

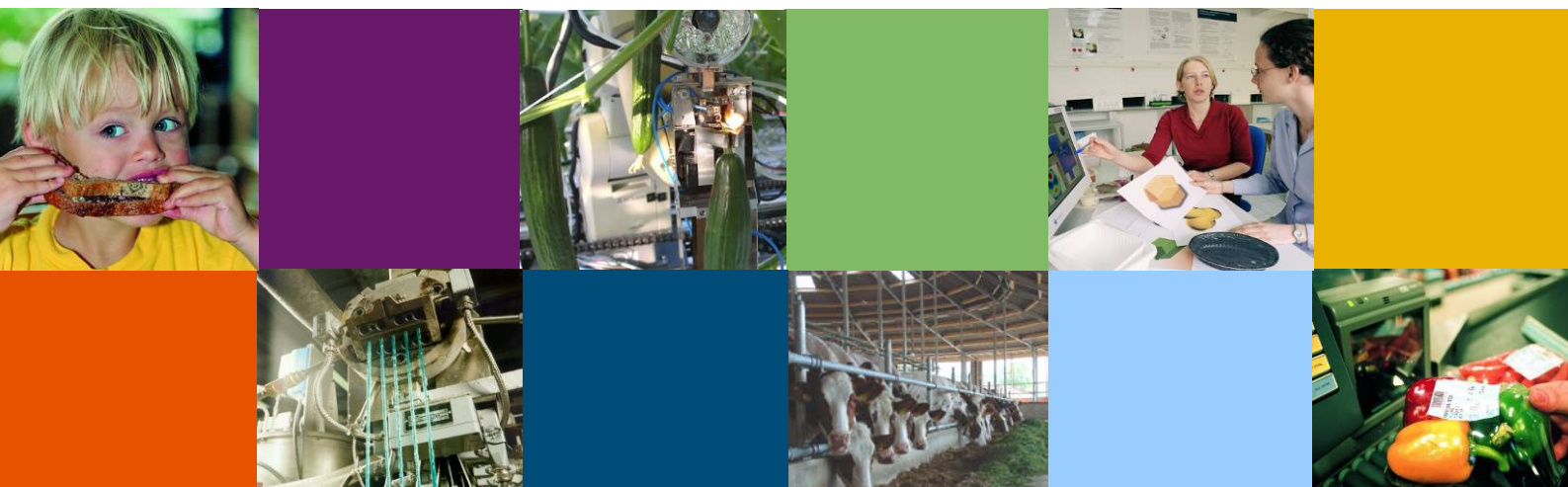


# Food losses in the Iranian Potato Sector

Identification mission

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Report 1750



## Colophon

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# 1 Introduction

This research has been commissioned and funded by the Dutch Ministry of Economic Affairs. It has independently been executed by Wageningen Food & Biobased Research Biobased and Wageningen Plant Research.

An important objective of the Iranian agricultural policy is to improve the productivity of the food supply chains and to safeguard food security<sup>1</sup>. Addressing the issue of postharvest losses will contribute to achieving these objectives. The application of existing agro logistic knowledge and technology should lead to improvements in the value chain.

In view of the importance of the potato production in Iran and the availability of Dutch outstanding expertise in the field of potato production, processing and agro-logistics, Wageningen University and Research and The Ministry of Economic Affairs in the Netherlands have started a project to identify the practical possibilities for improving productivity and quality in the Iranian potato production chain by using existing knowledge and modern, up to date technology.

This project will start with mapping the Iranian potato sector and getting insight in the amount of food losses from farm to fork. In doing so, opportunities for improvements related to food losses, and thereby potentially food security as well, will be identified. These opportunities will be discussed with Iranian authorities, partners of the Dutch and Iranian private sector, and research institutes.

This report presents the mapping of the Iranian potato sector, which is a result of a first mission to Iran. It is the intentions of the authors that this first missions will lead to both new and more effective collaborations between Iranian and Dutch partners resulting in increased food security.

The second mission will focus on the actual setup of a public private partnership to solve issues related to food losses and to increase food security. This second mission will be planned in the second half of 2017.

During the first mission, two potato growing areas have been visited: Isfahan and Hamedan. Multiple stakeholders in the capital Teheran have been consulted as well. During the project, relevant governmental bodies have been interviewed and umbrella organisations (like potato unions) have been consulted. Private sector parties involved with potato production, seed potato farmers, ware potato farmers, potato storage services providers, wholesale markets and the processing industry have been visited.

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<sup>1</sup> *As highlighted by multiple governmental bodies in Iran during the first mission introduced later in this document.*

The results of these visits are presented in this report. In chapter 2 of this report, the results of the first identification of the Iranian potato sector are presented. In chapter 3, the authors present opportunities on how to move forward.

The main conclusions and recommendations are:

- to reduce food losses, one needs a clear definition of what classifies as food loss (Section 3.1)
- a shift is needed from push supply chains to pull supply chains (Section 3.2), for this a product-market study is recommended
- as part of a total-chain approach, a wide variety of improvements can be considered to improve the potato sector in Iran (Section 3.2-3.6)

This report has been written as summary of the first mission and is intended for use by any potato stakeholder or potato value chain actor in Iran.

## 2 First identification of the Iranian potato sector

### 2.1 Introduction

This chapter shows an overview of the results of this project. First the general findings are presented in paragraph 2.2, after which results on seed potato production, ware potato production and production for the fresh market, mechanisation, storage and the processing industry are explained. Unless stated otherwise, the information in this chapter is based on interviews with stakeholders.

### 2.2 General findings

The first mission has resulted in a significant amount of insights with regard to the causes of food losses. Paragraphs 2.2 – 2.7 elucidate on this insights.

Defining the term ‘food losses’ and concluding the exact figures based on existing Iranian data appeared not feasible during the first mission. Despite the ambition of both the Iranian government and the Iranian private sector to reduce food losses, the exact figures were not found.

Some rough figures were shared, but because the definition of ‘food losses’ is not established, an estimation of the quantity of food losses could not be established. One of the interviewed government bodies estimates the total amount of potato food losses around 45%. Other figures related to specific supply chain steps or potato sectors are specified in paragraph 2.3 – 2.7.

The total production area of the Iranian potato sector is estimated at 160,000 – 170,000 hectares. Total annual production of about 5 – 5.5 million tons. Since 1996, the average yield per hectare has increased by one third from 23 to 31 tons per hectare, whereas in 1996 the total potato production area was about 140,000 hectare.<sup>2</sup>

Hamadan, Ardebil and Isfahan are the most important potato producing provinces, in total they cover 44% of the potato cultivation area. The average yield in Hamadan is about 40 tons per ha, the highest production in Iran, with peaks up to 80 tons per ha as was reported during our visit to the ministry of Agriculture. In Isfahan the average yield varies from 26-28 tons per hectare (summer crop) to 35-40 tons per hectare (winter crop).

Most of the total potato production is sold as ware potatoes, about 750,000 tons is used for processing, 600,000 tons is exported to neighbouring countries, and almost 500,000 tons is produced for seed potatoes.

Iran has very suitable conditions for potato production. In almost every season, potatoes can be grown in some part of the country. During our visit in March 2016, the early potatoes already had been planted in Hamadan one month earlier. Many potatoes were still kept in the stores and at the same time, recently harvested potatoes from the south of Iran were sold at the vegetable market in Isfahan.

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<sup>2</sup> B.J.M. Meijer and Veerman A., *Analysis of potato production and marketing in the Islamic Republic of Iran; report of a Dutch Potato Mission in Iran 14-24, May 1997.*

In both seed and ware potato production, water scarcity is a severe problem in many regions in Iran. In discussions with central and local governments, losses of potatoes are expressed as avoidable water losses. Many farmers apply sprinkler irrigation in crop production. However, farmers tend to shift to drip irrigation more and more because of water use efficiency. Modern potato planting machines are provided with a simple mechanism for unrolling the tubes for drip irrigation in the top of ridges during planting. The cost of the drip irrigation tubes is about EUR 20 per 100 meter in case farmers make the tubes themselves. The irrigation tubes are commonly re-used for other crops like cereals.

Generally, one opportunity for the Iranian potato sector is the lack of an integrated supply chains approach, focussing on specific markets (e.g. supply chains dedicated to potato chips or fresh consumer potatoes). A market driven supply chain and effective business model is absent, like the Dutch cooperative Avebe which has been setup in the Netherlands. In this cooperative, farmers are owners of the processor companies. All mayor players focus on their core business within the confines of their own company and focus on their own productivity, rather than maximizing productivity of the supply chain as a whole.

The entire (observed) potato sector can be considered as push supply chains in which maximization of output is the core challenge. Any supply chain actor producing (seed) potato is pushing their produce to any market available. Market channels like consumers and processors only buy the best quality and quantity available. This leads to food losses and unavailability during certain periods of the year.

A pull supply chain, in which producers focus on market requirements like quality, dry matter content, variety, size, volume and year-round availability could improve the sector significantly. Food losses can be reduced significantly by this shift and food security can be improved as well. In the recommendations paragraph, suggestions on how to achieve this shift are given.

The figure below shows different aspects of both push and pull supply chains.

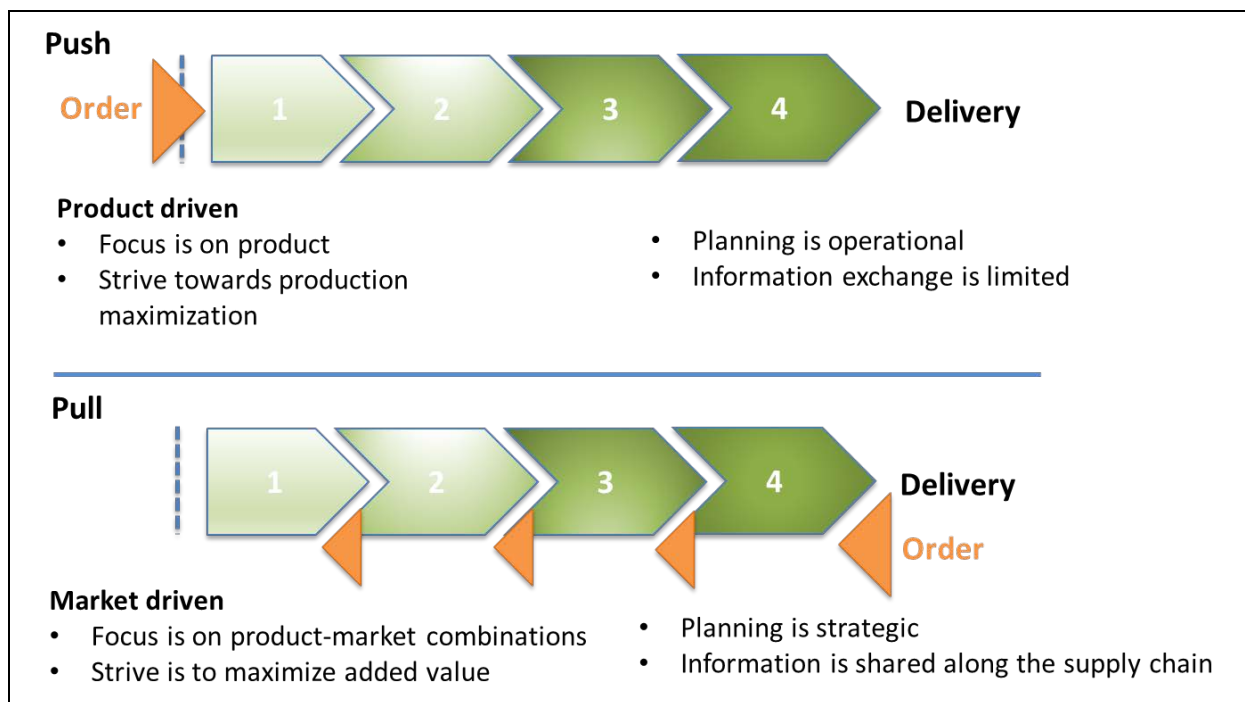


Figure 1: Push versus pull supply chains<sup>3</sup>

The next sections will go in more detail on the different aspects of the potato sector in Iran.

### 2.3 Seed potato production

The official Iranian seed potato sector is controlled to a large extent by the Union of seed potato producers of Iran. The total seed potato production is 160,000 hectares. Most of the potato farmers, about a hundred, are member of the Seed Potato Union. About 70% of the total quantity of imported seed potatoes is imported from the Netherlands, Agria is the most favoured variety, followed by Banba and Jelly. Marfona used to be an important variety; it's acreage is decreasing, this variety is especially used for fresh consumption. Agria is the most favourite variety because it's suitable for all purposes, either for ware potato and consumption, but also for processing into fries and/or chips. The price of imported seed potatoes of class SE is about one USD per kg.

So far, the Iranian Government restricts the amount of imported seed potatoes to 1,000 tons annually. This figure is mentioned by both Iranian and Dutch potato stakeholders. Both assume that the reason for this restriction is to protect the domestic seed potato market in Iran. In case of shortage of seed potatoes in Iran, this restriction can be suspended temporarily by the government.

The imported seed potatoes (preferably class S) are multiplied (planted and harvested) once or twice to class E or A and sold as certified seed to ware potato producers. The official seed system has the same structure as the official Netherlands seed producing system, starting with class S,

<sup>3</sup> Wageningen Food & Biobased Research, powerpoint presentation on Smart Agri-food Supply Chains, 2017.



multiplied to class SE and/or E (basic seed) and further multiplied to classes A and lower (certified seed). Each year about 600 to 700 tons of seed potatoes, almost all of class S, are being imported from the Netherlands<sup>4</sup>. The most important seed potato companies from the Netherlands which export to Iran are: Agrico, HZPC / Stet Holland, Europlant, IPM Potato and Den Hartogh.

In Iran, seven institutes/private companies have a license for mini tuber production of class S seed, two or three of them produce mini tubers on a larger scale. The mini tuber production facility that we visited, “Faruj Kesht” in Esfahan owned by Mr. Abedi, operates on a commercial basis and has a production capacity of 2.5 to 3 million mini tubers each year, which are being sold at EUR 0.10 to 0.70 per tuber. This mini tuber facility intends to expand their pre basic seed potato production to aeroponics culture as well in the near future. The other mini tuber company is also located in Esfahan and is owned by Mr. Behbahani. The mini tubers facilities together produce about 10 to 13 million mini tubers per year. Basic material is provided by the SPCRI (Seed and Plant Certification and Registration Institute), a subsidiary body of the Ministry of Agriculture.

Although Iran is not (yet) a member of the International Union for the Protection of New Varieties of Plants (UPOV), the institute is legally authorized to make its decision to register a variety based on different methods, including examining information and documents which are available in UPOV member countries or in countries which have concluded a Plant Variety Protection Agreement with Iran<sup>5</sup>.

There is also an unofficial seed potato system in Iran. The small potatoes of for instance a ware potato crop that cannot be sold to the market for consumption or for processing, are kept apart and stored to be sold as seed potatoes for the next season. From a quality point of view, this unofficial seed system should be discouraged.

## **2.4 Ware potato production and production for the fresh market**

Representatives from the processing industry we were informed that many potato farmers lack thorough knowledge of potato production, starting from ploughing and land preparation until selling to the market. Farmers face non optimal conditions during ploughing in autumn, causing many problems during the next growing season. For example, especially on the heavy clay soils the emergence of potatoes is more difficult because of the poor soil structure. Hard clods lead to severe damage of potatoes during the harvest of the potatoes. Another severe problem is that farmers do not produce potatoes for a specific end purpose: during the production, no distinction is made between fresh, table consumption, ware potato, potatoes for processing into chips or French fries. Even for processing itself it is important to distinguish between chips and fries production, as both products have their specific demands.

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<sup>4</sup> Source: NAO export statistics.

<sup>5</sup> From: UPOV working group document, Korea meeting, November 10 – 13, 2014.

As there is relatively limited market focus during the production phase, almost all grown ware potatoes are sold through a wholesale market. Most markets do not know which farmer produces which potatoes, and most farmers do not know which markets they are serving.

It is unclear to what extent crop rotation is being applied. Potatoes are commonly grown on the same fields each year in the north west of Iran (Ardabil region). Whether or not this intensive cropping system increases the infection of cut worms in potatoes – a severe quality problem in this region – should be investigated. In Esfahan, two crops per year are grown, one of which is potato. After that, rice is grown in combination with flood cultivation. In Hamadan a less intensive cropping system is applied, potatoes are grown every three or four years in rotation with other crops. The risks of intensive cropping systems with respect to soil borne diseases might be different from the Netherlands, due to very high temperatures in summer and/or applying flood cultivation system for rice production.

Traditional sprayers are used for the production of ware potatoes. Most growers have the ambition to use only drip irrigation, but have not invested in this yet. As water scarcity is getting a bigger problem each year, the need for drip irrigation becomes higher each year as well.

## **2.5 Mechanisation**

In Hamadan small potato farmers make an early start by planting potatoes by hand several weeks before the regular planting season starts using an automatic potato planter. In this way the small farmers hope to harvest before the harvest peak period and benefit from higher prices in the market.

On the (heavy) clay soils in Hamadan farmers often have problems with big clods. In some places these clods make it impossible to harvest the potato crop mechanically, because it damages the potatoes. The traditional potato digger with a robust chain and chain link can be used in those circumstances, but still there are many problems with potato quality because of damaging the tubers.

In Isfahan about 50% of the potato cultivation is mechanised, whereas about 90% of the potato area is mechanically harvested using a two row potato digger in most cases. Mechanisation in Iran is steadily increasing and gaining more importance. During our mission we visited Sabz Dasht Agricultural machinery company in Esfahan. Nowadays basic machinery for potato cultivation is available at low prices compared to machinery from Western Europe. Appendix A shows the machines prices that were reported during our visit to the machinery shop.

## 2.6 Storage

During the visit, the effectivity of three types of potato storage were discussed:

**Cold storage:** During the last five years new modern cold stores have been built in Hamadan region. Potatoes can be stored up to twelve months if necessary. During our stay in Hamadan and Isfahan we visited several new cold stores. Many new cold storages are being built and that existing cold storages are being expended. Remarkable is that, compared to cold storages of fresh fruits that have been observed in a previous project<sup>6</sup>, no Dutch technology has been observed within potato storages. Most of the doors of the cold storage are produced locally, while equipment within the cold rooms was mainly manufactured by French, Italian and Scandinavian suppliers.

During the project, the cold storage of imported seed potato was observed. These potatoes were in quarantine until they were released by the relevant government agencies. The quality of storage of can be considered as sufficient. No food losses were noted of these types of potatoes, as the value of imported seed potatoes is significant. Entrepreneurs cannot risk any losses and treat these potatoes the best way possible, resulting in considerably less food losses

Climate control within the stores is rather poor and could be improved with advanced technology from the Netherlands. Sprout inhibitors are not applied because of the poor ventilation within the potato bags.

Cold stores are mostly used for seed potato. The percentage ware potato storage in cold stores is increasing though.

### **Traditional uncooled storage in the ground:**

Most potatoes are kept in closely woven nylon bags of 50 kilogram and stored up to several months in so called traditional underground stores, or partly below the ground level with a building on top. Losses are quite high, up to 40% or more. Improved stores in buildings with outside air ventilation give better results, potatoes can be stored up to five or six months. We were informed that losses in these stores have decreased substantially.

**Traditional storage at the farm in regular buildings.** During the project, these type of storages have not been visited. Interviewed farmers claim that the use of this type of storage is ineffective due to significant food losses. It is expected that seed potato (excluding the unofficial system) are not stored in this type of storage.

Regardless of the type of storage, the type of domestically made bags used are not effective (imported bags are an exception to this). The humidity control of the seed potatoes is ineffective due to the usage of plastic bags. During the mission multiple losses were observed, mainly due to sprouting. Data of total losses is not available. One of the causes of this lack of knowledge is that 'storage providers' are not paid for effective storage, but per kilogram or per bag. If losses occur,

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<sup>6</sup>A.S. Schripsema A.S., Westra, E., *Fruitful Fruit Export Iran*, 2016.

the farmer deals with the consequences, not the storage provider. Data might be available at farmer level, but due to the large number of farmers, this information could not be collected within the scope of this project.

## **2.7 Processing industry**

The potato processing industry in Iran is growing. About 700,000 to 800,000 tons per year is processed, which is about 13% of the total volume of potatoes annually produced. French fries and chips are the most important segments in the processing industry. In addition to this, potatoes are processed for flakes, mash potatoes and salads as well.

Near Teheran we visited Talachin Agro-Industrial Company, one of the larger producers of potato chips and French fries in Iran. Besides potato chips and French fries, the Talachin Agro-Industrial Company fabricates potato chips of similar shape and size made of potato powder (similar to Pringles). Talachin has a capacity of 150 tons of French fries and potato chips per day. Agria is the most important variety for processing of potatoes. The input/output ratio is about 1.95, meaning that 0.95 kilogram of potato is lost when to produce 1 kilogram of French fries. In Western Europe, the ratio is 1.7. This ratio is mainly determined by potato quality. At the time of visit, potatoes from Ardabil region were used for processing, mainly because of their favourable sugar content. On the other hand, potato quality was poor because of black spots caused by cut worms, which is said to be a severe problem in that region.

During the mission, a visit was scheduled to a starch production facility. The factory was built by the Iranian government and was recently been sold to a private investor. At the moment the facility is not operational. We were told that production is not feasible due to multiple reasons. The exact reasons remain unclear, but can be related to negative business cases. The staff is looking into new business opportunities involving new varieties, they can achieve higher outputs per ton.

In a round table discussion organized by the Ministry of Agriculture in Esfahan, representatives of different processing industries complained about the quality of potatoes. In their opinion, they need better varieties specific for French fries and also for potato chips. However in the Netherlands the variety Agria is very popular for processing of French fries. Most farmers also lack knowledge of potato production for the processing market in order to produce higher quality potatoes that can meet the high standards. Advanced storage technology is also of great importance of the potato quality after a long period of storage.

In a closing round table discussion at the Dutch Embassy in Teheran much attention was given to the above mentioned topics. Attempts to introduce new varieties for processing have failed so far. On the one hand, the processing industry needs more suitable varieties, yet on the other hand the industry needs large volumes preferably of the same quality in order to keep the cost and

time for resetting the processing line as low as possible. This dilemma discourages the production of new varieties for the processing industry. This means that for a successful introduction of a new processing variety, a concerted action is required in which the processing industry as well as the Seed Potato Unit are very closely involved and guarantee to the farmer the supply of seed potatoes and demand of processing potatoes.

### 3 The way forward

#### 3.1 Defining and measuring relevant food losses

During the mission it became clear that both the Iranian government and the Iranian private sector have the ambition to reduce food losses. The exact quantities of food waste were not established during the first mission. The authors of this research assume that the data is not available due to two reasons: the definition of relevant food losses is not clear and the data is not collected.

To quantify the challenge one needs to define ‘food losses’. What needs to be considered as a loss? And why? For example: once parts of the potato are fed to animals instead of consumed by humans: is this a food loss? And, if yes, is it a harvest loss, postharvest loss, process loss, economic loss or any other loss? These questions have to be answered before food losses can be measured and quantified. The figure below elucidates on possible definitions of food losses.

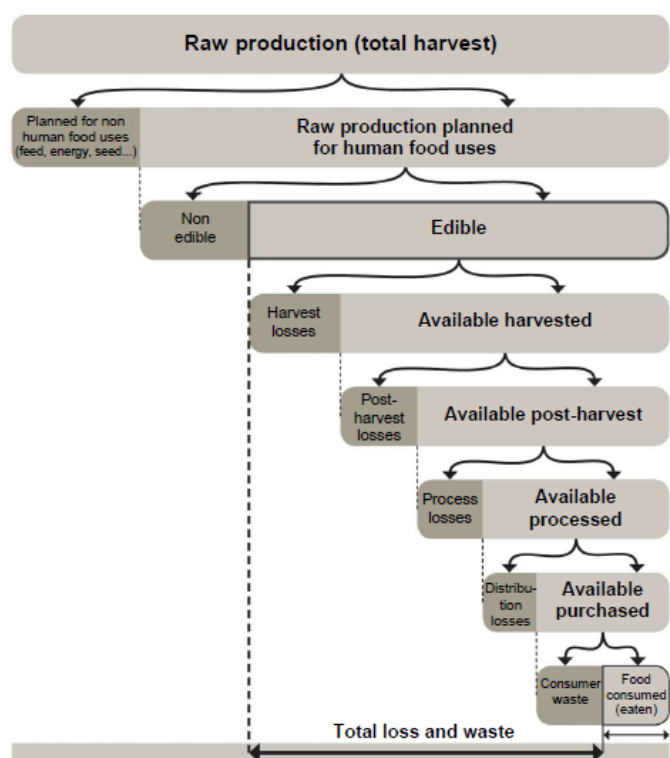


Figure 2: Possible definitions of food losses<sup>7</sup>

Once the relevant definitions are set, one can start collecting data that give insights into measuring and reducing food losses.

<sup>7</sup> Wageningen Food & Biobased Research, powerpoint presentation on general thoughts and considerations related to measuring food losses, 2017

### 3.2 First steps to shift from push to pull supply chains

During this project, it was established that the Iranian potato sector is mainly organized by push supply chains. Some entrepreneurs are considering opportunities to implement fruitful pull supply chains, but no finished projects are found.

Push supply chains lead to relatively high percentages of food losses. Additionally, unavailability during off season periods occur, leading to higher off season potato prices and food security challenges.

Three major issues can be illustrated to show the effects of potato push supply chains in Iran.

- 1) **High percentages of potato losses in processing:** As described in chapter 2.7, a relatively high quantity of potatoes is lost during the production of French fries. By implementing pull chains in which the right quality and the right quantity is guaranteed, this amount can be reduced significantly.
- 2) **Inefficient starch production:** The observed starch production in Iran is considered unfeasible and the production facility has been shut down, as also described in chapter 2.7. Implementing pull chains might lead to feasible business cases. For example by focussing on other potato varieties or waste of other production facilities.
- 3) **Unavailability of processing quality during certain periods of the year:** It was observed that low quality potatoes are being used for French fries processing, leading to food losses. Pull supply chains focus on market requirements and will examine how Iran can produce the right quality.

To be able to shift from push to pull supply chains it is advised to perform a product-market study. This quantitative study results in the most feasible markets and production areas, in such matter that focus and be given to promising opportunities. It will answer questions like:

- Can starch production be successfully implemented in Iran or not?
- Can processing facilities be supplied year round with high quality potatoes?
- To what extent will export of potato (products) be feasible in the near future?

The product-market study will support the decision making process: where should Iran focus on considering the potato sector? Thereby the study can be considered as the first step of a national, strategic vision of the development of the potato sector in Iran, including export possibilities to neighboring countries

Once the most feasible product-market combinations (e.g. French Fries for hotel chains in Teheran, starch to St. Petersburg or ware potato to supermarkets in Teheran), it is advised to perform a total-chain approach for improving the potato sector in Iran.

The most important challenges for the short and medium term are:

1. Introducing new varieties for specific markets
2. Improving knowledge of farmers
3. Implementation of advance storage and climate control

#### 4. Improving efficiency of the processing industry

These four challenges are elaborated below.

### **3.3 Introducing new varieties for specific markets**

At this moment, Agria is the most popular variety that is used for processing both for French Fries and for potato chips. Especially the processors ask for new varieties, however Agria is well known for its suitability for French fries processing. Quality can be improved to a considerable degree when suitable varieties are available. The demands for processing into potato chips are quite different from processing into French fries. Also the fresh consumption market and the ware potato market have other demands with respect to the best suitable potato varieties. In 2017, about 30 new varieties have been sent by Dutch companies for Value for Cultivation and Use (VCU) testing in Iran.

### **3.4 Improving knowledge of farmers**

As described in chapter 2.5, many farmers, especially smallholder farmers, still grow potatoes the traditional way. They do not produce for a specific market and many problems during the growing season occur. Problems with specific diseases or pests like cut worms in Ardabil region or infections with fungi, viruses or bacteria are common. From similar experiences in other countries in the region (Bangladesh, India, China) we think that practical training and demonstration projects are necessary for improving the knowledge level of farmers for producing quality potatoes for specific markets.

### **3.5 Implementation of advanced storage and climate control**

Although many new modern storage facilities have been built recently, especially in Hamadan and Isfahan region, there is a need for improving long term storage of potatoes by using the best available storage, cooling and climate control equipment. In modern potato stores, potatoes are being stored at too low temperatures, and it is not clear if the temperature and climate regime is the same all over the building. Netherlands companies have outstanding experiences in long term potato storage in many different climate zones all over the world.

### **3.6 Improving efficiency of the processing industry**

Processing of potatoes has increased over the years, especially processing of potato chips and French fries. There is a growing market for processed potato products within and outside Iran. Until now, export volumes of processed potato products are low, yet opportunities for exporting to neighboring countries will increase when potato quality and efficiency rates of the processing will improve in the near future.

To elucidate on the above mentioned way forward, a second mission to Iran will be planned in which participation of the Iranian and Dutch private sector will be discussed.



## Appendix A

The following machines and prices were reported during our visit to the machinery shop:

Automatic potato planter, 2 row:	EUR 2,000
Automatic potato planter, 2 row with appl for drip irr. tubes:	EUR 3,000
Potato ridger, 2 row with fertilizer application:	EUR 1,700
Rotary hiller, 2 row:	EUR 3,500 – 4,000
Rotary hiller, 4 row:	EUR 9,000
Potato digger, 2 row traditional chain:	EUR 2,000
Potato digger, 2 row, modern chain (Broekema, NL):	EUR 4,000
Potato digger, 2 row, long version with adjustable chain:	EUR 6,000 – 7,000
Onion digger, 1.80 m.	EUR 3,000

We also visited a machinery designer in Zazeran region, near Esfahan, a one man company making specific machinery for Iranian conditions. For instance:

Potato planter, 2 row automatic:	EUR 3,000 – 4,000
Potato planter, 2 row automatic with double fertilizer appl.:	EUR 6,000
Haulm cutter, 2 row:	EUR 2,000

The basic machinery is produced in Iran, specific equipment parts are imported from Italy, Holland and other countries.