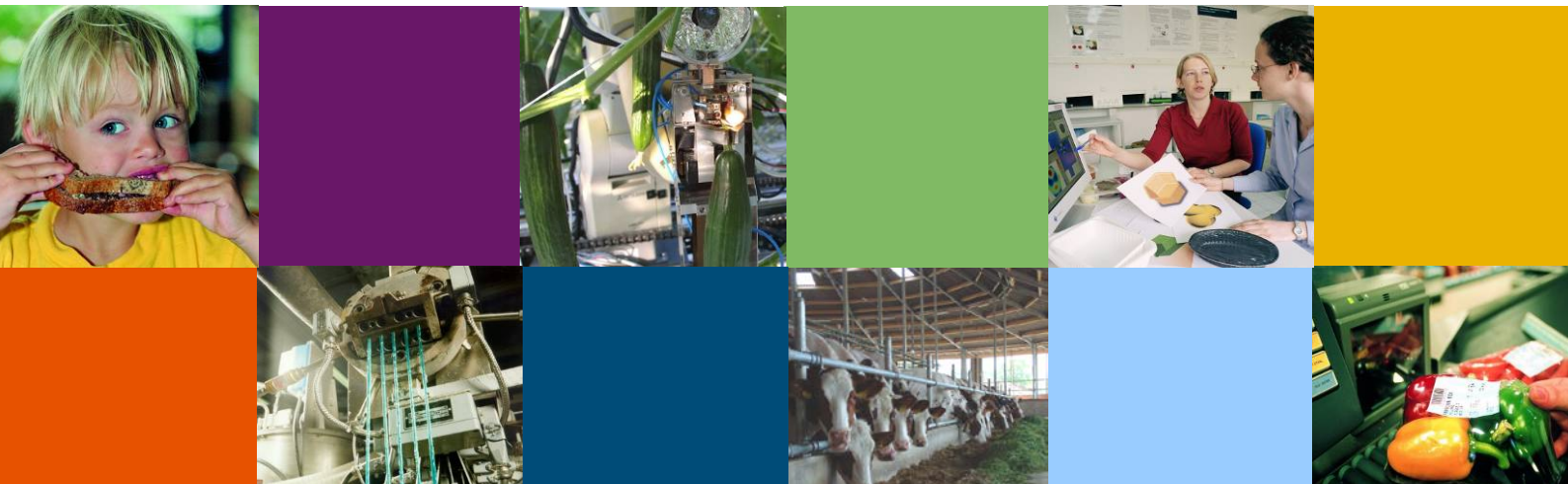
FOOD & BIOBASED RESEARCH
WAGENINGEN UR

Chain strategies for the agrologistic sector in Egypt

The examples of hydroponics vegetables, aquaculture and soft fruit.

N. Waldhauer
M. Poelman
M. Blom-Zandstra

Report 1646



Colophon

Title	Chain strategies for the agrologistic sector in Egypt. The examples of hydroponics vegetables, aquaculture and soft fruit.
Author(s)	N. Waldhauer, M. Poelman, M. Blom-Zandstra
Number	1646
ISBN-number	978-94-6257-720-6
Date of publication	April 2016
Version	Definitive
Confidentiality	No
OPD code	OPD code
Approved by	N. Koenderink
Review	Intern
Name reviewer	W. van den Broek
Sponsor	Netherlands Enterprise Agency (RVO)
Client	Embassy of the Kingdom of the Netherlands in Cairo, Agricultural Office
Photos	Unless otherwise mentioned photo credits by participants in this study

Wageningen UR Food & Biobased Research
P.O. Box 17
NL-6700 AA Wageningen
Tel: +31 (0)317 480 084
E-mail: info.fbr@wur.nl
Internet: www.wageningenur.nl/en/fbr

Content

1 Introduction

1.1 Background

Worldwide we observe the parallel trends of a significantly increasing world population and of strong urbanization resulting in changes in the consumption pattern for food, namely increasing demand for fruit and vegetables, meat and fish, milk products, fruit juices, soft drinks, beer, wine and spirits as well as higher standards regarding food safety, freshness, taste and fashion in food (UNFPH, 2008; IFPRI, 2008). These developments can also be observed in Egypt with the explosive growth of the total population, an increasing middle class and in parallel a growing demand for fresh food of high quality and taste (Dawoud, 2013). First local initiatives answer to these demands, especially catering to the upper class of the Egyptian society who has both awareness of the problem and enough wealth to pay for more expensive products. However, these developments are too slow to solve the problem of how to serve the changing demand of a growing urban population in the near future and thus the problem is only increasing. Adding to this the already existing water scarcity in Egypt, which is expected to increase with the completion of the Renaissance Dam in Ethiopia[1], increasing pollution of surface water and inefficient current agricultural production systems, it becomes evident that food security is one of the priority targets of the Egyptian government. Increasing the efficiency of traditional production systems and decreasing postharvest food losses are two important aspects that can contribute to achieving this target.

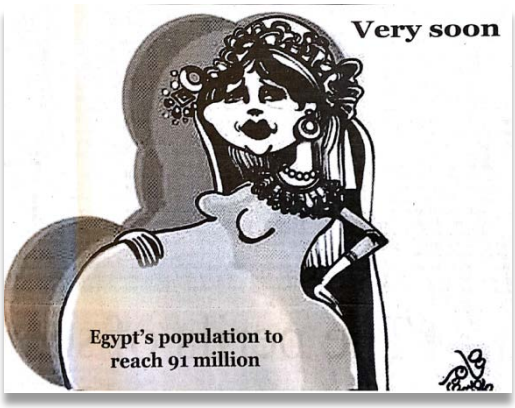


Figure 1: Egypt's growing population is an increasing concern. (Source: Egyptian Mail, April 05, 2016.)

The Netherlands on the other hand has significant experience and expertise worldwide in the production of fresh fruit and vegetables and on how to transform the tradeinto successful business models. Therefore the agricultural office of the Dutch Embassy in Egypt in close cooperation with DGAGRO of the Dutch Ministry of Economic Affairs has been developing a program on metropolitan food security and agrologistics in Egypt since June 2012. The program is targeting the improvement of food security in Egypt in general and the reduction of post-harvest losses in particular as major gains in securing food supply of the population are expected in this area. Launching the Agrologistic Forum Egypt-Netherlands was an important milestone in the development of the combined Dutch-Egyptian efforts for improvement of agrologistics and food security as it allowed to create a vision on this topic in Egypt, raise awareness and gain momentum for further activities.

[1] http://www.fao.org/nr/water/aquastat/countries_regions/EGY/index.stm *(accessed April 18, 2016).*

1.2 Objectives

The objective of this study is the development of concrete chain strategies for three specific value chains, which will contribute to reducing postharvest food losses. These strategies can then be implemented by the private sector, either directly or where necessary in a project consortium in the form of a pilot. The chosen value chains are hydroponics vegetables, aquaculture and soft fruit chains. The study was initiated by the Dutch Embassy in Cairo and financed by the Netherlands Enterprise agency (RVO).

Important questions that need to be answered for setting up a chain strategy are:

- What is the current situation in each of these value chains and why are they important for the food sector in Egypt?
- Which elements of the current value chains need to be changed and how in order to reduce losses and improve the links between producer and consumer?
- What are main bottlenecks for the introduction of the new concepts?

The researchers have conducted an objective and independent study in order to answer these questions. The findings are described in this report. It is important to note that this research is a continuation of work done earlier and thus the research approach varies per value chain. However, the proposed strategies all target the reduction of post-harvest losses and the improvement of food security in Egypt. The concrete problems and the proposed strategies differ per chain, although some overarching patterns can be identified such as lack of knowledge and quantitative production and market information, important differences in small and large farmers, the role of regulations and the importance of water scarcity for implementing changes leading to lower water use in production but also decreasing postharvest losses that lead to better use of resources. It is to be noted though that reactions to the proposed strategies as well as additions and adjustments to it highly depended on the participants in the working groups. The number of participants varied from 4 in the aquaculture working group to 15 in the two other working groups. Also, the expertise of the participants varied significantly. The participants of the aquaculture working group had significant expertise and were known to the workshop leaders. The participants of the soft fruit working group also seemed well informed though purely representing larger producers. The participants of the hydroponics working group were quite mixed with some experts and some participants without any knowledge of hydroponics production. The wider applicability of the results is therefore limited and the findings should be considered in this context.

This report and the findings mainly aim at parties being interested in using the opportunities the overall situation in Egypt (as described under 1.1) offers. These are mainly Egyptian market players that are already working in one of the value chains as well as Dutch supplier of input materials and importers. Furthermore, this report is also targeting the wider interested public as

the findings could offer a starting point for similar research in other emerging counties that face a similar situation as Egypt.

1.3 Methodology

This study is a continuation of earlier work in all of the three value chains. The researchers have been active in these value chains in Egypt for a longer period. Literature research and review of earlier studies of Wageningen UR formed an important first step. This was further extended by interviews with forerunners in the sector.[2] For the soft fruit chain an extra one-week field visit in Egypt was added in order to collect further detailed information. A detailed report of this visit is to be found in the annex. Finally, the developed value chain strategies were discussed with Egyptian sector representatives and further validated, where necessary adjusted and further developed.

1.4 Report outline

Chapter 2 gives a brief overview of the Second Agrologistic Forum Egypt-Netherlands, where the three strategies were presented and break-out sessions organized to develop these further. Chapters 3, 4 and 5 explain the strategy of each of the three value chains including the results from the break-out sessions during the Agrologistic Forum and individual conclusions per chain. Chapter 6 summarizes general conclusions for all three value chains and gives a further outlook of the topic.

[2] *For confidentiality reasons not all details, neither on the participants nor on specific shared information, can be shared in this report.*

2 Second Agrologistic Forum Egypt-Netherlands

In November 2014 the Agrologistic Forum Egypt-Netherlands was launched with the following aims:

1. Exchange knowledge and good practice between various players in the agrologistics field;
2. Identify cooperation potential between Egyptian and Dutch parties;
3. Facilitate in finding funding for identified pilots and projects.

Setting up this platform was the result of a program on agrologistics in Egypt that has been developed by the Dutch Ministry of Economic Affairs, DG AGRO, in close co-operation with the agricultural office of the Embassy of the Netherlands in since June 2012.

On April 03, 2016 the second edition of the event took place at the American University in Cairo (AUC), Campus Tahrir Square, focussing on the reduction of food losses in both improving existing value chains as well as setting up efficient new value chains in newly reclaimed land (see program in Appendix B). This set an excellent frame for presenting the developed chain strategies with representatives from the Egyptian sector. Besides presentations of the findings the event also offered the opportunity to organize a break-out session for each of the three value chains where the findings were discussed with a selected number of the participants of the forum as to validate, if necessary adjust and further develop these.

Figure 2: Second Agrologistic Forum Egypt-Netherlands

The event was well received with estimated around 40 participants, mainly from Egypt, covering the agricultural and logistics industry, governmental institutions, NGOs and knowledge institutions. A keynote was given by Dr. Richard N. Tutwiler, Professor and Director of the Research Institute for a Sustainable Environment (RISE) of the AUC. This keynote set the frame for the following presentations, pointing out as main challenges that are currently being faced by Egypt the global trends of climate change and globalization together with local trends such as:

- Rising economic inequality and division of the society with a growing middle class;
- Declining national resources, in particular pointing out water scarcity and land as a resource under threat;
- Increasing cost of ecosystem services (food supply, maintaining of the habitat, resources);
- Growing pollution and waste;
- A contradictory socio-economic situation and lack of trust within the society.

However, according to Mr. Tutwiler, this situation also offers the following opportunities:

- Demand for high quality products;
- Growing internal demand from growing middle class;
- Technological innovations;
- Need for increased efficiency;
- Green technologies;
- Need for good management skills.

3 Hydroponics vegetables production for the local Egyptian market

3.1 Hydroponics strategy

3.1.1 Introduction

Hydroponics vegetables were chosen as one of the three value chains as it is expected to be part of a possible solution to the established problems of an increasing population, rising urbanisation and middle class with changing consumption patterns and water scarcity in Egypt. Currently, hydroponics production is very limited in Egypt with small-scale farming and limited experience with production systems. Therefore, it is currently not suitable for larger scale production for the local market (Waldhauer, Soethoudt, 2014), so it is necessary to upscale the current production, link it to the relevant market segments in Egypt and implement capacity-building elements.

3.1.2 Production and market

Currently, there are just a limited number of growers that use hydro- or aquaponics systems. All produce short-cycle leafy vegetables, e.g. lettuce, kale and herbs. The production systems are low-tech solutions and thus offer significant opportunities for technical upscaling (Soethoudt, Hendricks, Waldhauer, 2016). Considering different market channels the following can be stated in terms of current market and target market: The retail market demands for a higher production at a steady quality and steady supply than cannot be realized by the existing hydroponics production. Also in terms of price the current price for hydroponics leafy vegetables makes it be out of reach for the largest share of the population. Larger scale production and higher technical solutions (incl. mechanization) will lead to a cost decrease and will thus in the longer term make the product more accessible for more people.

Figure 3: Hydroponics lettuce in a local supermarket

The mainly consumed products such as tomato, eggplant, onions, squash and cucumber are not produced in hydroponics systems (Soethoudt et al., 2016; Dawoud, 2005). The out of home market offers better opportunities for hydroponics products. The requested volume by medium-scale restaurants and hotels are more suitable to the production possibilities and also the price of the hydroponic product is of less impact as a client to a restaurant pays for the meal as a whole in which the cost of the individual ingredient has a less strong impact. Finally, foreign tourists, in particular form Western countries, are more demanding of leafy vegetables than the local population as in their home countries leafy vegetables are more important parts of the diet (Soethoudt et al., 2016). Generally, for food purchase it can be said that quality is an important driver as is the (perceived) safety of the

product. Price is not the most important driver, though can limit the choice if the price is too high and play an important role in the relation of perceived quality and price (Soethoudt et al., 2016).

3.1.3 Strategy

Overall it can be established that there is a significant gap between the current hydroponics production and current and future consumer demand. In other words, the demand for hydroponics at this moment is already bigger than the production and this will only increase. Therefore, the opportunity for hydroponics production is significant. Water scarcity and water-efficient production are not important topics for the consumer (yet). Thus, a marketing strategy should not build on these aspects but on the quality of the hydroponics product. The most interesting business case can be established for tomatoes as these are the most demanded product in Egypt. A suitable market channel to focus on is the small-scale restaurant or hotel segment in Cairo.

3.2 Results of the working group

The working group consisted of c. 15 participants. Some of these were active in hydroponics production or related sectors (e.g. supply of inputs). Others were interested in the topic as they considered setting up hydroponics production within their existing traditionally producing farms. A third group of participants attended out of pure curiosity for the subject without any particular background knowledge on the topic.

Figure 4: Impression of the working group on hydroponics vegetables

The working group discussed the presented strategy and mainly focussed on barriers the sector is facing in changing to hydroponics agriculture. It was generally agreed that there is a significant market for hydroponics in Egypt that has not been satisfied yet. This offers interesting opportunities for entrepreneurs.
The following main barriers were identified:

- Business model for hydroponics production
    - How to finance the relatively high investment cost in the beginning? (access to capital)
    - Which price covers the cost, delivers the necessary margin and is acceptable for the consumer?
    - What is in it for the consumer and how to sell the advantages of hydroponics products? (marketing, building a brand)
- Knowledge and capacity-building aspects

- What is the right technical solution for the situation in Egypt?

Generally, it was stated that it is important to find the right solution for Egypt not by copying a system from other countries but by a try and error cycle that adapts existing systems to the circumstances in Egypt (e.g. climate).

Further important conclusions of the working group were:

- A main concern for the initial investment is how to convince investors that this technology can work in Egypt as there is no proof of concept yet and the general belief is that greenhouses do not work in hot climates.
- Setting up a demo farm including for example a restaurant or a chef school could be an attractive model.
- In Cairo the restaurant scene is booming and thus a very interesting market. Additionally, real-estate prices are increasing which leads to restaurants maximising the surface serving customers and minimising the kitchen and storage surface. Also, labour cost in Cairo is rising and restaurants reduce their personnel. Thus, offering semi-processed vegetables could be a very interesting option as this reduces the work that needs to be done in the restaurant.
- Hotels are under pressure due to a reduction of tourist numbers for safety concerns. One of the strategies of hotels is offering all-inclusive packages at relatively low rates as to still cover their cost. Food is included in these packages and is considered one of the cost elements where cost can be cut. Also, the type of tourist changes and the top-end tourists hardly come to Egypt at the moment. Consequently, they are not considered a suitable target group.
- Setting up cooperation in Egypt is difficult as this is not part of the general culture. In some areas, e.g. Aswan, cooperation for the export was realized, however, there are no examples of cooperation for the local market. In the current situation with small-scale hydroponics start-up producers cooperation would help to decrease cost, e.g. for input materials or for transportation, and thus make the product more interesting for the market. Also, cooperation could help in capacity-building as producers could learn from each other instead of all going through the same learning curve.
- Currently, the hydroponics producers control the entire chain including sales, packaging, transportation. They would be interested in outsourcing these aspects and purely focus on production, but there is currently no trustworthy partner to take over these aspects.
- Having a common transportation system and a central unit for e.g. washing, cutting and packing products would be very interesting, for the producers as well as for the restaurants (see point above). Washed and cut products could also be attractive for Nile cruise ships.
- It is also crucial to educate consumers and chefs so they understand, e.g. what the advantages of a hydroponics product are, or that common products lead to high waste due to low quality which needs to be considered in a price comparison.

3.3 Conclusions

The general strategy as presented is supported with focus on exclusively restaurants and not hotels. Important considerations are to be made as to whether to uplift current hydroponics producers to a high-tech level or target new hydroponics producers with a mid-tech solution. The first could deliver an important proof of concept for high-tech hydroponics in Egypt with a high impact per farm, however, would only target a very limited number of producers. The main barriers encountered in these cases is the access to credit. The latter could target a significant share of the production, however, its impact per farm would be limited. Capacity-building would be an important aspect of the second option. An additional option to be explored further is the setting up of a central unit for processing. The first indication is that there is demand for such a market player on both sides, from the producers that wish to outsource these activities, as well as from the clients (the restaurants) that wish for semiprocessed products and are willing to pay a higher price as long as their savings in surface and personnel are still higher than the additional cost.

4 Towards a resilient aquaculture industry with new approaches

4.1 Aquaculture strategy

The aquaculture industry in Egypt is significant in size. Egypt is the world's second largest producer of farm raised tilapia. Besides tilapia several other species, such as mullet, carp, etc. are produced, of which mullet is the most dominant. The industry is currently mainly producing for local markets, in which fish provides a very suitable protein source.

The aquaculture industry is dependent to a large extend on imported feed ingredients, which results in a feed import reliance of 80-90%. The increase in the prices of feed ingredients, particularly imported ingredients such as fishmeal, soybean, corn, oils and additives has led to parallel increases in feed prices (El-Sayed, 2013). Production of marine fish is performed mainly in pond systems, which derive their juveniles from natural resources. Marine aquaculture is not directly described in this document.

The production cycle of tilapia is short, and can only achieve one production cycle per year, due to cold winters resulting in mortality and slow growth. The primary market is currently focused on whole (non-processed) fish for different local markets. Tilapia is mainly produced using several thousands of (official and non-official) hatcheries. Production is mainly based on drain water from agriculture, whereas access to high quality fresh water is lacking.
Timing of fish harvest is mainly dependent on crop quality on one hand, and market demand (price setting) on the other. Fish are harvested by draining the pond followed by net harvesting. In some cases special channels (additionally dug in the pond) have been constructed to maintain an adequate water temperature and to facilitate the concentration of fish prior to harvest.
Marketing is mainly done by middlemen, either by direct trade or by auction. Fish are normally not chilled prior to market. Best practice is that middlemen chill the fish post-harvest. Fish are marketed alive (gaping), or non-processed. Fish are sold to fish mongers, middlemen, processors and traders. Processing is limited, but in development in Egypt.

4.2 Bottlenecks in the value chain

Value chain assessments by the aquaculture feed industry have led to the following recommendations based on identified treats for the industry.

- Reduce dependency on expensive feed ingredients.
- Improve capacity for production of high quality feeds.
- Increase employment opportunities in the aquaculture feed sector.
- Improve access to credit for fish farmers.
- Improve access to training.
- Feed production & feed management & fertilizer use
- Strengthen the legal and policy environment for feed production, quality control, handling.

A complete summary of the current bottlenecks in Egyptian aquaculture, including potential future developments is depicted in table 4.1.

Table 4.1 Summary of the current bottlenecks in Egyptian aquaculture, including potential future developments

	Current situation	Future situation (short/medium)
Hatcheries	Hormone use to increase males. Immune system weak.	More use of natural sex reversal by water temperature.
Production systems	Ponds, no overwintering, mono culture of Tilapia	Simplified RAS, overwintering, crop adaptation, polyculture
Production cycles	One 6 month season, 1 cycle small size, 1 larger size	Extended season, 2 cycles small size
Production efficiency	High, based on traditional cultures Decreasing due to changing environment	Best management practices, feed and water quality management
Species	Tilapia, mullet	Tilapia, catfish (polyculture)
Post-harvest losses	High due to lack of cold chain High due to lack of sector organisation Low in certain chains due to "live" market	Lower due to introduction of cold chain
Power availability & reliability	Lack of reliability and constant supply, depending on fluctuating fuel prices.	Optimised, e.g. by solar panels
Sourcing & import reliance	Most raw materials for ingredients imported. Vulnerability for currency fluctuations. High differentiation in feed quality. Increasing feed prices.	Increased local production of raw materials. More efficient RM use, improved quality and sustainability.
Mortality	Few diseases, mortality due to stress and cold nights	Reduced stress and semi-control production systems to avoid temperatures < 20 C. Best management practices and trainings to prevent mortality.
Crop yields	Yields not optimised due to less efficient production systems and supply oriented production.	Increased due to more efficient production systems, cycles, sourcing and market oriented production

Operating costs and financial return	85% of total costs from feed. FCR not optimised. As a consequence financial returns are not optimised.	70-80% of total costs from feed. More optimal FCR due to higher feed quality. Financial returns Increased due to more efficient production systems, cycles, sourcing and market oriented production
Water use	Use of agricultural channels, potential pollution with fertilizers and pesticides. Availability depends on agricultural activities. Salinity issues in coastal ponds.	Higher quality control, improved water management to ensure sufficient water quality and quantity.
Land use	Rent increasing annually.	Government reduced rents
Logistics & infra	Rainy season and unpaved roads cause casual problems with accessibility to/from farms.	Investments in better roads
Domestic markets	Highly dependant on imports. Applies to feed, frozen and wild Tilapia	More robust, less dependent on imports
Market oriented production	Few planning for market production. Multiple sizes produced, not linked to market segments.	Production planning & adaptation, specific sizes tailored for specific market segments
Consumers	Market for smaller sizes is not provided for.	Larger fish (>200 gr) for middle income consumers and smaller fish (100-150 gr) for lower income consumers
Supply chain	Many different smaller parties in feed, hatchery, grow out, processing separated.	More vertically integrated companies
Competition	Few importers in feed business, low competition.	More local producers, higher competition
Fish prices	Relatively stable, occasional decrease due to large quantities of production.	Stable, production peaks are more levelled.
Marketing	Media occasionally reports on contaminated Tilapia.	Quality controls and enforcements prevent risks of

	Increased concerns with consumers with respect to cultivated Tilapia.	contamination, and removes worries of consumers
Consumer preferences	Preference for wild and frozen imported Tilapia.	Increased preference for cultivated Tilapia, due to better control, higher quality, favourable prices
Subsidy system	No focused subsidy systems in place.	Reforms focussing public-private partnerships, innovation and demonstration. Novel production strategy demonstrations.
Stakeholder cooperation	No platforms for sharing knowledge available.	Water platform, training centers
Credit and financial support	No access for small-scale farmers.	Micro-credit instruments for small-scale farmers
Capacity building	Service not available. Lack of knowledge with farmers on best management practices, e.g. feed, feed management, fertilizer use.	Capacity building trainings focussing on best management practices available.

4.3 Results of the working group

The working group for aquaculture was joined by few (four) attendees. All were closely related to the development of the aquaculture industry in the past and in the planning and development of future scenarios. Based on the discussion a selection of thoughts for discussion were addressed.

Salinizing regions are abundant in the North of Egypt. This threatens the fresh water aquaculture industry, however, this could also be used to stimulate a change to brackish water aquaculture including Red tilapia. This change requires an evaluation of the resilience of Red tilapia versus Nile tilapia, including potential genetic improvements (selection and breeding). The transition to Red tilapia production requires marketing strategies, insight in consumer acceptance, and insights in production potential. Therefore pilots to address these issues are relevant to promote the security of production capacity of salinizing regions.

(Semi) Recirculation systems need to be developed and implemented for areas with low water availability and water scarcity (if not for the entire industry). These systems use less water than typical pond systems, and are therefore suitable to play an important role for aquaculture perspectives in future water scarcity situations. Also, the used water can efficiently be re-used in agriculture, providing nutrients and water. The development of (simple) closed aquaculture

systems also fulfils a need for the application of all season production cycles, which enables multiple crop per annual cycle, as well as producing larger sized crop for high end markets.

In post-harvest loss reduction the group identified the possibility of creating a market for processed fish, including filleting. The by-products from the fish processing industry (if logistically concentrated) could be used to produce fish feed ingredients (fish meal), creating a more resilient local access. This especially enables high end markets to increase competitiveness with international markets (waste price). It should be noted that the fish feed ingredients from one species may not be used to feed similar species.
Export of tilapia, carp and mullet is considered a relevant development, since this will frontier the possibilities to set up high end value chains. Investments for import and commitment to the export ambitions are easier to find than addressing similar issues in local high end value chains. The export market is currently inhibited by the lack of adequate legislation and control. Also, consumer perception (for the entire aquaculture sector) is such that consumers perceive aquaculture products as high in contaminants, although various sources do not confirm this perception. A consumer awareness program should facilitate the demand in aquaculture products, providing a more stable local market.

The group was triggered by the opportunities for Agriparks for aquaculture. Especially the development of new areas for example for new land reclamation zones in areas with brackish water access could benefit from aquaculture and vice versa. The water from brackish water sources is optimal in terms of replenishment (connected to the marine system), and could functionally be used in brackish water agriculture-aquaculture systems. These areas are on a remote distance to the market, however, can provide adequate access to export markets (depending on the region of development).

4.4 Conclusions

Based on the discussion in the workshop, and prior value chain assessments the following prioritization of short term interventions can be made for the development of the value chains (post- and pre-harvest losses, and production optimization). Key in the developments is to sustain and improve the current production, and current production systems. Second is the adaptation to the changing conditions in water scarcity and population growth (and less space). Third is the direct requirement to market diversification, including market organisation and arrangement of the players in the value chain.

1) Sustainable intensification of the current production system
    a. Best Aquaculture Practices
    b. Utilise cash crop and protein crops to achieve aims (poly culture)
    c. Water efficiency
    d. Tenure and investment organisation
    e. Optimisation of raceway systems, including potential for overwintering

    f. Vertical integration of companies for export purposes and high end markets
    g. Trained community organisations for provision of lower income markets
2) Opportunities for brackish water aquaculture
    a. Mullet – Red tilapia culture
    b. RAS production
    c. Improving tilapia strains
3) Market diversification
    a. Organisation
    b. Power arrangements
    c. Healthy balance for food security, and export
    d. Export needed to drive high end market production

Recommendations for the mid- to long-term are primarily found in the development of an export industry to help the development of a processing industry for high end markets. This requires the implementation of RAS and overwintering technologies, enabling a year round market access and support of efficiency of brackish water aquaculture. Pilots to support this are highly recommended.
Integrated aquaculture and agriculture concepts are always on the agenda for Egypt, especially if the road is opened once the regulation for use of water for aquaculture is approved.

5 Towards a sustainable soft fruit chain: The case of strawberry and grapes

5.1 Strategy for the soft fruit chain

Food losses in the soft fruit chain are an important issue in Egypt and may be caused by 1. Diseases (fungi, viruses, bacteria, insects, nematodes, mites), 2. Fruit damage (bruising, cracks, picking by birds), 3. Bad quality (unbalanced maturity fruits, taste, aroma) or 4. Short shelf life. In general, soft fruit is vulnerable for losses during both cultivation and in the postharvest phase. The losses may origin from inadequate farm management (insufficient pest management and fertilization, inadequate pruning), inadequate anticipation on environmental disturbances (too wet, too dry, too hot, too cold) and careless handling after harvest (sorting, packing).

5.1.1 Strawberry

Strawberry is an annual crop, mainly grown in the open field. Both early and late varieties are used. Early varieties (like Elyana) are grown from mid-September, when soil T is 30-35℃, for 45 days. Late varieties (growth starts about 10-15 days after the early varieties) are grown for 45-70 days. Early varieties have higher yields than late ones. For the consumption of strawberry fruits two different products can be differentiated: 1. Directly eaten as fresh fruit and 2. Juice or food additives produced from frozen fruits. High quality fruits are used for the fresh fruit market and the most of it is exported, to the Netherlands (Albert Heijn), UK (Marks & Spencer), Ireland, Canada, Germany, Russia, Greece, Saudi Arabia, China (Hongkong). Important competitors are Morocco and Spain. Acceptable low quality fruits are used for local markets or frozen to be processed towards juices or food additives. The sensitive steps in the production and postharvest chains for the occurrence of food losses are presented in Figure 5.1.

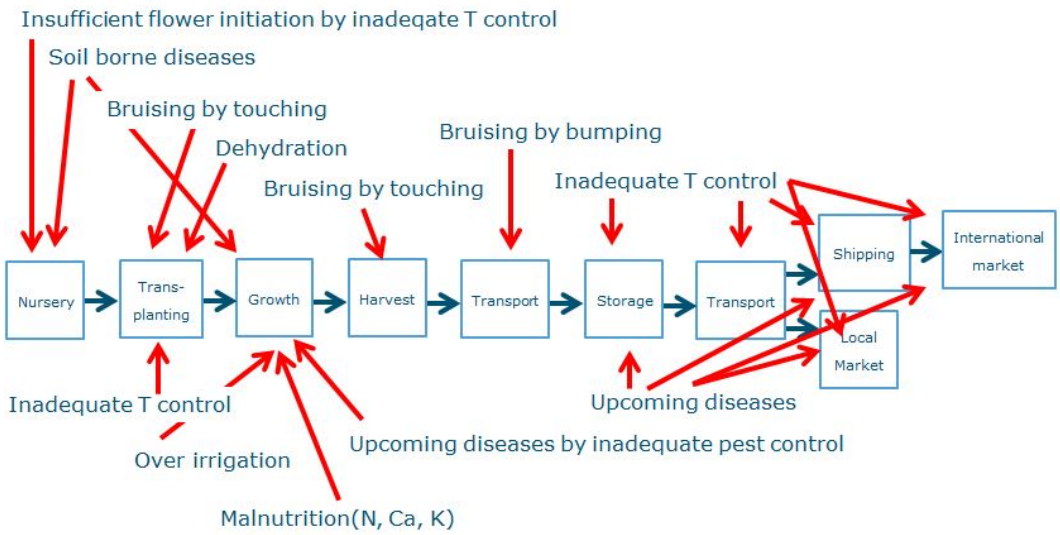


Figure 5-1 Threats in the strawberry production and post-harvest chain

5.1.2 Grapes

Grapes trees are perennials, mainly grown in plastic greenhouses and having an active growing period and a dormancy period (cold period). Trees are pruned while keeping 1 main branch with 1 shoot (the best one is selected). There are many different varieties and three types (early-mid-late). The period between early and late types is 6 weeks. The fruits (red and white) of the grapes are mainly used for the fresh market. High quality fruits are exported, fruits with low quality (but still acceptable for sale) are used for the local market or processed. The sensitive steps in the production and postharvest chains for the occurrence of food losses are presented in Figure 5.2.

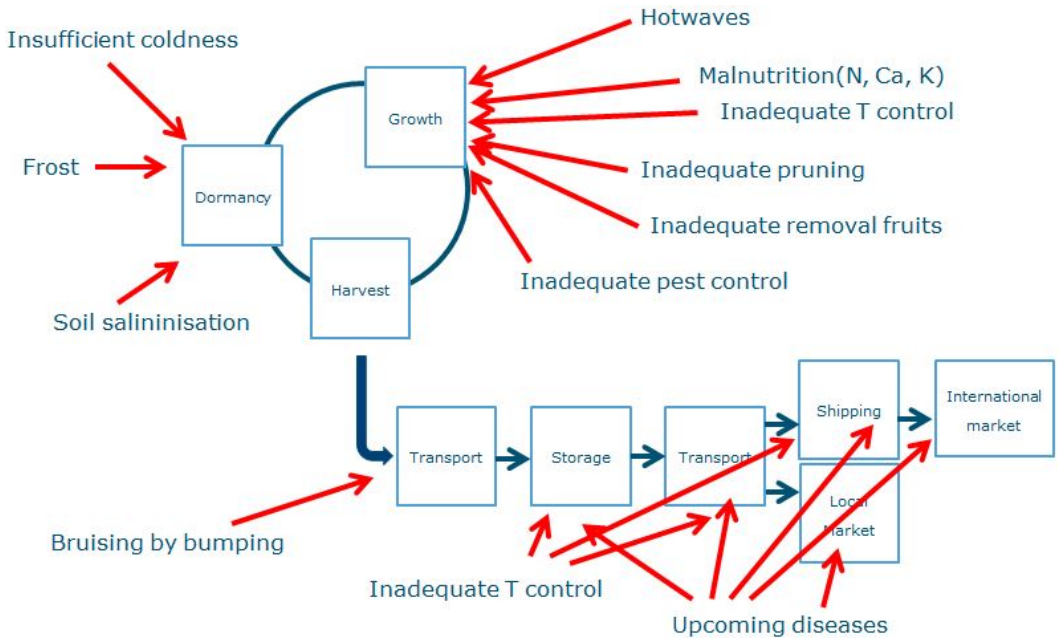


Figure 5-2 Threats in the grapes production and post-harvest chain

5.1.3 Bottlenecks

The main bottlenecks to deal with the threats during the production and post-harvest phases are:

- High costs for the purchase of adequate equipment for climate control (during cultivation and post-harvest storage).
- The need for labour. For strawberry the careful handling during and after harvest needs much labour. For grapes an adequate pruning is very labour intensive.
- Insufficient awareness/knowledge on farm management (fertilisation, pruning and pest control) and hygiene during harvesting.
- Insufficient monitoring of water availability, extreme weather conditions, salinity threats, etc.
- Regulations with respect to the allowance use pesticides and zero-tolerance on residues.
- A huge (economic) distance between the local-market-chain and the international-market-chain.

5.1.4 Strategies

Different strategies can be used to tackle the threats:

- A shared sense of urgency. Cooperation between all stakeholders, a shared range of ideas and a joint approach will give opportunities to exchange ideas, knowledge, technical support and to make the logistics more efficient.
- Identification of problems and solutions. Bottlenecks have to be quantified and economized to give insights in solutions with best perspectives and feasible to elaborate.
- Improvement of the knowledge, technology and training.
- Improvement of the cold chain.
- Better alignment between the local market chain and the international market chain
- Better quality control.

5.2 Results of the working group

At the workshop c. 15 people participated. All appeared to be employed in the soft fruit sector and were well informed about the topic. During the first part of the session the chain was discussed. Several participants considered the presented chain incomplete and emphasized the need to add more steps in the chain, in particular the step 'sorting and packaging' as this step is highly sensitive to losses.

Then, the bottlenecks mentioned in the presentation were discussed and prioritized. The lack of enough awareness and quantitative information on losses and costs for improvement were unanimously seen as the most important bottlenecks for food losses. The bottlenecks were ranked in order of priority as follows: 1. Awareness, 2. Labour, 3. High costs (especially for cooling and storage), 4. Distance between local market and export market, 5. Regulations and 6. Monitoring.

Additional bottlenecks mentioned were:

- The production of soft fruit may outreach the consumption. It was generally considered that the export market has the potential to absorb more soft fruit.
- It is very difficult to create opportunities for small farmers to increase their production capacity.
- Egypt is not able to produce enough seeds.

It was further discussed whether the topic for the small farmers chain equalled the one of the big farmers, whether all problems or

bottlenecks were sufficiently understood and whether all future perspectives were adequately mapped. An important issue raised was the fact that small farmers have to compete with big farmers. An appropriate way to tackle this problem was not found. It has to be emphasized that (unfortunately) most/all participants considered the topic mainly from the large farmers' point of view. So, good insight in and knowledge on the small farmers' production chain is still needed.

5.2.1 Suggestions and way forward

The gap between small farmers producing for the local markets mainly and big farmers producing for the export mainly was generally seen as a big issue in Egypt. More knowledge (quantification losses, technical solutions, ways to downsize costs, etc.) is needed to overcome this gap. It was suggested to find a way to get rid of middlemen and to establish Marketing Centres to facilitate small farmers to produce and sale their products at low costs.
More knowledge and dissemination of knowledge can be generated by starting up training programmes, more extension visits or in-house training, farmer-field-school meetings, publications on latest updates of markets and EU-updates.
An important incentive for cooperation and to tune the different production chains will be the introduction of a system with inspection, standards and GAP certification.

5.3 Conclusions

It can be concluded that both during the growth and the post-harvest phase of the soft fruit several threats for food losses exist. Especially, the gap between the small farmer chain and the big farmer chains is seen as great difficulty for short term solutions. Awareness and lack of knowledge are considered as important bottlenecks and need to be improved as soon as possible.

6 Conclusions

In this study new chain strategies for hydroponics vegetable production, aquaculture and soft fruit were presented. These are seen as opportunities to reduce post-harvest losses and contribute to food security in Egypt, situated in the context of a growing population and growing urban middle class, changing consumption patterns, related increasing pressure on the food system and expected further increasing water scarcity.

Overall we can conclude that each of the three value chains faces significant problems at the moment, which leads to a suboptimal performance of the chain. The specific problems differ per chain and so do the proposed chain strategies and interventions. The proposed strategies, based on earlier research, literature and stakeholder interviews were generally well received and supported by the attendees of the working groups. Additions and slight alteration were made, however, no structural changes of the proposed strategies.

We can also see certain aspects that form a more general barrier for improvement and introduction of new concepts in several value chains:

- Missing knowledge and quantitative information is one of these aspects and the need for capacity-building was expressed several times.
- Also, we see a gap between smallholder farmers and large farmers having not only different levels of knowledge and capacity but also different possibilities for upscaling to newer forms of production.
- Another recurring barrier is the current situation of regulation which forms a barrier to certain improvements and changes in the studied value chains.
- Finally, we see water scarcity coming back in several of the argumentations for necessary changes in the chain. It is not yet part of the consumer conscience, however, chain players are aware of the problem and its expected rising importance in the near future.

As for the further development of the initiatives the hydroponics vegetable and the aquaculture value chains seem to offer the most immediate potential for starting up pilots implementing (parts of) the proposed strategy.

References

Dawoud, S. (2005): An analysis of food consumption patterns in Egypt.

Dawoud, S.D.Z. (2014): Econometric analysis of the changes in food consumption expenditure patterns in Egypt, Journal of Development and Agricultural Economics, Vol. 6(1), pp. 1-11.

El-Sayed, A.F.M. (2013): On-farm feed management practices for Nile tilapia (Oreochromis niloticus) in Egypt. In: M.R. Hasan, M.B. New (Eds.) (2013): On-farm feeding and feed management in aquaculture, FAO Fisheries and Aquaculture Technical Paper No. 583, pp. 101-129.

IFPRI (2008): High Food Prices: The What, Who, and How of Proposed Policy Actions, Policy Brief, May 2008.

Soethoudt, J.M., Hendricks, J., Waldhauer, N. (2016): Opportunities for hydro- and aquaponics in Egypt.

UNFPH (2008): State of world population. Unleashing the potential of urban growth.

Waldhauer, N., Soethoudt, H. (2014): Metropolitan food supply in Egypt: Market analysis hydroponics production for selected urban areas.

Acknowledgements

This project was initiated by the Netherlands Embassy in Cairo and we wish to express our gratefulness to Joost Geijer, Head of the Economic Department and Agricultural Counsellor, Marwa Hussein, Senior Policy Advisor, and Charlotte Gerards, Management Assistant to the Agricultural Counsellor, for the excellent local support whenever necessary. We wish to further extend our appreciation to the Netherlands Enterprise Agency who financed this project. Finally, we wish to thank everyone who has thought along this research, shared their thoughts and helped us shape and sharpen our own ideas.

Appendix A – Report on field visit to Egypt, February 21th to 26th to study losses in the soft fruit chain, especially strawberry and grapes.

Greet Blom, Plant Sciences Group – Wageningen UR

For consumption of strawberry two different products can be differentiated: 1. Directly eaten as fresh fruit and 2. Juice produced from frozen fruits. Food losses may origin from inadequate farm management, environmental disturbances and climate change. I visited different farms and interviewed different people, in cooperation with Mr. Hakiem Yassin, Plant Systems.

Interviews

February 22th, 2016. Mr. Kamal Gadall Eldakak, Farm manager ICAPP (for 27 years) and Mr. Amr Ahmed Elsamkry, Assistant Quality manager at an ICAPP farm in Ismailia.

ICAPP produces strawberries for large buyers in countries, like the Netherlands (Albert Heijn), UK (Marks & Spencer), Ireland, Canada, Germany, Russia, Greece, Saudi Arabia, China (Hongkong). Important competitors are Morocco and Spain.

For ICAPP plant and soil borne diseases are very important issues. Losses can be caused by: 1. negative effects of weather on yield and 2. bad quality of the fruits (f.e. inmature parts), which will disqualify them for sales.

Nursery: soil grown (substrate is sterilized, origins from Ireland and only used once). 8-15 mm transplanting. When too big, no transplanting. Optimal root length: 15 cm, # root branches: 10, minimal secondary root length: 15 mm.
Another possibility: hydroponic germination. Less losses, but too expensive. So, focus is on soil grown germination. Threats: soil borne diseases and insects on leaves seedlings. Measurement: spraying with pesticides to kill insects.
High temperature during the nursery period may cause: Reduction flower initiation in 1st cut and the occurrence of green tip (Figure 1) which makes the fruits unsuitable for export. Zn probably reduces the occurrence of Green Tip.

Figure 1. Green tip

Early varieties (like Elyana) are grown from mid-September, when soil T is 30-35℃, for 45 days. Late varieties (growth starts about 10-15 days after the early varieties) are grown for 45-70 days. Early varieties have higher yields than late one. High soil temperature and low N during germination are important for flowering induction.
During germination, a daily mist treatment (max 10 minutes to prevent fungi) is used for cooling. Main disease is Antracnose (caused by members of the *Colletotrichum fungi*). Losses during germination are in order of magnitude of 5%.

QUESTION for WUR:

- Which is the relationship between macronutrients and strawberry decay?
- How can losses be minimized? (Nutrition, diseases, practical management)
- How much are losses in the Netherlands?

Transplanting process: soil is removed from roots by washing (1. By fresh water from the canal with 400 ppm salts/ions (pH=6.5-7.0), 2. by water with chemicals to wash away soil borne diseases (about 1000 ppm salts), 3. by fresh water to remove chemicals).
After the wash step, plants are: either temporary stored in cooling boxes (in case of a long distance to field) or direct transplanted into the field. The period from washing until planting in the field is as short as possible to minimize losses (6-48 hours).

Former advice: keep seedlings at 4℃ during 72 hours. It worked well for some cultivars, for all other cultivars it did not succeed in better yields.

QUESTION for WUR:

- Why difference between cultivars? What are effects on 'early' and 'late' cultivars?
- What period between washing and planting in the field is optimal? At what T (air, soil) and humidity should they be kept in the meantime?

Figure 2. Harvesting strawberries by women

Field growth: soil preparation by ploughing for soil aeration. Field is pre-irrigated to remove chemicals and reach field capacity. Ridges (110 cm) and furrows (25-30 cm) are prepared. Ridges are covered with a thick plastic layer for soil solarisation (16 days) to kill seeds of unwanted weeds. Before transplanting this plastic is removed.

Seedlings are transplanted (4 at a row of 110 cm) and covered by a new layer of plastic to let the plants acclimatise and avoid them from dehydrating, to facilitate harvesting and to push back the threat of soil borne diseases. After a few days holes are made in the plastic to uncover the plants. No straw mulch is placed in the furrows, as this may attract rats and mice.
During growth:

- Bees are hired to initiate pollinations.
- Water is stored in a water reservoir as a buffer for periods of water scarcity.
- Birds are scared away by yelling. Nutrients are daily applied.

- Some fields are used for the testing of new varieties.
- Strawberries produced for frozen products (juice) are separately grown.
- Diseases during growth causing 5% losses: fungi, bacteria, insects, viruses, birds and physiological disorders (high temperature, over irrigation, coldness, fertilization deficiency, calcium deficiency, etc.)

Figure 3. Visualisation of damage or by diseases affected fruits

Harvest: Harvest start after about 45-60 days. Important features (expectations) of strawberry: number of flowers/plant, fruit size, fruit colour, fruit aroma and fruit sweetness/taste. Yields at 1st cut is not as high as in the 2nd and 3rd cuts, while market prices are relatively low (controlled by the national market mechanism). So, production costs for the 1st cut are too high and do not get adequate returns on investments. The amount of fruits are: about 10 at 1st cut, about 40 or more in 2nd and 3rd cut.

The harvesting of the fruits is done by women (figure 2) as they are best suitable to handle the fruits softly. Fruits are not touched directly, but picked from the stalk. Fruits that are damaged or affected by diseases should are not harvested. These anomalies are visualized at big billboards for convenience of the gatherers (Figure 3). After harvest, strawberries are temporarily stored at low temperature. Fruits are transported to the packing units by tractor. At packing, colour and quality of the fruits are evaluated; when colour and quality do not satisfy, fruits are thrown away.

Bottlenecks which may cause losses: the bumping during transport and bruising by packing in boxes, which can be prevented when fruits are cooled (at 10℃) directly after harvest. However, this measure is too costly.
Diseases after harvest: powdery mildew and Botrytis, which manifest themselves only during the export phase and damages the reputation of ICAPP.

February 23th, 2016. Visit to El Giza region, community with medium-size farmers growing strawberries for ICAPP. This region produces strawberries already for about 40 years ago. The production method has been traditionally for a long time, until ICAPP innovated methodology 8 years ago. Farmers changed from the local market towards export and started to pay attention to quality issues.

Figure 4. Garlic planted between the rows of strawberries

In some fields, rows of garlic were planted between the rows of strawberries to fight nematodes (Figure 4). The strawberries harvested during the visit were meant to be frozen and further processed. While picking, both by men and women (Figure 5), the fruits they were touched and thrown in a basket. However, transportation of the baskets is done by a truck (slowly), which may cause bruising of the fruits. Plants were irrigated during about 40 minutes two times a day until the brix of the cellular sap goes down.

Figure 5. Picking of fruits for frozen products

February 24th, 2016. Visit to grapes farms in Berkash Giza to meet Eng. Fayez Dewidar (grapes crop manager) and Eng. Mohamed Kamal (General technical manager) from the company Technogreen (grapes, beaches, nectarines, vegetables), founded in 1988 and mainly oriented on export (NL, UK). Both white and red grapes are produced in plastic greenhouses (covered against frost). Trees are pruned keeping 1 main branch with 1 shoot (best one is selected). There are different varieties and three types (early-mid-late). The period between early and late types are 6 weeks. White varieties (Figure 6 and 7) are early ones (sweet), with a rootstock, which starts early dormancy at the end of November. Varieties of the red grapes are: Flame, Cilar 15, Alar 29. The start of the spraying (water) during dormancy is critical. In an optimal winter climate (optimal temperature) the start of the watering (spraying) may be done in the first week of January. If the winter is too warm, dormancy will not happen. Trees keep on producing leaves, which will exhaust the trees. This can be countered by spraying late. Trade-off is 1 ℃.
The amount of cold stratification hours needed for the dormancy depend on the variety and varies between 100-180 hours. Last 3 years no problems occurred.
Losses, caused by suboptimal climate control (frost or too high temperatures during dormancy), may be caused by growth of shoots without bunches. Possible solutions: selection of other cultivars, less pruning (more shoots per branches), but this measure will require much extra work and extra costs.

Other losses: soil borne diseases (nematodes, Rhizoctonia, Pythium); aboveground (mildew, Botrytis); insects (millibug, anthracnose); mites.

Figure 6. Growth of a white variety of grapes

Crop management: removal of shoots (1.5 kid/shoot by one bunch, removal fruits from the bunche (shoulders; fruits are used for raisins and currants) by scissors to get proper size and sugar content. Control of the proper crop loads is a matter of experience. Standards for brix and size are: for white grapes 15-16 and 18 mm, respectively and for red grapes (contain more acids) 17 and 18 mm, respectively.
Losses during growth by: hot damage by hot waves (> 35℃). Solutions: opening plastic greenhouse, irrigation (to force opening stomata).
Losses may occur by: diseases (Botrytis, Phytophthora, Downy Mildew), suboptimal size/taste management, suboptimal climate control.
Necessary 85 – 100 cm shoot length before flowering to optimize photosynthesis and net thinning for optimal light interception (prevention burning leaves by covering).

Harvest: from mid-May - end July. After cutting, bunches are packed in crates. Crates are covered with a sheet and transported by a tractor to the pack house within 1-1.5 hours (every 5 minutes delay causes a loss of shelf life of 1 day). Temperature in the pack house: 18℃-20℃, to stop sap

flow. Shipping to UK and NL (8 containers/day). An optimum between the frequency of transportation from the field to the storage rooms (costs) and loss of shelf life by long-term stay at high temperatures is chosen.

Threats:
- hot waves (mid-June: 35℃-38℃). Then, harvesting is done from 5 am until 9 am.
- transportation of crates on bumpy roads (emergence of cracks)
- post harvest diseases: Botrytis(still active in cold store at 0℃).

Treatment for Botrytis 2 times: at 80% flowering and just before softening (3 weeks before harvest). Thereafter, no treatment is allowed any more (because of the risk of fruit contamination (residues). Tests on the existence of residues is done 4-5 days before harvest. In harbour the existence of residues is also tested (certification). After harvest, water supply should be continued (to prevent salinization), while many growers wrongly stop water supply because of the costs.

Question: How can Phytophthora and downy mildew (encapsulated) be treated best?

Figure 7. Developing bunche of a white variety of grapes

February 25th, 2016. Visit to Agricultural Engineering Research Institute (AEnRI)- Dokki, Giza-Egypt, attended by Prof. Essam Wassif (Director of AEnRI), Prof. Hazeem Mehawed (Head Researcher of Agric. Eng.- AEnRI), Dr. Amal Abdel Mageed (Researcher of Agric. Eng.- AEnRI), Dr. Samar Attaher (Researcher of Agric. Eng.- AEnRI), Eng. Osama Mubarek (Assistant Researcher of Agric. Eng.- AEnRI) and Mr. Abdel Hakeem Yassin (Plant Systems Co.). Text below is based on minutes by Dr. Samar Attaher.

The objective of the meeting was to discuss the fields of interest for future cooperation between Wageningen University and Research Centre and the Agricultural Engineering Research Institute (AEnRI). Prof. Wassif gave a brief introduction about the research activities which have been held by AEnRI:

- Farm mechanization studies,
- On-farm irrigation studies,
- Integrated agricultural management studies,
- Waste management studies,
- Environmental engineering & bioengineering studies,
- Systems analysis of agricultural systems studies.

Prof. Wassif highlighted the pressing national priorities and needs to increase the agriculture productivity to achieve the national goals of food security, which is strongly limited by environmental and economic challenges. I highlighted some research topics which could meet the common interest of the both sides of the meeting, such as:

- Assess the impacts of environmental pressures on different types of agroecosystems,
- Studies of some adaptation measures for producing field and vegetable crops under marginal environmental conditions (climatic stresses, water stresses, salinity…),
- Using Models and decision support systems (DSS) for on-farm management and the adoption of the adaptation measures,
- Integration between engineering applications and IPM (integrated pest management) practices and strategies.

The following points were highlighted for possible future cooperation:

- Optimized engineering applications to manage arid and semi-arid agroecosystems under marginal environmental stresses (climatic, water, and salinity stresses),
- Optimized engineering applications of protected agriculture, to optimize agricultural production under marginal environmental conditions,
- Engineering applications for olive fruits harvesting,
- Applications of information technology tools and DSS on developing on-farm management strategies to face the growing environmental stress over different types of agroecosystems.

The suggested forms of future cooperation were 1) Researchers short visits and 2) formulation of joined research projects.

Appendix B – Program Second Agrologistic Forum Egypt-Netherlands

Agenda Launch Second Agrologistic Forum Egypt-Netherlands

3rd April, 2016

Venue: Oriental Hall, the American University in Cairo

Tahrir Square Campus, 113 Kasr El Aini St.,Cairo

09:00 - 09:30	Registration and Coffee
09:30 - 09:45	Welcoming Remarks: **Mr. Joost Geijer**, Head of the Economic Department Embassy of the Kingdom of the Netherlands
09:45 – 10:00	Keynote address: **Dr. Richard N. Tutwiler**,Professor and Director Research Institute for a Sustainable Environment (RISE)
10:00 – 12:00	Presentation : A. Improving food security in existing chains through the development of specific chain strategies • Hydroponics vegetables production for the local Egyptian market (Nina Waldhauer MSc, Wageningen UR/ FBR, ir. Joep Hendricks, HortiAlliance) • Towards a resilient aquaculture industry with new approaches (ing. Marnix Poelman MSc, Wageningen UR/ IMARES) • Towards a sustainable soft fruit chain. The case of strawberry and grapes. (dr. ir. Greet Blom, Wageningen UR/ PRI) B. Applying lessons learned to land reclamation ambitions • Urban planning and land reclamation (Erasmus University Rotterdam) • The Agropark concept (Mirte Cofino MSc, Wageningen UR/ Alterra) • Capacity building (Gerard Vos, BCI)
12:00 – 12:30	Coffee Break
12:30 – 14:10	Workshops: 1. Hydroponics vegetable production for the local Egyptian market (Nina Waldhauer MSc, Wageningen UR/ FBR) 2. Towards a resilient aquaculture industry with new approaches(ing. Marnix Poelman MSc, Wageningen UR/ IMARES) 3. Towards a sustainable soft fruit chain. The case of strawberry and grapes (dr. ir. Greet Blom, Wageningen UR/ PRI)
14:10 – 14:30	Wrap-up & Conclusions
14:30 – 15:30	Lunch