



# Working paper- food loss in Morocco



Shared Prosperity **Dignified Life**





Shared Prosperity **Dignified Life**



### **VISION**

ESCWA, an innovative catalyst for a stable, just and flourishing Arab region

### **MISSION**

Committed to the 2030 Agenda, ESCWA's passionate team produces innovative knowledge, fosters regional consensus and delivers transformational policy advice. Together, we work for a sustainable future for all.



**Economic and Social Commission for Western Asia  
United Nations Economic Commission for Europe**

# Working paper- food loss in Morocco



United Nations  
Beirut

© 2022 United Nations  
All rights reserved worldwide

Photocopies and reproductions of excerpts are allowed with proper credits.

All queries on rights and licenses, including subsidiary rights, should be addressed to the United Nations Economic and Social Commission for Western Asia (ESCWA),  
e-mail: [publications-escwa@un.org](mailto:publications-escwa@un.org).

The findings, interpretations and conclusions expressed in this publication are those of the authors and do not necessarily reflect the views of the United Nations or its officials or Member States.

Authors: Unless otherwise specified, the source of all photographs are the document authors.

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Links contained in this publication are provided for the convenience of the reader and are correct at the time of issue. The United Nations takes no responsibility for the continued accuracy of that information or for the content of any external website.

References have, wherever possible, been verified.

Mention of commercial names and products does not imply the endorsement of the United Nations.

References to dollars (\$) are to United States dollars, unless otherwise stated.

Symbols of United Nations documents are composed of capital letters combined with figures. Mention of such a symbol indicates a reference to a United Nations document.

United Nations publication issued by ESCWA, United Nations House,  
Riad El Solh Square, P.O. Box: 11-8575, Beirut, Lebanon.

Website: [www.unescwa.org](http://www.unescwa.org).

22-00291

# Acknowledgements

---

This publication was developed in collaboration between the United Nations Economic and Social Commission for Western Asia (ESCWA) and the United Nations Economic Commission for Europe (UNECE). It is the fruit of a UNECE-led project entitled “Increased policy coherence and sustainability of national production and consumption patterns in North-South and South-South agriculture trade”, which aims to support countries in addressing the challenge of food loss and waste.

The research was conducted under the guidance of Ms. Reem Nejdawi, Chief of Food and Environment Policies Section, ESCWA. The main contributing authors were Mr. Mohamed

Boughlala, ESCWA consultant; and Mr. Rami Sabella, Economic Affairs Officer, ESCWA; and Mr. David Oyetunde, UNECE consultant.

Support on methodology and data validity were provided by Mr. Said Saghir Zarouali, ESCWA focal point at the High Commission of Planning in Morocco, and ESCWA consultants Ms. Cornelia van Wesenbeeck and Mr. Faouzi Bekkaoui.

Valuable inputs and reviews were provided by Ms. Sarah Daniel, ESCWA consultant; and Mr. Fidele Byiringiro, Economic Affairs Officer, ESCWA.



# Key messages

- *Morocco is experiencing food loss at different levels: wheat loss takes place mainly during storage at farm level, whereas loss in dates happens during cultivation and harvesting – due to insects, bird attacks and poor harvesting practices.*
- 
- *To reduce food loss in the date and soft wheat sectors, it is fundamental to initiate direct contact with farmers who harvest and manage storage warehouses. This can be done through a well-trained team of extension workers who can highlight the reasons for the losses and disseminate good practices to minimize them.*
- 
- *To reduce loss in soft wheat, awareness-raising and capacity-building initiatives are needed to inform farmers about proper storing, such as requirements and standards for suitable storage construction, insulation techniques, cleaning and disinfecting methods, packaging material and ventilation requirements. For dates, the focus should be on disseminating proper harvesting techniques for the different varieties of dates, and protection from attacks by birds, moths and insects.*
- 
- *Further potential to reduce loss would be reuse, recycling into processed food or non-food items, compost and energy production.*
-





# Executive Summary

---

Taking the recommendations of the Regional Strategic Framework for Reducing Food Loss and Waste in the Near East and North Africa region, this study specifically, provides decision makers in Morocco with the necessary information to cut food loss for dates and soft wheat, it promotes good practices along the entire value chain, and helps policy development. Morocco is experiencing food loss at different levels. Wheat loss takes place mainly during storage, whereas loss in dates happens during cultivation and harvesting, due to insects, bird attacks and poor harvesting practices.

To minimize losses in dates and soft wheat, the Ministry of Agriculture, Fisheries, Rural Development, Water and Forests should initiate direct contact with farmers who harvest and manage storage warehouses. This can be done through a well-trained team of extension workers who can highlight the reasons for the

losses and disseminate good practices that can minimize them.

For soft wheat, the focus should be on enhancing small and medium farmers' warehouses, including construction and insulation techniques, cleaning and disinfecting methods, packaging materials and ventilation requirements. For dates, the focus should be on disseminating proper harvesting techniques for the different varieties of dates, and protection from attacks by birds, moths and insects.

The study shows the important role that the Ministry of Agriculture can play to enhance rural development in parallel to reducing waste. Developing the date sector would contribute much to local development, and to supporting the private sector to consider and invest in the aspects of re-use, recycling, compost and energy production.



# Contents

---

Acknowledgements	iii
Key messages	v
Executive Summary	vii
Introduction	1
<b>1. Implementation methodology</b>	<b>9</b>
A. Methods for answering the research questions	9
B. Research samples	9
<b>2. Research boundaries and scope</b>	<b>15</b>
A. The choice of commodities	15
B. The choice to analyse food loss	15
C. The transition from soft wheat to flour (or other soft wheat derivatives)	16
D. Regions covered by this study	16
<b>3. The Moroccan soft wheat sector</b>	<b>17</b>
A. Soft wheat production and import	17
B. Economics of soft wheat	19
C. Soft wheat supply chain	20
D. Soft wheat food loss extent, causes and critical points	22
E. Recommendations on how to reduce soft wheat loss	24
<b>4. The Moroccan date sector</b>	<b>27</b>
A. Date production and import	27
B. Date supply chain	30
C. Date loss extent and causes	31
D. Recommendations on how to reduce date loss	33
<b>5. General recommendations and conclusions</b>	<b>37</b>
A. General recommendations to reduce food loss	37
B. Conclusions	37
Annex	39
References	47

## List of tables

Table 1. Research sample related to soft wheat	10
Table 2. Dates research sample	12

## List of figures

Figure 1.	FAO Conceptual model for food loss and waste	3
Figure 2.	Food loss and waste indices distinction	4
Figure 3.	Food loss from post-harvest to distribution in 2016	4
Figure 4.	The Lansink ladder	5
Figure 5.	Evolution of wheat area in Morocco	17
Figure 6.	Evolution of wheat production in Morocco	18
Figure 7.	Evolution of wheat import in Morocco	19
Figure 8.	Flow chart of the general Moroccan soft wheat supply chain	20
Figure 9.	Moroccan palm groves	27
Figure 10.	Evolution of date production in Morocco	28
Figure 11.	Moroccan date imports	29
Figure 12.	Flow chart of the general Moroccan soft wheat supply chain	30

# Introduction

---

## Background

This report forms part of a series of food loss and waste assessment studies within the framework of a project led by the United Nations Economic Commission for Europe (UNECE) entitled: "Increased policy coherence and sustainability of national production and consumption patterns in North-South and South-South agriculture trade". The present study was prepared as a collaborative project between the United Nations Economic and Social Commission for Western Asia (ESCWA) and UNECE. Similar studies were prepared for countries in South America, Africa and Asia.

The report outlines research on soft wheat and date food loss<sup>1</sup> given their importance in the Moroccan context. The Arab Forum for Environment and Development (AFED) states "A reduction in cereal losses along the food supply chain cannot be overemphasized" as such losses represent discarded food supply and involve wasted natural resources such as land, water, energy and fertilizers (AFED, 2014). Soft wheat is an important basic good in the Moroccan household consumption basket, the average wheat consumption per inhabitant is 200 kg per year, i.e. three times more than the world average (Terre-net, 2020), it is mainly used to produce bread, which is a fundamental nutrient on each table. Therefore, huge quantities of soft wheat are produced nationally,

which is still insufficient to fulfil national demand, hence, wheat is still imported in high quantities.

In Morocco, dates still belong to the most important and appreciated products for trading at oases-based communities. Besides, dates are appreciated for their food and feed utilization and serve as a socioeconomically and traditionally important commodity for the Moroccan population (El Hadrami and M. Al-Khayri, 2012). Some industry has also evolved around the date palm, such as pitting, crushing and sieving factories, which contribute to local employment. Following the principle of leaving no one behind, the research has devoted great attention to dates, given their important role in the socio-economic dimensions of oases-based communities.

Although undernourishment in the Arab region, opposed to other developing regions, has been comparatively low, political, social, and environmental challenges impact the accessibility to nutritious and sufficient food. According to ESCWA, the Arab region is currently "off-track" in regard to the sustainable development goal 2 "Zero hunger", which looks at ending hunger, achieving food security and fostering sustainable agriculture (ESCWA, 2021). Most states in the Arab region are subject to very low rainfall and scarce cultivatable land capacities, a situation that, by default, welcomes

---

1 For the sake of institutional alignment, this report, as the FAO and the sustainable development goal 12.3, refers to food loss in regards to production and every supply chain stage up to the retail and consumer level, which is then referred to as food waste.

any efficiency improvement in dealing with food supply. Regarding that, the reduction of food loss and waste is seen as one possibility to improve food security and simultaneously lower production costs (Razzaz and others, 2017).

## Food loss and waste: global context

**What is defined as food loss and waste; and what is the difference between loss and waste?** There have been several efforts, by countries and international organizations, to define food that does not find its destination in human consumption. However, in 2019 the United Nations, via its Food and Agriculture Organization (FAO) released a conception of food loss and waste which scoped the topic regarding certain aspects. While nearly every definition, up to 2019, was referring to lost food with a definition of “food waste”, FAO decided to clearly differentiate between what is lost and what is wasted.

According to FAO, “food loss” refers to “the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain, excluding retailers, food service providers and consumers. Empirically, it refers to any food that is discarded, incinerated or otherwise disposed of along the food supply chain from harvest/slaughter/catch up to, but excluding, the retail level, and does not re-enter in any other productive utilization, such as feed or seed” (FAO, 2021). Losses occur for several reasons, which include inappropriate storage and handling, unstable markets, bad weather and overproduction.

In comparison, food waste describes the decrease in the quantity or quality of food

resulting from the behaviour of retailers, food service providers and consumers.

Food is wasted in several ways:

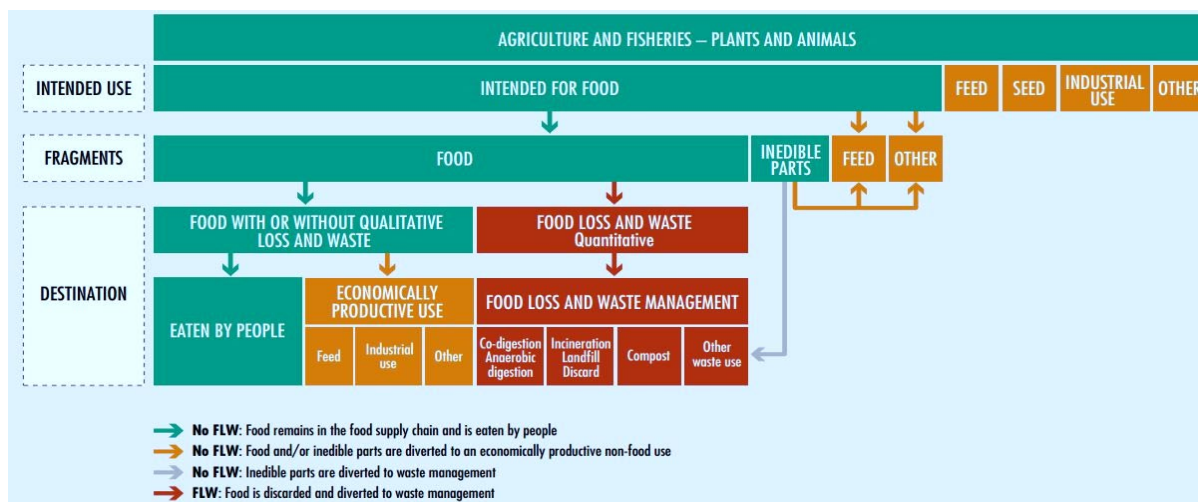
- Fresh produce that deviates from what is considered optimal, for example in terms of shape, size and colour, is often removed from the supply chain during sorting operations.
- Foods that are close to, at or beyond the “best-before” date are often discarded by retailers and consumers.
- Large quantities of wholesome edible food are often unused or left over and discarded from household kitchens and eating establishments (FAO, 2021).

Figure 1 shows the FAO conceptual model for food loss and waste (FLW). The main pillars of the model are: intended use, fragmentation, and destination when analyzing what does and does not include FLW (FAO, 2019).

Discarded food occurs at every stage along food supply chains. However, globally, there is a difference between what is discarded between low- and high-income countries. In general, low-income countries show food loss concentrations along the primary supply-chain stages, mostly due to inefficient storage capabilities and lack of adequate cooling systems, bad infrastructure and transport, while high-income countries generate most food waste within the latter part of the supply-chain (retail-, consumer level) (Venkant, 2012); (Lundqvist, de Fraiture and Molden, 2008).

The reasons for FLW throughout supply-chains are multifaceted. Here, the question arises as to what has been put into place to quantify the volumes (which would ultimately allow for tracking the progress)?

Figure 1. FAO Conceptual model for food loss and waste



Source: FAO, 2019.

## Volumes of loss and waste

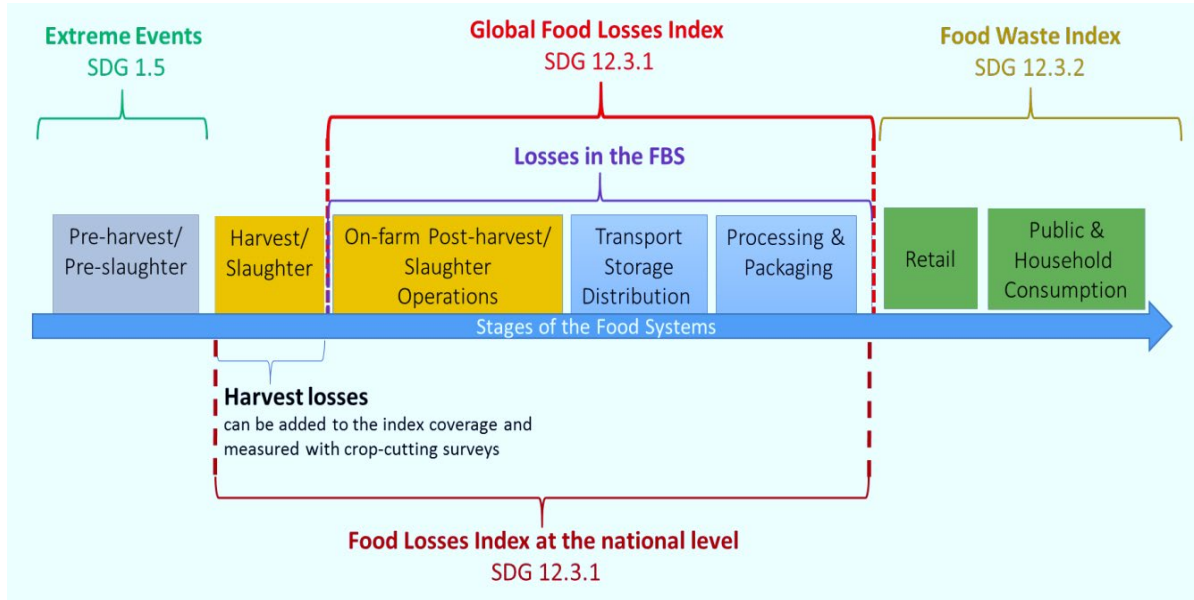
Initially, the FAO study (Gustavsson and others, 2011) involved the first systematic global and regional FLW quantification effort. The study estimated that 33 per cent of global food was either lost or wasted. At one point, this was estimated to be a total weight 1.3 billion metric mt (FAO, 2021).

As part of the pioneering work, the Gustavsson study presented helpful data but, in retrospect, needs to be cautiously interpreted. Although the study served as an approximation to display the FLW extent and flagging the issue in the international discourse, data scarcity tied the authors to bring in several assumptions of the FLW levels, especially along distribution and consumption. Ultimately, it needs to be mentioned that the limitations involved in the Gustavsson project make a replication of the study highly circumstantial.

Therefore, in order to increase the subject clarity and enable progress measurement in relation to the agenda target 12.3, the estimates from 2011 are in the process of being replaced by the Food Loss Index (FLI) and the Food Waste Index (FWI). Figure 2 shows the scope of these indices.

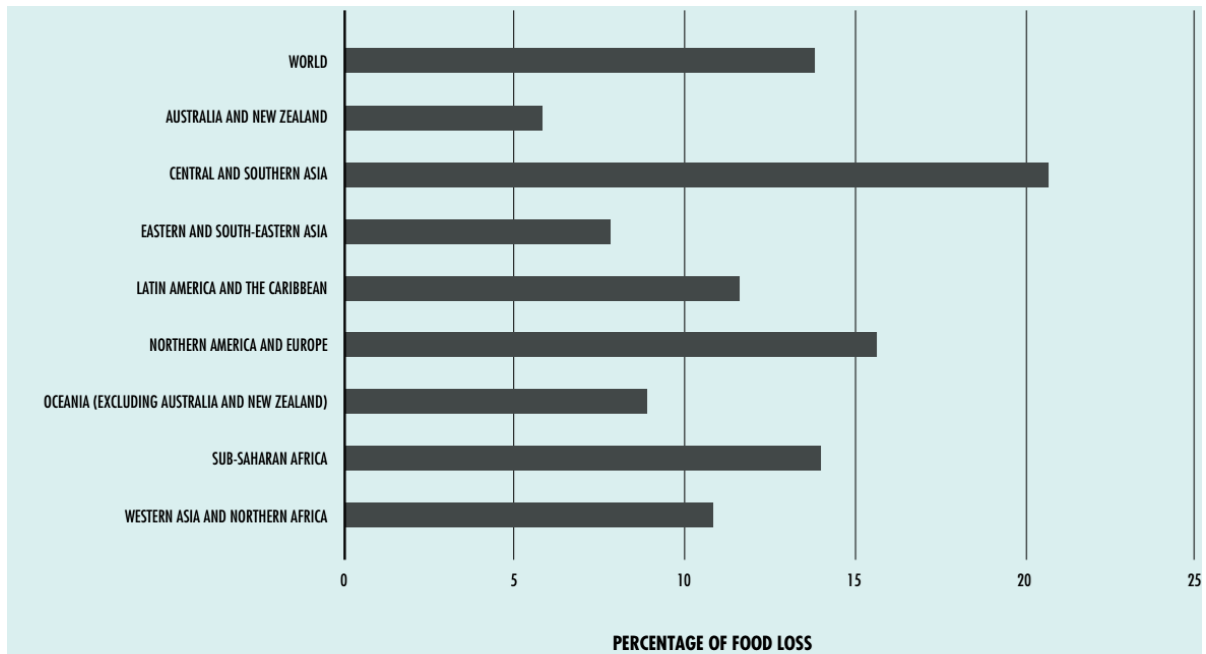
The FLI provides new loss estimates from the post-harvest stage up to the very point of “goods acceptance” by the retailers. Therefore, the FLI does not include food waste by retailers and consumers. First estimates of the FLI indicate that around 14% of global food is lost within the measurement spectrum. Figure 2 refers to the report metadata of indicator 12.3.1 Global Food Loss Index’, “The indicator looks at the trend in structural losses. It monitors progress on the supply side of food chains, as it measures if the share of agriculture production that does not reach the retail stage in 2030 has increased or decreased with respect to the base period and by how much. The numerator of the indicator indicates the level of losses and informs on the magnitude of the problem” (FAO, n.d.).

Figure 2. Food loss and waste indices distinction



Source: FAO, n.d.

Figure 3. Food loss from post-harvest to distribution in 2016



Source: FAO, 2019.

**Note:** Percentage of food loss refers to the physical quantity lost for different commodities divided by the amount produced. An economic weight is used to aggregate percentages of regional or commodity group levels, so that higher-value commodities carry more weight in loss estimation than lower-value ones.



Figure 3 shows the food loss percentages of the broader global regions. Here the food loss percentage is calculated by dividing lost quantities by the respective amount which was produced. Central and Southern Asia, with approximately 21 per cent, show the highest food loss percentage. Preceded by North America and Europe, Sub-Saharan Africa, Western Asia and Northern Africa, which ranks 5th with 11 per cent food loss.

### Food loss and waste management

This report aims to set the ground for collective action through a future country-specific practical action plan (roadmap) to guide the country in the development of mitigating measures to reduce food loss for dates and soft wheat. Therefore, the report will shed light on global mitigation measures and approaches, and possible interventions on how to mitigate the food loss issue.

### The Lansink ladder

In 1970, to reduce and manage food waste throughout food supply chains, the Dutch politician and one of the pioneers in food waste management<sup>2</sup>, Lansink, proposed a specific order, through which waste can be dealt with. Years later, Lansink's proposal was named the "Lansink ladder" which is still a framework that is commonly used to structurally manage waste (Recycling.com, 2021). In six phases, Lansink proposed to tackle

waste in a hierarchical order that, from top to bottom, goes from preventing, re-using, recycling, energy producing, incinerating, to lastly landfilling (Recycling.com, 2016).

Inevitable and strongly suggested by numerous researchers and organizations as well as suggested by Lansink, the prevention of food waste generation is paramount.

Figure 4 shows the Lansink ladder for waste management. In other words, when recommending preventive measures to tackle food loss and waste, the questions have to be:

1. Is it possible to reduce the volumes? Yes, no, or partly. If not or partly.
2. Is it possible to re-use the discarded food? Yes, no, or partly. If not or partly.
3. Is it possible to recycle the discarded food? Etc.

Figure 4. The Lansink ladder



Source: Recycling.com, 2021.

2 Here, related to preventive measures, the term 'waste management' has to be used interchangeably for food loss and waste. The difference between food loss and waste was not made in past definitions and seemingly has not transitioned to 'food loss and waste management'. When speaking of prevention, waste management refers to food that has left the supply chain at any stage.

## Food loss and waste: Arab region

In 2015, the report on the Regional Overview of Food Insecurity Near East and North Africa, which includes most ESCWA members, states that approximately “34 per cent of food supplies suitable for human consumption are being lost or wasted in the Near East North Africa [NENA] region”. The report further stresses that in the NENA region, which considerably depends on international markets to meet its food needs, such FLW levels are unexpected. From the perspective of NENA’s scarce resource base and low food productivity, high FLW is said to be both uneconomical and ecologically detrimental, not to mention the lost potential of food security (FAO, 2015).

As another report (United Nations Environment Programme, 2021) indicates, FLW data in the Arab region is scarce. According to FAO, food loss and waste in the Arab region is primarily caused by inadequate policy and regulatory frameworks, a fragile infrastructural base, technological deficiencies and often a lack of innovation. For example, according to FAO the region holds a limited cold chain capacity, while sufficient capacities are particularly important in view of the hot climate (FAO, 2012).

Further, in a combined effort between the Organisation for Economic Co-operation and Development (OECD) and FAO, FLW volumes in the NENA region were estimated to be at 250kg/capita per year, with a value of \$120 per capita (conservative estimate), or over \$60 billion per year (OECD and FAO, 2014). The lost natural resources due to FLW reportedly amount to 42 km<sup>3</sup> of water and 360 million hectares of land annually.

In 2012, the FAO estimated that early stage food chain losses of cereals in the NENA region

exceeded 16 million mt, which translated to the potential to feed between 70 and 100 million people (FAO, 2012). At that time, the annual losses of wheat in Egypt (both locally produced and imported) were valued at 6.6 billion Egyptian pounds (over \$1 billion), while the value of maize losses was estimated at 1.5 billion pounds. Halving the wheat and maize losses would have enabled annual savings of roughly 4 billion pounds.

In 2014, a regional strategic framework for reducing food losses and waste in the Near East and North Africa region was set in response to the, two years prior, 31st session of the FAO Regional Conference for the Near East. Part of this session was to “assist member countries in addressing the key challenges of reducing food waste and losses by conducting comprehensive studies on impact of food losses and waste on food security in the region and in establishing a plan to reduce food losses and waste in the region by 50 per cent within 10 years” (FAO, 2015).

In essence, the Regional Strategic Framework has four constituents (FAO, 2015):

1. Data gathering, analytical research and knowledge generation.
2. Awareness raising and promotion of good practices along the entire supply chain.
3. Development of policies and strengthening of collaborations as well as networking.
4. Promoting investment and specific projects.

This study takes the recommendations of the Framework into consideration: it gathers data and analyses it in the Moroccan context, raises awareness about the reasons and hotspots of food loss, and sets the ground to develop policies that promote the implementation of good practices to reduce food waste in the country.

## FLW in Morocco

FLW data in Morocco are barely available and primarily refer to household food waste; the 2021 United Nations Environment Programme report shows an estimated 91 kilograms of household food waste per capita and year (United Nations Environment Programme, 2021).

## The research objective

The purpose of this study is to give specific insight into the causes of food loss along the soft wheat and dates supply chain in Morocco as well as to investigate opportunities for food loss prevention. Ultimately, it aims to set the ground for the Government to develop a food loss prevention roadmap for dates and soft wheat, which could serve as guidance towards

mitigating food loss of other seeds, vegetables and fruits.

## The research questions

In relation to the objective, the following research questions were formulated. Firstly, what is the approximate soft wheat/dates loss extent along the supply chain stages in Morocco? Over the years, what has been the food loss trend of these commodities? Despite the qualitative nature of this study, the previous questions serve as an approximate quantification of the loss issue related to soft wheat and dates. Secondly, what are the main causes of loss? Thirdly, what are opportunities to prevent food loss generation along the Moroccan soft wheat and dates supply chain stages?



# 1. Implementation methodology

---

This chapter elaborates on how the research is designed for it to serve as an attempt to answer the research questions.

## A. Methods for answering the research questions

Regarding the first research question about the extent of loss; primary data were collected from organizational records and, if not available, from interviews. For the second research question on where and why, the data were collected via problem-based semi-structured interviews with the supply chain actors (see annex A for the questions).

Further, for research question three on the opportunities to prevent food loss, the conducted interviews also served to collect views on current and future possible prevention methods along the related commodity supply chain.

## B. Research samples

For the research sample of the study, the most important production and trade regions for soft wheat and dates were targeted. In those regions, representatives of the main commodity supply chain stages were interviewed. In addition, representatives of the most important organizations, related to the studied commodities, were interviewed. The interviewee sample mainly consists of people who oversee several processes in and outside

their supply chain stage (chapter 3 and 4 detail each commodity supply chain).

### 1. Research sample for soft wheat

Firstly, the two regions Casablanca-Settat and Fès-Meknes qualified for being studied (see chapter 3 for more details on this regional selection). All participants were in one of those regions. For Moroccan soft wheat production, there were three groups of farmers: small, medium and large. For each group, roughly 20 participants gathered for the focus group. representatives (20-25 p. = upper limit due to Covid19 restrictions) (for more details, see table 3).

Further, the top ten market share holding millers in the country as well as the six leading importers gave their insights on their soft wheat storage and transportation. Next, ten trading and transporting companies participated in this study. Here it is worth mentioning that traders own at least one truck for transportation; and sometimes several, some of which they also rent out.

Representatives of professional soft wheat organizations, as points of accumulated commodity information, were also interviewed:

- The National Interprofessional Office of Cereals and Legumes (ONICL) is a public establishment under the dual supervision of the Ministry of Agriculture and Maritime Fisheries and of the Ministry of Economy and Finance (ONICL, 2021). It is responsible for

studying all the legislative and regulatory measures likely to enable it to have the necessary information to balance supply and demand as well as to regulate the market for cereals, legumes and their derivatives.

ONICL's main functions include:

- Control of the quantities available in cereals at the level of the storage organizations to ensure the safety stock
- Management of an information system on the internal and external markets for cereals and legumes capable of helping decision-making, both for private operators and for the administration.
- The Moroccan Agricultural Cooperatives (CAM) and the National Union of Agricultural Cooperatives (UNCAM) are mainly involved in importation, collection and industrial processing. UNCAM, which represents CAM before the public authorities, participates in conversations related to cereals import offers. Ultimately, it is about improving their bargaining power vis-à-vis all partners in the grain sector, given the new liberalization conditions.
- The Federation of Cereals and Legumes Traders FNCL represents the Moroccan

cereals, and their derivatives, trading sector (FNCL, 2021). Members mainly include:

- Operators on the local market.
- Trading companies of national and international markets.
- Agricultural cooperatives united within UNCAM.

The share of the Federation members reaches:

- More than 70 per cent of the collection and marketing related to Moroccan national soft wheat production.
- More than 90 per cent of Moroccan cereal imports.
- The National Federation of Flour Mills (FNM) represents the industrial flour milling sector, which is both important in the economic development and in ensuring the country's food security (FNM, 2021). The FNM mission is to design and implement advisory as well as technical assistance to support its members to meet new demands of a free market.

Table 1 shows an overview of the research sample related to soft wheat.

Table 1. Research sample related to soft wheat

Supply chain stage/Other actors	Participant count	Participant information	Region
Production	114	Small (18) -, Medium (21), Large Famers (16)	Casablanca-Settat
		Small (22) -, Medium (19), Large Famers (18)	Fès-Meknes
Transportation	20	Milling companies (10), Traders and Transporters (10)	Casablanca-Settat and Fès-Meknes
Importation	6	Small (1) -, Medium (2), Large firms (3)	Casablanca-Settat and Fès-Meknes

Supply chain stage/Other actors	Participant count	Participant information	Region
Storage and Packing	11	Casablanca-Port	Casablanca-Settat
		Milling companies Medium (4), large firms (6)	Casablanca-Settat and Fès-Meknes
Trading	10	10 soft wheat trading companies	Casablanca-Settat and Fès-Meknes
Professional soft wheat organizations	4	Inter-professional Office of Cereals and Legumes (ONICL) Moroccan Agricultural Cooperatives (CAM) and their National Union (UNCAM) National Federation of the Flour Mill (FNM) National Federation of Cereals and Legumes Traders (FNCL)	Regional level

## 2. Research sample for dates

For studying dates loss in Morocco, the two regions Draa and Tafilalet qualified for this study (see chapter 4 for more on regional selection).

Regarding date production, the research sample consists of two main groups: the traditional and modern plantations. For each group, roughly 20 farmers participated. Further, the regions host all operating refrigerated storage units in Morocco. Representatives of every storage unit in those regions were interviewed.

Regarding traders and transporters, ten companies participated in the study. Similar to soft wheat trade and transport, date traders and transporters own one or several trucks.



**Focus group with farmers.**

Table 2 shows an overview of research sample related to dates.

Table 2. Dates research sample

Supply chain stage/other actors	Participant count	Participant information	Region
Production	78 Farmers	Traditional Plantation (19), Modern Plantation (18)	Draa
		Traditional Plantation (20), Modern Plantation (21)	Tafilalet
Transportation	-	-	-
Storage and packing	3 companies	<ul style="list-style-type: none"> <li>• Unit in Agdez - CEO+ 2 Managers.</li> <li>• Unit in Tamouzmoute - CEO+1 Manager.</li> <li>• Unit in Tarnata – CEO+1 Manager.</li> <li>• All units hold a 400t capacity.</li> </ul>	Draa
	2 companies	<ul style="list-style-type: none"> <li>• Unit in Erfoud – CEO+2 managers.</li> <li>• Unit in Tinjdad – X.</li> <li>• All units hold a 400t capacity.</li> </ul>	Tafilalet
Trading	-	-	-
Professional dates organizations		DPA, ORMVA	

### 3. Data collection

In order to address the project objectives, we used two methodologies to collect the necessary data: individual semi-structured interviews for wheat importers, millers, wheat traders, date traders, date storage and packaging units and focus group discussion for farmers.

Surveys with millers, wheat importers and traders were carried out by telephone after setting an appointment. Interviews with wheat

transporters, date transporter, date traders, date storage and packaging units, wheat storage services at Casablanca port and Moroccan Agricultural Cooperatives (CAM) were carried out face-to-face.

Since storage methods vary depending on farm categories, it was decided to conduct separate workshops with small, medium and large-scale farmers. The main criterion for selecting these farmers was a good knowledge of loss problems and their causes.



In order to prepare the workshops and identify the potential farmers to attend the meetings, a prior visit to the project zones was organized and contacts with local extension services were made. The extension service agents were very helpful in identifying the farmers in whose homes the workshops took place and all the meetings' costs were covered by the project.

Interviews were carried out in Arabic and conducted separately with different categories of farmers using pre-prepared guidelines. Interviews were not recorded due to their informal nature and at the request of the interviewees.

The workshops were moderated by a researcher and a second person took notes. At the beginning of each meeting, the participants were informed about the confidentiality of the discussions. The moderator's main tasks were to introduce the objective of the workshop, manage the duration of the discussions, make sure that all relevant themes are covered and increase the active participation of all invited farmers in order to express clearly their opinions. Estimation of farm-level losses for each type of storage was identified after the participants reached a consensus.



## 2. Research boundaries and scope

---

This research has four main boundaries (limitations), which need to be highlighted to better understand the outcomes and recommendations.

### A. The choice of commodities

This study tackles food loss for two goods: dates and soft wheat. In general, cereals and other carbohydrate-rich foods account for the main source of dietary energy in Morocco (FAO, 2015).

Dates still belong to the most important and appreciated products for trading at oases-based communities. Further, dates are appreciated for their food and feed value and serve as a socioeconomically (and traditionally) important commodity for the Moroccan population (El Hadrami and M. Al-Khayri, 2012). Over time, an entirely new industry has evolved around the date palm. For instance, pitting, crushing and sieving factories now contribute considerably to local employment. Dates also yield a high nutrient and calorie density. The high nutrient and calorie-to-weight ratio of dates holds the potential to feed many humans while using little volume.

Secondly, soft wheat was chosen, mainly for two reasons. Firstly, in Morocco soft wheat is a staple food, which is supposed to add to food security for a large part of the population. Secondly, it is governmentally subsidized.

Subsidized soft wheat production ensures an income to the country's farmers hence there is an incentive for them to maintain and increase production. Ultimately, what is lost can neither serve its purpose for the population nor for the subsidy that has been paid out. This makes it a double loss.

### B. The choice to analyse food loss

As this study focuses on food loss and does not tackle waste, it involves supply chain actors from production/harvest, sortation/packing, collection/transportation, up to but excluding, the retail level.

Furthermore, this study does not look at dates and soft wheat, which "[...] re-enter in any other productive utilization, such as feed or seed". The analysis spectrum might be different if one were to base a study on a FLW concept different from that of FAO.

Given the peculiarity of the soft wheat production and consumption in Morocco, where small farmers play a large part in production, transportation, storing and hence in food loss, the analysis has been extended to include food loss in the special cases of small farmers and farming families. Therefore, food waste of soft wheat for small farmers was analysed and accounted for. Although soft wheat for small farmers, essentially farming families, are part of

the production stage, they supply their own families with approximately 80 per cent of their production, of which considerable volumes are discarded. At this point one could plausibly make the case for labelling this as food loss but, as food leaves the supply chain during consumption, it can be equally argued for it being a case of food waste.

### C. The transition from soft wheat to flour (or other soft wheat derivatives)

The transitioning point at which soft wheat is being processed and transformed into another product forms another research boundary. The research builds on the fact that loss analysis of soft wheat stops when it has been processed and/or transformed into something else, simply because it would be a different product. For example, if one were to study the causes for apple food loss, analysing actual apple puree losses would not belong to that study. Of course apples that are lost during processing are still related to apple food loss but once the apples (together with additives) have been transformed it can be argued that the puree is now related to apple puree loss, despite the main ingredient being apples.

However, unlike apples and other commodities which have their main purpose in being consumed unprocessed, soft wheat is (almost entirely) instrumental for wheat flour production. Due to soft wheat's instrumental nature, it was decided to extend the research scope to the point of industrial mills' warehousing, as storing flour could be related to flour loss or even be considered food waste if it is assumed that from there it goes to retail and consumption (flour in shops, bread-making, etc.).

### D. Regions covered by this study

This study does not cover dates and soft wheat losses in every location of their occurrence in the Morocco. The study locations were selected according to the most important regions where the two commodities are intensively produced, traded, transported and stored.

For soft wheat, the research scope involves the regions Casablanca-Settat and Fès-Meknes.

For dates, the Draa and Tafilalet regions served as the research location. See chapters 3 and 4 for more on regional selection.

### 3. The Moroccan soft wheat sector

This chapter discusses Morocco's soft wheat production and import since the year 2000. It explains the research sample choice for this study.

#### A. Soft wheat production and import

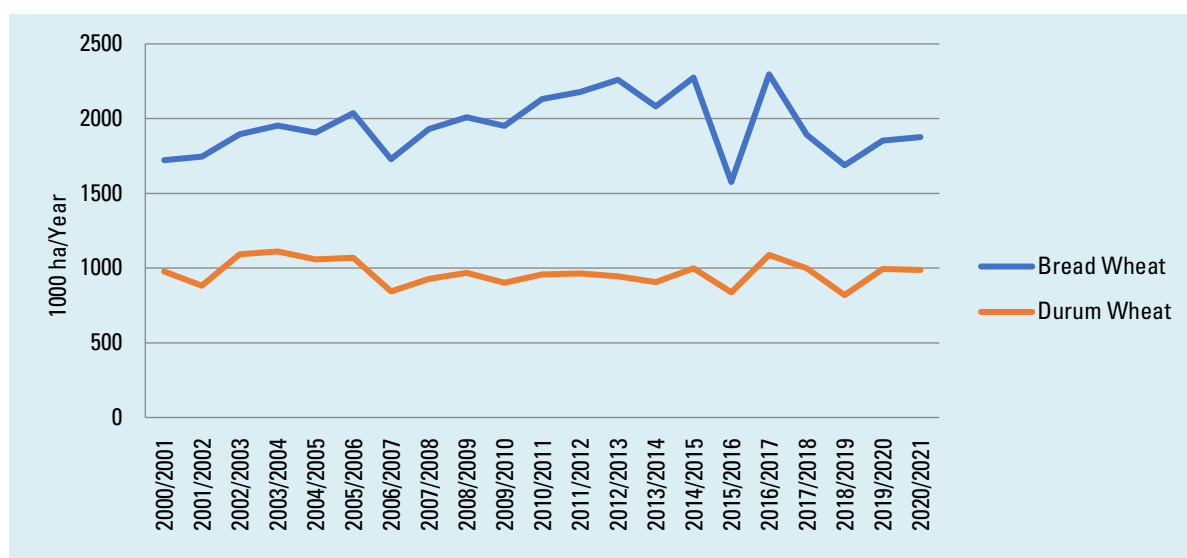
While agriculture plays an important role in the national economy, cereals are among the main commodities grown. They occupy around 75 per cent of arable land and represent about 45 per cent of the total agricultural production value (Bishaw and others, 2018). The commodity's contribution to the country's gross domestic product is 13 per cent, and providing 38 per cent of the total national employment (Bishaw and others, 2018). The sector also provides indirect

support for 60 per cent of the population and generates an export revenue of roughly 25 per cent (Bishaw and others, 2018).

Until the early 20th century, cereal cropping in Morocco was dominated by barley, followed by durum wheat. At the turn of the 20th century, bread wheat was introduced into Morocco by the French colonizers. In the 1980s, there has been an increase in both bread and durum wheat areas, while the considerable increase in bread wheat areas is, essentially, the result of intensified policies pursued by the Government (Bishaw and others, 2018).

During the years 2020 and 2021, the areas occupied by bread and durum wheat reached nearly 2.86 million hectares (MAPM, 2021).

Figure 5. Evolution of wheat area in Morocco



Source : L'Office National Interprofessionnel des Céréales et des Légumineuses (ONICL, 2021).

Figure 6 shows that bread wheat, occupying 40 per cent of the total cereal area, has relatively been the most important cereal with an average sown area of around 1.99 million hectares since 2010.

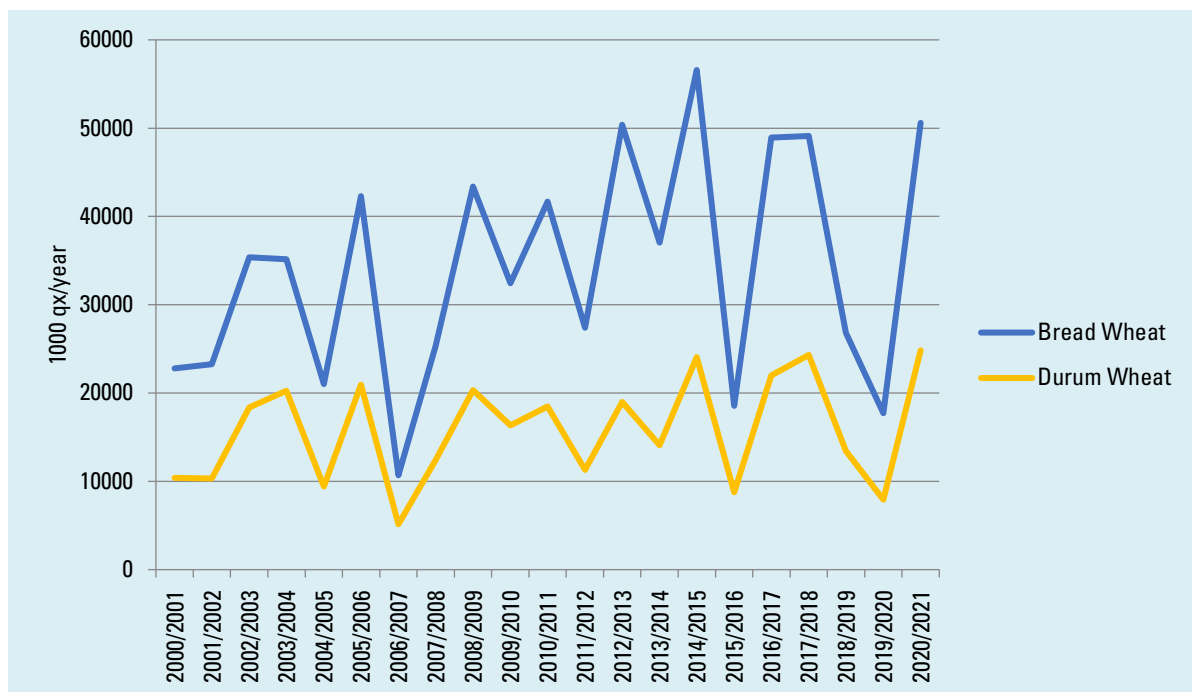
The annual total wheat sown area is within a range of 2.41 million hectares in an unfavourable year (2016) and 3.38 million hectares in a favourable season with early rains (2017). This variation is subject to the rain spatiality and temporality during the autumn season, in particular the months of November and December during which ploughing, and sowing are carried out.

Wheat is cultivated in different agro-climatic zones and in rotation with other annual crops

such as legumes, industrial crops and fodder crops. The main production regions are located in the rainfed areas of the plains and plateaux of Chaouia, Abda, Haouz, Tadla, Gharb.

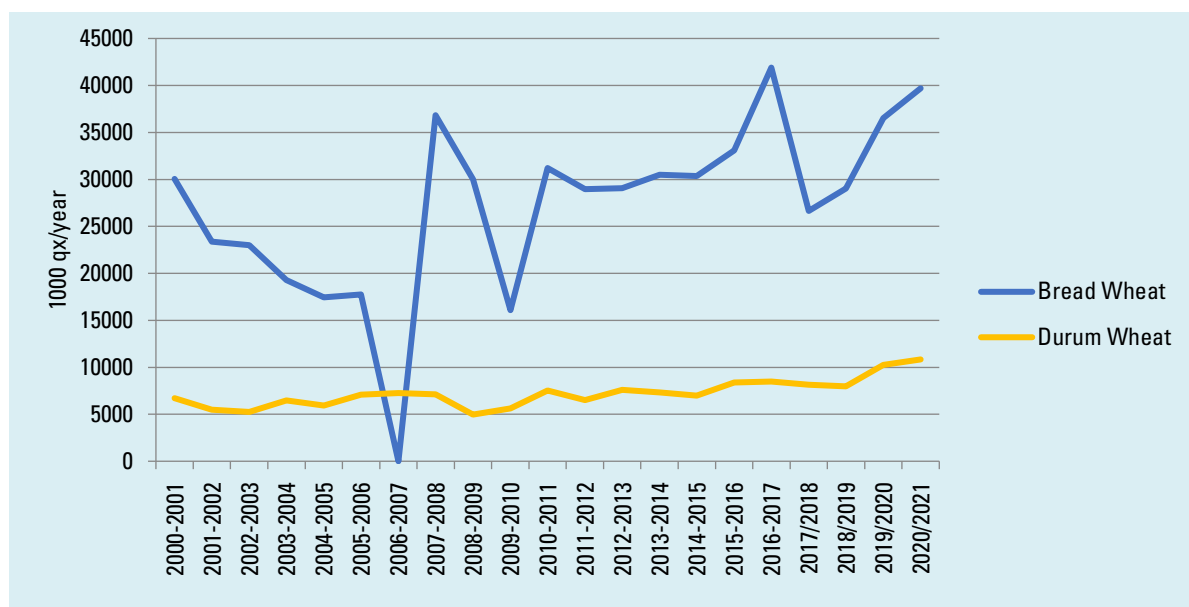
Figure 7 shows the Moroccan wheat production evolution from 2000 to 2021. Wheat production in Morocco is characterized by significant inter-annual variations mainly due to climatic, technical and structural factors. The average production during the last twenty years has been around 3.4 million mt for soft wheat with a peak of 5.6 million mt recorded in 2015 and 1.6 million mt for durum wheat with a peak of 2.5 million mt recorded in 2021, as per the ministry of agriculture (MAPM, 2021).

Figure 6. Evolution of wheat production in Morocco



Source : L'Office National Interprofessionnel des Céréales et des Légumineuses (ONICL, 2021).

Figure 7. Evolution of wheat import in Morocco



Source: L'Office National Interprofessionnel des Céréales et des Légumineuses (ONICL, 2021).

Figure 7 shows Moroccan wheat imports from 2000 to 2021. As domestic production has been falling considerably short of meeting national consumption, the country relies on imports for roughly 50 per cent of its domestic demand and wheat imports have therefore increased.

The low yield levels are the primary reason for the production and consumption mismatch. Although over the years the country brought forward substantial yield increases, the average yield for soft wheat during the last 10 years was about 1.9 ton/ha (ONICL, 2021). However, more adoption and use of adequate agronomic practices and new wheat varieties will improve yield performance and reduce the gap between potential and actual yield and increase yield stability.

## B. Economics of soft wheat

In Morocco, the average wheat consumption per inhabitant is 200 kg per year, i.e. three times more than the world average. This cereal is a staple in the household diet in Morocco. But the country does not produce enough, and between 2014 and 2019, local production only covered on average 54 per cent of cereal needs (wheat, corn, barley), according to ONICL (National Interprofessional Office of Cereals and Legumes) (Terre-net 2020).

Unlike other Maghreb countries, it is private operators who import wheat in Morocco. But ONICL regulates imports in the case of supply problems. Every year as the harvest approaches, the country raises its import taxes to encourage domestic production and once supplies are reduced, the taxes are lowered to allow imports again.

### 1. Target reference price of national production

The target reference price for the purchase of soft wheat from the national production of the 2021 harvest was 2,800 MAD per ton (MAD/mt). This price is for standard quality wheat and includes all charges, taxes and margins inherent in the purchase from the producers and the delivery to the industrial flour mill. It may, where appropriate, be subject to bonuses or reductions which are freely negotiable between the parties concerned (ONICL, No. 4, 2021).

### 2. Soft wheat storage bonus

Storage organizations (cereal traders as well as CAM and UNCAM) benefit from a storage premium of 20 MAD/mt per fortnight for the storage of soft wheat from national production. The quantities of soft wheat from national production eligible for the storage premium are those from purchases made during the collection period, declared and validated by the services of ONICL (ONICL, No. 4, 2021).

### 3. Fixed premium for imported soft wheat

The soft wheat import refund system consists of the implementation of a lump sum premium to be paid by the State in favour of importers if the port cost price exceeds 2,700 MAD/mt (ONICL, No. 6, 2021).

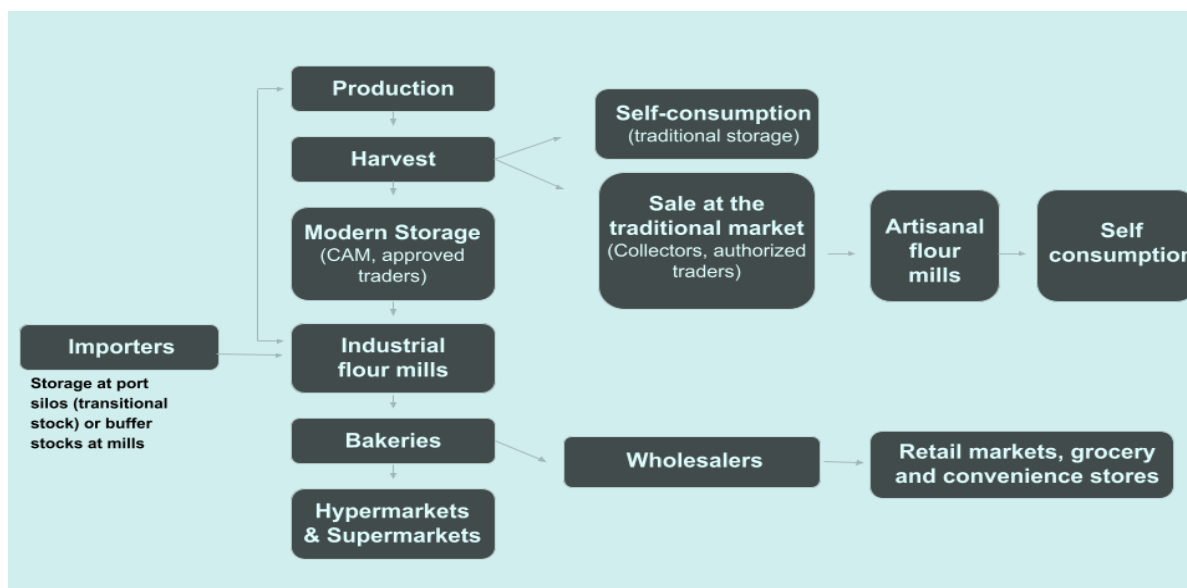
The flat-rate premium relates exclusively to the quantities of bread-making soft wheat:

- Imported by storage organizations (cereal and pulse traders, CAM and UNCAM) and their Union), as well as industrial flour mills.
- Imported between 1 November 2021 and 30 April 2022, as certified by port authorities.

## C. Soft wheat supply chain

The main objective behind the illustration of the wheat supply chain is to identify all the actors and organizations involved in the chain and identify the flows that link them upstream or downstream of products.

Figure 8. Flow chart of the general Moroccan soft wheat supply chain





The diagnosis of the different parts of the chain will allow us to identify the critical points of losses, which represent the points or the stages of the chain where the losses are the most and have the greatest influence on the economic results of the chain.

After discussions with the major players in the wheat sector, two sub-chains of wheat supply have been identified: the chain linked to imported wheat and that relating to locally produced wheat.

### 1. Supply chains for imported wheat

The analysis of this wheat supply chain begins from the port of unloading to bulk storage in a processing industry (milling). The performance of each link in the private or public cereal import chain is assessed. This analysis was conducted from the main grain port of Morocco, Casablanca (63 per cent of imported cereals at national level) (ANP, 2021) to storage units.

The main stages of this chain are as follows:

- Unloading of wheat at the port (directly unloaded in trucks or transits in the silos of the port).
- Storage at port silos, in general temporary (1 to 3 weeks).
- Transport from the port to storage units belonging to importers or millers.
- Storage by importers or millers.

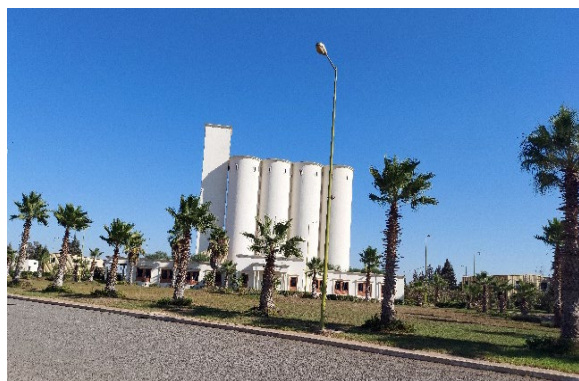
### 2. Supply chains for locally produced wheat

#### (a) Upstream of the sector

- Producers: total nearly 1.2 million farms, i.e. 80 per cent of all farms. The number of market-oriented cereal farms is estimated at

nearly 300,000, with performance levels strongly correlated to size. The remaining number of cereal farms are geared towards self-consumption (FNM, 2020).

- Collectors or traders: these are intermediary traders between the producer and the storage organization or the flour mill who buy the cereals either directly from the producers or in the souks [markets] and/or the grain halls.
- Storage organizations: the storage capacity held by storage organizations (permanent cereal traders and CAM) is divided into 227 depots held by 168 operators, including 5 cooperatives. More than one third of the capacity of storage organizations is in the form of silos (ONICL, 2020).



**Storage at CAM.**

#### (b) Downstream of the sector

- Industrial flour mills: these have milling facilities that crush wheat with a view to marketing the resulting products, and all have facilities to store their wheat.
- Artisanal flour mills: these are small cereal-processing units providing services to their customers, generally made up of producers and consumers who buy cereals in the souks and grain markets. They do not have storage facilities.

## D. Soft wheat food loss extent, causes and critical points

Annex B displays a summary of the field work results related to soft wheat loss extent and causal origin. Relatively speaking, high loss volumes occur at the production stage with up to 20 per cent, 5-7 per cent at collector's storage and 5 per cent at commercial sales on the market. The remaining participants show lower loss volumes ranging between 0.4 per cent and 2 per cent.

### 1. Soft wheat food loss at storage level

The storage of wheat is an important step in ensuring the food security of Moroccan consumers. Proper storage helps suppliers withhold their produce until price is at a suitable level, and therefore maximize their profits. Good storage also enables grain quality obtained at the time of harvest or pre-storage to be maintained and degradation of the grain to be prevented. In Morocco, wheat storage is characterized by two storage methods: modern and traditional. The techniques used according to these two modes are:

- Traditional underground storage in *Matmoras* or grain pits dug in the soil and storage in rooms.
- Storage in sheds, stores, silos in bulk or in bags both on the farm and at storage professionals (cooperatives, traders, flour mills).

#### (a) Traditional storage and its critical points

Traditional storage is encountered exclusively at farm level. In fact, farmers use traditional techniques to save part of their harvest to meet their consumption and seeds requirements for the next season. Traditional storage methods

vary according to climatic zones, socioeconomic conditions, the nature of the products and their destination (seeds, consumption, market).

#### (i) Critical point 1: underground storage

Underground storage, *Matmoras*, is one of the most widespread methods of storage in rural areas. It can be considered as the most ancestral system, and the best known in rural Morocco. The *Matmora* is an underground room, in the form of a spherical-truncated cone, generally dug near the house. In the past, this type of storage was used by all categories of farmers, and the number of *Matmouras* gives an idea of the size of the farm. Currently, this storage mode is used more by small-scale farms.

Nationally, this storage system has a total capacity estimated at 10 million quintals (Dahmali, 2001). In this storage mode, the temperature is around 20 °C against 30 °C and 40 °C outside.

The disadvantage of this type of storage is that it can cause significant losses in dry weight, caused in particular by re-humidification of the product by the infiltration of water into the ground or by water condensation in the upper part of the warehouse (Bartali, 1998).



**Matmora.**

According to the farmers surveyed, the underground storage of wheat during a period of 12 months can cause losses of up to 20 per cent of the dry weight of the cereals if the walls are covered only with straw. These losses are reduced to 10 per cent if the walls are covered with plastic. About 50 per cent of these losses are generally recovered, either in the form of food for livestock or sold at lower prices (20 per cent to 30 per cent less than the normal price). The causes of these losses are a lack of aeration, moisture infiltration and insect attacks.

In small farms, a significant portion of the produced wheat is used for home-consumption and the use of less expensive storage systems capable of preserving the quality of the grains is very suitable for this category. Thus, reducing losses for this type of storage depends on several elements, such as: good control of grain humidity at the entrance, use of enough chemicals to eliminate as many insects as possible before storing the grain, covering the walls with waterproof plastic to avoid moisture infiltration and ensuring periodic control of the stored wheat.

#### **(ii) Critical point 2: storage in rooms**

These storage rooms are constructed either in reinforced concrete or in local materials. Storage inside these rooms is usually done in bags and occasionally in bulk. According to the discussions with the farmers surveyed, this type of storage is generally used by medium and large farms. Storage of this type is also used to store wheat for private consumption, wheat for sale and seeds for the next cropping season. Losses linked to this mode of storage vary between 10 per cent and 15 per cent. Around 40 per cent of these losses are recovered and used for animal feed. A reduction ranging from 20

per cent to 30 per cent is observed in the price of recovered wheat due to reduction in quality.

The main causes of losses cited by farmers for this type of storage are lack of proper aeration, insect attacks and rodents. Farmers argued that windows of such storage rooms are very small or sometimes non-existent. Moreover, such storage rooms are built by artisans who do not have knowledge of the standards for storage buildings.

#### **(b) Modern storage**

Wheat storage in Morocco is generally found in storage organizations such as Moroccan Agricultural Cooperatives (CAMs), traders, flour mills and at ports for limited periods. Wheat is carried either in stores (in bags or in bulk) or in silos (in bulk). The latter are structures made of reinforced concrete or metal, special for grain storage, and are generally equipped with specialized equipment for handling, sorting and weighing, and ventilation systems. The storage capacity of operators amounts to 67 million quintals, of which more than 75 per cent is held by storage organizations (ONICL, 2015).

In the cooperatives, wheat losses were estimated from 1 per cent to 2 per cent for a period of storage of about four months. The causes given are due mainly to lack of maintenance of the aeration system, high humidity of grains at the start of the storage, presence of insects and rodents and lack of staff.

At the level of traders or collectors, storage houses used allow the storage of wheat either in piles of bags or in bulk, or a combination of both. The storage of wheat in bulk helps to mitigate the high cost of the baggage. Wheat losses are estimated to be between 5 per cent

and 7 per cent. The main causes are the lack of aeration, absence of humidity control during the period of storage, and the presence of insect and rodents.

In flourmills, however, wheat losses are relatively low and vary between 0.8 per cent and 1 per cent. The causes of the loss are high temperatures, variations in humidity and the presence of insect and rodents.

The lowest wheat losses were observed at port level, varying between 0.4 per cent and 0.5 per cent. This is mainly due to the short period of storage (transit storage).

## 2. Soft wheat food loss at transport level

Losses caused during transport are very low compared to the other stages of the wheat supply chain. In general, losses are estimated at 1 per cent to 2 per cent. The main reasons behind this are the relatively short distance travelled by the trucks and the use of modern trucks with covered dumpsters.



**Wheat loss during transport.**

## E. Recommendations on how to reduce soft wheat loss

In light of on the previous analysis of soft wheat losses and primary data from stakeholders in the soft wheat value chain (annex B), the study came up with the following recommendations on how to reduce the loss.

### 1. Improve harvesting conditions

The state of the grains at the start of storage (maturity, humidity level, cleanliness) is decisive for the success of the storage operation. Two essential aspects need to be improved:

- Determining the optimal harvest date to help farmers determine the right level of humidity at storage, which can lead to shattering of the ears and the breakage of seeds, or too high humidity, which favours the proliferation of insects.
- Using a combine harvester to ensure speed and economy of the harvesting operation (10 to 20 ha/day) instead of expensive and scarce labour during this period. However, technical skill is required in the use of a combine harvester to limit crop losses and grain breakage. Harvesting should be done in warm weather.

### 2. Improve quality of traditional storage on farms

Well-preserved wheat in ideal storage conditions will contribute to increased income for farmers since it will be possible for them to sell their grain when demand is high and usually this coincides with a rise in wheat prices on the market.

For storage at small-holder level, where the major part of the production is intended for

home consumption and spread over the whole year, the use of less expensive storage systems is suitable, especially if it is intended to ensure wheat supply for household, or to preserve the nutritional quality of the seeds for the next harvesting season. Therefore, we recommend the following enhancements to the existing small-scale systems:

#### (a) Underground storage (*Matmoura*)

This method is adapted to the semi-arid or Mediterranean climate of Morocco and is the least expensive mode and adapted to long-term storage. The choice of the type of soil as well as the location is very important. The *Matmoura* must be perfectly insulated with a plastic coating so that the stored grains are sufficiently dry. The use of plastic also provides good protection against rodents, insects and impurities. In fact, sandy soils are not suitable for underground storage as they are caricaturized by high water holding capacity. In such cases, introducing a hard floor is preferable. Moreover, it is recommended that the *Matmoura* should be elevated rather than fully covered underground, which helps avoid water infiltration.

#### (b) Storage in rooms

Medium-sized farms generally tend to use this mode of bagged storage. For this type of conservation, it is recommended to use jute bags, which are more suitable than polypropylene bags. It is also recommended to improve the aeration of the room where the bags are stored. In addition, it is necessary to avoid the use of phosphine without a supervision of a technician in to avoid risks of human intoxication.

The use of low-capacity metal silos is a solution to consider. These silos can be used individually or by a small group of farmers. However, it should be noted that the major difficulty that arises in the use of modern metal silos on farms lies in their high acquisition cost. For this, it might be necessary to provide farmers with subsidies to encourage them to modernize their storage methods.

#### (c) Training on wheat storage and conservation techniques

As straightforward as it may sound, an awareness of the reasons for food loss and what it implies comes prior to any prevention. The analysis shows that when storage was not carried out in compliance with certain standards and conditions, it did not allow good conservation of the wheat and thus harmed its quality (including loss in quantity, deterioration of the grains, infestation). Nevertheless, in a competitive economy, quality is an important determinant of price and quantity sold by each farmer, thus, increasing storage effectiveness to preserve quality is essential.

Training and raising the awareness of farmers and storage organizations on this subject is of great importance. Farmers need to be more familiar with the key concepts in the storage and preservation of wheat, issues such as best harvesting/storing timing, humidity levels of seeds and storages, ventilation, and conservation maximum time under different circumstances.

It is recommended that the Ministry of Agriculture, through extension workers, disseminate knowledge on these fundamentals of storing wheat, raising their awareness on the importance of good storage and good

preservation of cereals, and its impact on food loss and profitability. Training needs to enable them to identify the main “enemies” of wheat stocks and the appropriate means of control.

Therefore, and considering wheat loss hotspots and the feedback of farmers as in annex B, the following general recommendations can be made for guidance and extension work with farmers:

To reduce wheat losses occurring along traditional (small-medium) storage:

- Advice on buildings standards to be used upgrade current wheat storages and construct future ones.
- Use of good control methods for insects and rodents by appropriate chemicals.
- Aeration techniques and control measures to keep grain dry and in good condition.

To reduce wheat losses occurring along modern storage entities (CAMs, traders, flour mills, ports), the following measures are highly recommended:

- Good control of the grain’s humidity at the start of storage.
- Continuous control of the temperature and humidity during the period of storage.
- Control the insects and clean the stores before starting the storage.
- Minimize the mechanical transfers.
- Organize training on storage for different actors in the chain.

Awareness-raising initiatives can take the form of uncovering potential partnerships with other stakeholders in the value chain, who could, for example, buy low quality seeds for other purposes. Analysis shows that five supply chain actors have no soft wheat recovery method in place, and as a result, in the case of customer rejection, the soft wheat will most likely be lost. An effective method to further develop the value chain is through a buyer-to-buyer meeting, where farmers, traders, transporters, exporters and other market players such as mill owners and large-scale bakeries, can meet to uncover potential vertical integration strategies, and development of the value chain.

## 4. The Moroccan date sector



**Dates from Errachidia region.**

Dates and palm trees are key contributors to regional economic development in Morocco, both forming the main pillar of the oasis economy. Date production and trading activities contribute between 20 per cent and 60 per cent of income for more than 1.4 million inhabitants. In addition to fruit production, palm trees provide various materials for crafts, construction or energy production (Agriconsulting Maroc S.A, 2015).

### A. Date production and import

The national palm grove has one of the richest varietal profiles at the international level with more than 400 varieties. This variability is produced on a geographical area which extends over 13 provinces located in the south-east of Morocco, in particular those of Ouarzazate, Zagora, Er-Rachidia and Tata (figure 9) with 98 per cent of the national production (Harrak, 2012).

**Figure 9. Moroccan palm groves**



The noblest date varieties with the most promising potential can be found in the palm groves of Er-Rachidia, Ouarzazate, Zagora and Tata that. Together, the districts of Ouarzazate and Er-Rachidia represent 91 per cent of the total production of Morocco.

About 50 per cent to 60 per cent of this production is commercially marketed. The other production regions (mainly Tata and Figuig) represent the remaining nine per cent of production (Harrak, 2012).

In production areas such as Figuig (which produces about two per cent of the national harvest), a greater percentage of the harvest is consumed at the household level.

In the past, the Moroccan date sector experienced a sharp decline in its surface area, with 87,000 hectares in 1948 and 47,000 in 2001

(IOS, 2009). This considerable degradation is due to a combination of several factors, such as bayou, drought, silting up, insufficient water resources, disinterest of oasis populations, fragmentation of land preventing the formation of large profitable units, lack of professional organization, heterogeneity of plant material (preponderance of poor-quality clones), lack of modern production control techniques and the poor valuation of dates. Nowadays, the date sector has visibly progressed since the implementation of the Green Morocco Plan. Indeed, the sector currently occupies 59,640 hectares against 48,000 hectares over the period 2003-2007, which represents 92 per cent of the area defined in the programme contract for the date palm.

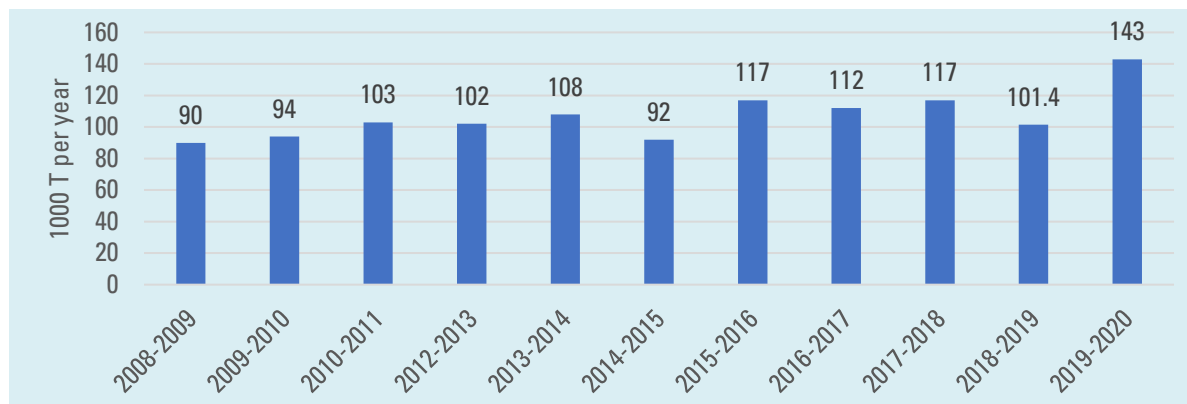
The development of planted areas has been accentuated by modern intensification and reconstruction of traditional oases. The related operations were financed through the incentive system of the Agricultural Development Fund. With the implementation of the Green Morocco Plan, and thanks to the efforts of producers, the date sector has shown improved performance. The production of dates has thus undergone a gradual development. Figure 10 shows the

evolution of date production since the 2008-2009 cropping season.

Nevertheless, the sector's development is faced with certain constraints, mainly due to dependency on imports to supply the local market and the lack of refrigeration capacity, which limits the quality and quantity maintenance of dates that should be commercially marketed.

In accordance with the strategic orientations of the Green Morocco Plan, in particular the objectives of the programme contract for 2020, Morocco faced the challenge of accelerating the pace of the surface expansion of the date palm area to improve productivity. This programme contract targets the rehabilitation and reconstitution of existing palm groves over an area of 48,000 hectares and the extension of plantations outside the palm groves over an area of 17,000 hectares. The Green Morocco Plan has planned new plantations according to appropriate methods such as density, spacing, alignment, irrigation, management and technical assistance to farmers (pollination, bagging, harvesting, conditioning, conservation, training and supervision).

Figure 10. Evolution of date production in Morocco



Source: FAOSTAT.



In addition, and in order to rely less on date importing, cover national demand and better match supply and demand, the strengthening and improvement of valuation including, in particular, cold storage is necessary to limit quantitative and qualitative losses (Harrak, 2012). Therefore, the Department of Agriculture has planned the creation of additional date cold storage units with a 400 mt/year average capacity. These units will be mainly installed in the regions: Meknès-Tafilalet, Souss-Massa-Drâa, Guelmim Smara and the Oriental. The units will be carried out jointly and equally between the private sector (20) and the State (20).

In Morocco, the main date markets are in Marrakech, Casablanca, Fez and Agadir. In Agadir, for example, the date market sales are between 10 to 15 mt per day during typical periods. At harvest time, the same market sales increase to 100 mt daily. Despite these sold volumes, national date consumption remains relatively low. The per capita date consumption is approximately five kilograms. This rate is significantly lower than those in other date-producing countries (e.g. the Saudis consume 30 kilograms while the Emiratis and Libyans consume respectively 18 and 14 kilograms per person and year). The Algerian consumption is 10 kilograms per year, while that of Mauritians

and Tunisians oscillates between six and seven kilograms per person per year (IOS, 2009).

The trade balance of dates shows a consistent deficit, which is covered by date imports from Algeria, Tunisia, Iraq and the United Arab Emirates. Since 2010, imports have increased as shown in figure 11.

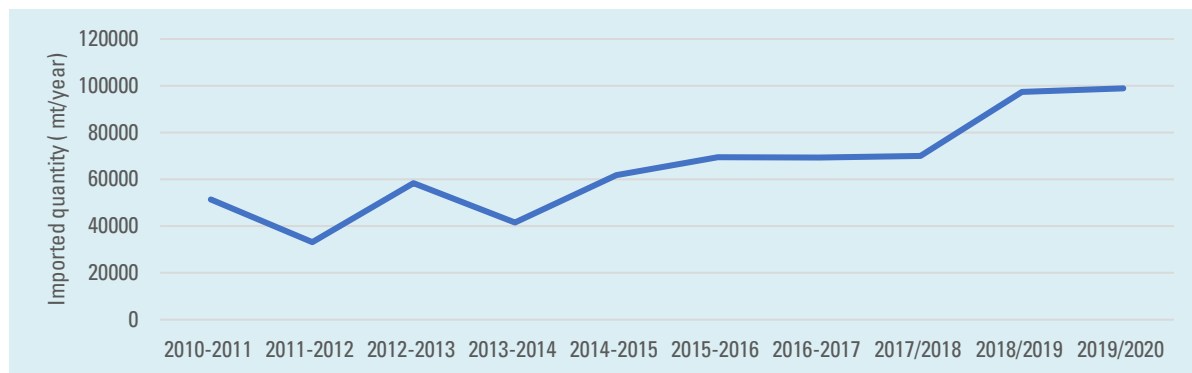
Comparatively, date exports are low and do not exceed, on average, 70 mt per year (FAOSTAT).

Due to the important socioeconomic role, date sector management experienced a major institutionalization. The related dynamic is displayed by:

- The increased producer support and initiative forming professional organizations.
- The creation of the National Agency for the Development of Oasis Zones and Argan (ANDZOA) in 2010. Essentially, ANDZOA's mission is to coordinate actions related to palm grove development and oasis ecosystem protection

The creation of two active federations: The National Federation of Date Producers and the Moroccan Interprofessional Federation of Dates (FIMADATTES).

Figure 11. Moroccan date imports



Source: FAOSTAT.

FIMADATTES was created in 2010 after the creation of the Regional Association of Meknès Tafilalet, the Regional Association Souss Massa Draa and the South-East Figuig Regional Association. The federation contributes to upgrading the date production sector, which provides an added value to a sector that has suffered from several problems in the past.

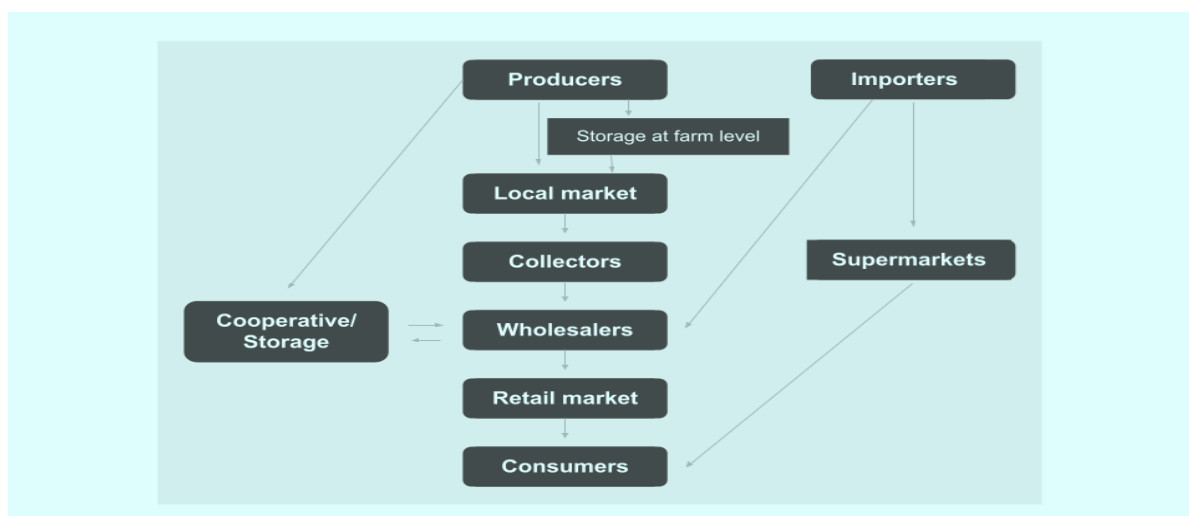
## B. Date supply chain

The date sector in Morocco includes a set of private operators (producers, collectors, wholesalers, traders and retailers) and public institutions whose relations are organized around transactions on date flow (Figure 12). This sector is considered a priority in the intervention strategy of the Department of Agriculture. Indeed, its development is of vital interest due to its economic, social and environmental impacts in oasis areas. It is in this sense that a programme contract for the development of the date palm sector was signed in 2010 between the Government and the Interprofessional Federation FIMADATTES

(Fédération Interprofessionnelle Marocaine des Dattes). The outline of this programme contract is as follows:

- Rehabilitation and reconstitution of existing palm groves over a total area of 48,000 ha.
- The creation of new plantations, outside the palm groves, over an area of 17,000 ha.
- The achievement of a date production of 160,000 tons in 2020 and 185,000 tons in 2030 against the current 90,000 tons.
- Strengthening the national availability of vitroplants by increasing the average annual production capacity to 300,000 plants between 2010 and 2020 against 60,000 plants/year during the five-year period 2005-2009.
- The valuation of an overall tonnage of 110,000 tons, i.e. nearly 70 per cent of the production expected by 2020, including 70,000 tons in fresh packaged dates, 20,000 tons in processed products and 20,000 tons in animal feed.
- The development of exports of dates of superior quality to reach 5,000 tons in 2020 and 10,000 tons in 2030 against negligible quantities currently achieved (ANDZOA).

Figure 12. Flow chart of the general Moroccan soft wheat supply chain



## 1. The producers

The production of dates in Morocco concerns an area of around 50,000 ha, with a total of nearly 5 million palm trees, which represents 4.8 per cent of the world's date heritage. It is located mainly along the Ziz and Drâa valleys (Agricultural Credit of Morocco).

## 2. The collectors

Collectors represent a central link in the supply chain. They work mainly in the purchase and assembly of dates in the production areas to sell to wholesalers, semi-wholesalers and retailers (national market) or at the level of packaging stations. They are individual operators who generally work in a seasonal and informal way.

## 3. Wholesalers

Marketing channels for dates produced at the national level are complex to analyse because they involve a large number of operators of various forms. After the collectors, which are generally linked directly to the producers, there intervene wholesalers, intermediaries, retailers and local and wholesale markets before dates reach the consumers.

## C. Date loss extent and causes

### 1. Loss at farm level

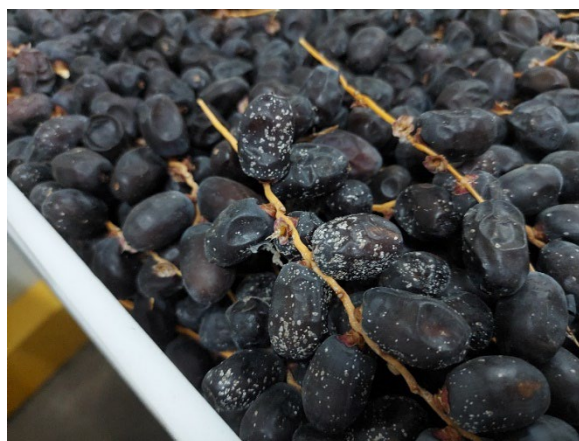
The results of the analysis confirmed that most of date loss occurs at the producer level. Through surveys and workshops with farmers, it was possible to estimate these losses according to their specific causes.

At the farm level, the losses are mainly due to attacks by the date moths and birds, which are

the major enemies of the date sector in Morocco. The other losses are less significant and include over-ripe dates that fall from palm trees, fruits that remain on the trees, malformed, immature or scalded fruits.

#### (a) Losses due to moth and insect attacks

According to farmers, the moth can infest a significant amount of harvestable crops annually. The moth larva attacks dates in palm groves, storage and packaging units, and wherever there are maturing dates. The adult female lays eggs on dates, especially those that have fallen but remain trapped in the developing bunch. The eggs hatch after four days. The larval period is three to eight weeks, depending on the temperature. Up to three generations of fruit moth can develop within a single fallen fruit trapped in the bunch. The results of the studies showed that these losses are estimated at average of 10 per cent. These losses occur during the storage period at farm level.



**Losses due to moth and insect attacks.**

#### (b) Losses due to bird attacks

Birds can cause serious damage by feeding on the fruit during the different stages of fruit

development. The soft and semi-soft varieties are the most attacked while the dry varieties are rarely subject to these attacks. According to farmers, losses caused by birds are estimated at 15 per cent. Fruits partially attacked by birds can still be used for animal feed.

#### (c) Losses due to scalded and deformed dates

These losses include scalded and deformed dates. The losses are estimated at around 3 per cent of the dates harvested. These dates are generally reused as livestock feed.

#### (d) Losses corresponding to un-harvested dates

The un-harvested dates correspond to the fruits that remain on certain palm trees because of the height of the trees. Farmers do not harvest these dates when the selling price of these dates does not cover the cost of labour invested in harvesting. The losses due to un-harvested dates are estimated at 2 per cent.

#### (e) Losses due to dates falling from palm trees

The winds are mainly the cause of date falls from palm trees. Farmers estimated these falls at 1 per cent. The dates remain on the plots or between cut leaves at palm base.

### 2. Loss along cold storage units

The number of refrigeration units installed in production areas remains clearly insufficient to meet the needs of farmers. The various pre-storage operations carried out at the level of the refrigeration units include reception, registration, weighing, sorting, washing and drying. Washing and drying operations are not practised in all refrigerated units.

Losses of dates at the refrigeration units' level are very low compared to those at the farm level and are of two types, the qualitative losses and the losses in weight.

#### (a) Qualitative losses of dates

Each variety has a suitable refrigeration temperature. Storing all the varieties at the same temperature can cause changes in the external appearance of the fruits such as the bursting of the epidermis of the dates and the crystallization of sugar on the external part of the date. The deterioration in quality concerns 1 per cent of the dates stored in these units. These dates of lower quality are still consumable but their price decreases by about 50 per cent.

#### (b) Weight loss during cold storage

When dates are placed in cold rooms in the absence of relative humidity regulators, as is the case for all the refrigeration units visited, weight loss is inevitable. The loss in weight of dates stored for three months at a temperature of 5 °C in the absence of control of the relative humidity is estimated by officials of refrigeration units at 2 per cent.

### 3. Loss at markets

#### Losses at rural markets (local souks)

During the date harvest period, traders come to get supplies from rural markets (souks) and rent storage space in refrigerated units to store their products. The dates are spread directly on the ground covered by a plastic tarpaulin. During loading and unloading dates fall on the ground and mix with the sand and become inedible. Children collect these dates and sell them as animal feed. According to sellers' estimates, these losses are around 0.7 per cent.

## D. Recommendations on how to reduce date loss

In the light of the information on date losses, spots and causes, and the primary data from stakeholders in the value chain (annex C), the study came up with the following recommendations on how to reduce date loss.

### 1. At farm level

Workshops with farmers revealed that attacks by insects, birds and the methods and operations practised during harvesting are the main causes of losses at the farm level. The harvesting of dates is a particularly important operation that determines the quality of the packaging of dates. Dates harvested in a clean and adequate way allow a great saving of time during cleaning. On the contrary, dates harvested in an improper way (soiled by sand or damaged during the fall) lead to additional work for the packaging units.

#### (a) Measures to limit losses caused by birds

In order to limit the losses caused by inappropriate harvesting tools and methods, and bird attacks and to ensure a good quality of dates, it is recommended that the Ministry of Agriculture should work with farmers and date cooperatives to raise their awareness on the pros and cons, and use possibility of the following methods of harvesting:

- Harvest the dates one by one as they mature (grappling method). It is justified for good quality varieties with a very remunerative selling price (case of the Mejhoul variety). It is also the best way to obtain good-looking fruits. The picked dates are to be collected in a suitable basket connected to the picker by a rope, which allows the picker to descend gently with the full basket.
- For dates with staggered maturity, the bunch is shaken, and the ripe dates are left to fall into a bag. Two people must often do this operation, one takes the bag and the other shakes the bunch.
- For good quality dates like Mejhoul and Boufeggous, the bunch can be wrapped before being cut and then roped down to the ground below the tree covered with a tarpaulin. As for the medium-quality varieties, the date bunches are cut all at once and lowered to the ground by means of a rope to the ground below the tree covered with a tarpaulin.
- Use of the sleeve pocket at harvest time. The pocket caps the date bunch. Apply a back and forth motion to the fork, shake the bunch and detach the ripe dates. This last one is collected by the pocket and led by the sleeve directly into a box. This mode of harvesting offers advantages, but can only be used for cultivars with hanging bunches.
- For varieties with simultaneous ripening, the date bunches should be cut when fully ripened. For dates of average quality, the date bunches are to be cut when 75 per cent of the fruits have reached maturity. Once on the ground, the date bunches are shaken, and the ripe dates are collected. The dates remaining in the date bunches must continue to ripen under appropriate conditions.
- The bagging of the date bunches by bags of various kinds (e.g. special paper, plastic, nets) ensures good protection of the dates against birds and insects and guarantees good quality. It also promotes the growth of young fruits and allows several advantages during ripening (e.g. homogeneous appearance, grouped ripening).

### (b) Measures to limit losses caused by moths and insects

In order to limit the losses caused by moths and insects, it is recommended to treat dates in the palm grove as soon as possible, to eliminate insect larvae and eggs before they hatch. To limit attacks by moths and insects, farmers can select any of several recommended methods:

- Biological control: date moths have several natural enemies, particularly parasitoids, which can contribute to a caterpillar parasitism rate of around 5 per cent in fields and 10 per cent in warehouses.
- Use of pheromones extracted from females: they are used for the fight against several insects, particularly Lepidoptera, and provide information on the appropriate time for the intervention. These substances have given positive results in capturing a good number of pests.
- Not to leave harvested dates in fields for a long time, and to pick up all dates left after harvest in between cut leaves at palm base and on the ground, as they constitute a breeding ground for insects.

### (c) Measures for sorting dates at farm level

Whether to be sold immediately or stored for a long time, dates must be free from diseases and defects, and therefore sorted accordingly. Moreover, sorting must be carried out as the dates are harvested.

Good practice indicates that dates need to be sorted into different categories by maturity, and into homogeneous batches (according to colour, texture, size and water content). The dates should be grouped by variety as well so as to eliminate the damaged dates (rotten or parasitized) and to draw aside the foreign bodies.

For hygienic and efficient sorting, it is better to provide special areas or sheds, with a tin roof or preferably a thatched roof. Sorting tables allow workers to work faster, whether they are seated or standing. Tables can be covered with a polyethylene sheet, which is easy to clean and inexpensive. Adequate lighting is also important.

When the season ends, the premises must be cleaned and prepared for the next season. Moreover, spraying inner walls of the warehouses with lime and properly aerating the storage places are good practices that prevent insect proliferation. Lastly, it should be explained to new farmers that the new harvest should never be mixed with that of the previous year.

## 2. At refrigeration storage unit level

Quality standards for dates, such as the Moroccan standard, the standard of the United Nations Economic Commission for Europe (UNECE DDP-08) and the FAO/WHO Codex Alimentarius standard (Codex Stan 143-1985) require among the quality criteria for the date trade a guaranteed live insect infestation rate of 0 per cent. Therefore, the fight against insect infestation must receive special attention by applying effective disinfestation processes such as elimination of insects by fumigation or heat, storage areas should be appropriately cleaned before storage. The Phostoxin fumigation operation must be practised in all refrigerated units under the control of institutions responsible for food safety.

Trying to check if limited refrigerated storage capacity, unreliable power supply, or the hot climate have direct impact on date loss, the study found that is adequate for the following reasons: (a) storing in houses and non-

refrigerated storages is still a common practices in oases regions, and besides, refrigerated units may reach maximum capacity in extremely good seasons, when quantity produced is remarkably high and (b) as all refrigeration units are equipped with auxiliary generators, power cuts never cause food loss in those units.

However, the study found that in all the refrigeration units visited, the relative humidity regulation system is not activated due to a lack of training on how to operate the system. But all managers of the different units of this type of storage are aware of the fact that refrigeration

must not modify the characteristics of the fruit, such as texture, humidity and colour. Storage for six to eight months requires a moisture content not exceeding 25 per cent and storage at a maximum of 0 °C. Storage for eight months or more becomes possible only if the moisture content is below 20 per cent. Dates with a humidity that exceeds 25 per cent turn dark during storage at very low positive temperatures. Therefore, it is recommended that managers of refrigeration storage units receive proper training on the role humidity regulation plays in preventing loss, and how it contributes to increasing profitability.





## 5. General recommendations and conclusions

---

### A. General recommendations to reduce food loss

For both soft wheat and dates the analysis show that there are barely any recovery methods to further channel the produce. In fact, customer rejections related to differences in product appearance and lower quality appears to be a reoccurring issue, which results in definite losses.

This calls for a systematic business-model adjustment to ensure sustainable loss prevention and rural development. Therefore, and in reference to Lansink ladder's waste management model, it is recommended that the Moroccan soft wheat and date sectors pay attention to the aspects of reuse, recycling, compost and energy production. Incentives should be given to the private sector, mostly SMEs and women entrepreneurs, to achieve product innovation – reusing low quality produce and inedible parts can add value.

For dates, if reducing loss volumes is not possible, reusing low quality dates should be facilitated by supporting suppliers to find markets that accept such quality at a lower price. If reuse is not possible, supporting farmers and other stakeholders in the value chain to recycle and process low quality produce into a third product, for instance date jam or date seed coffee, would create jobs in local communities, reduce loss along the chain, and help in greening the local economy. If recycling is not possible, turning dates into feed or recycling in terms of fibre extraction would still reduce waste and generate value.

Rejected dates can also be used to produce compost and energy.

Lastly, as information on food loss in Morocco is almost inexistant, further research is necessary. Given the qualitative nature of this study, a quantitative one is also desirable to precisely measure the quantity lost and the recoverable percentage. It is recommended that the responsibility of data gathering on food loss should be delegated to a public entity such as the national bureau of statistics to collect data that feeds into policy design to reduce food loss and waste.

### B. Conclusions

This study takes the recommendations of the regional strategic framework for reducing food losses and waste in the Near East and North Africa region. In particular, it provides decision makers with the necessary information to cut food loss for dates and soft wheat, it promotes good practices along the entire value chain and helps policy development.

Reducing loss in dates and wheat helps at different levels: it saves natural resources such as water and land for other purposes, it helps farmers gain more income and, therefore, they can become more food secure, and creates potential for new industries and jobs that build on recovery and reuse of low quality goods. Cutting losses can also help limit the high dependency on foreign markets to meet domestic demand for soft wheat and dates,

which indirectly entails further losses during shipments from exporting countries to Moroccan ports. It is recommended that the Ministry of Agriculture integrate the recommendations listed in this study in its operational plans and mobilize resources to conduct further similar studies on other important commodities in the country.

In relation to the extent of food loss for soft wheat, the main supply chain stage of concern is the storage stage. Along this stage losses are estimated to reach 20 per cent as well as 5-7 per cent at the collector's storage. Ultimately, underground storage and storage in rooms seem to pose soft wheat loss hotspots primarily as a consequence of temperature and humidity issues as well as rodents and insects.

As for the socioeconomically important dates, the study shows that losses also mostly occur along production. With losses reaching 10-15 per cent, the main causes relate to moths, insects and bird attacks, deformed dates as well as to dates falling from palm trees.

To deal with losses in hotspots along the two value chains, the Ministry of Agriculture needs to initiate direct contact mainly with farmers who harvest and manage storage warehouses. This can be done through a well-trained team of extension workers who can highlight the previously mentioned reasons for losses and disseminate good practices that can minimize losses. In terms of soft wheat, the focus should be on enhancing small and medium farmers' warehouses, including construction and insulation techniques, cleaning and disinfecting methods, packaging materials, and ventilation requirements. For dates, however, the focus should be on the dissemination of proper harvesting techniques for the different varieties of dates, and protection from attacks by birds, moths and insects.

Even if this study was focused only on soft wheat, all the actors surveyed confirmed that the estimates on soft wheat losses and their causes are exactly the same for durum wheat. Therefore, the recommendations for reducing losses in soft wheat are also valid for durum wheat.

# Annex

---

## A. Guideline questions for problem-based semi-structured interview on soft wheat and date food loss in Morocco

Semi-structured interviews provide room for further personal contribution and understand what the participant perceives as important in regard to food loss.

The interviews were conducted according to the process of how the commodities move through their supply chain: with representatives of production, transportation, warehousing, sorting and packing, and trade. We asked how the participants depicted the causal chain of food loss in relation to their own work and responsibilities.

### Perceptions, Attitudes and Experiences

1. Is reducing wheat/dates losses an important issue for the actor/why?
2. If yes, since when?
3. Why?
4. What are the causes of wheat/dates losses in the business?
5. For each loss identified above, what are the processing or recovery methods used?
6. What are the losses initiated upstream and those that you know downstream? Who are the other players involved in these losses?
7. For each source of loss identified, what is the wheat loss in metric mt and/or in % of production?
8. Are there regular issues with product rejections by your customers? If yes, can you describe or assume what has led to the issue? Can you quantify the rejected product (over week, month, quarter)? What do you do with the rejected products?
9. To what extent are you facing issues to bring products to market which, in terms of size, shape, taste, deviate from the current market demand? If yes, what happens with the products that you could not bring to market?

### Possible Considered or Implemented Solutions

1. What are the economic losses generated for each type of loss and overall?
2. What measures are in place within your company/farm to reduce these losses?
3. What measures are in place within your company/farm to value these losses?
4. For each of these measures, can you describe the means implemented for this valuation and assess the economic results?
5. What other possible measures have been considered that are not being implemented or have been abandoned? Why?

6. What are the difficulties or obstacles to valuation? Why?
7. Who is involved in the treatment and reduction of these losses? Who decides how to deal with these losses? Who can influence this decision?
8. What are the non-economic constraints encountered in the management of these losses (technical, regulatory, organizational, commercial, sector problems, etc.)
9. What are the specifications and contracts that bind you with your customers and suppliers? What terms are likely to generate losses? How do you reduce these impacts?

### Motivations for Reducing Wheat/Date Loss

1. Is a reflection currently underway on this subject within your company? What motivates and does not motivate this reflection?
2. What reduction or valuation approaches are currently being conducted: prevention - optimization of processes - recovery in human food (co-products, promotions and donations) - recovery in animal feed - other recovery?
3. What is the economic impact of these losses? And that of their treatment or not treatment?
4. What are the reasons for the treatment currently practiced for wheat/dates losses and valuation?

### Perceptions of the Future

1. Do you think that the volumes of wheat/dates losses will increase, maintain or decrease in the coming years? Why?
2. How do you think the treatment of these losses will evolve in the years to come within your company/farm?
3. On which levels should we act as a priority to reduce losses or better value them?

## B. Matrix summarizing the data on losses for wheat

	Is reducing wheat losses an important issue	If yes, since when?	Why?	What is the wheat loss in %	What are the causes of losses	Recovery methods used	Other players involved in these losses	Regular issues with product rejections by your customers?	What do you do with the rejected products?	Measures are in place to reduce these losses	Measures are in place to value these losses	Recommended Measures to reduce losses
Storage at farm level	Yes 80%	Always, but more in recent years	+ Our religion advises us to avoid losses + Losses are lost money	+UGS 20% +Rooms 10 to 15% (large and medium farm)	+ Lack of ventilation, + Moisture infiltration, + Insect Attack + rodents (pollute grains)	Recovery in animal feed (UGS 10%, Rooms 5%)	No	+ Yes, % of humidity + 1000-grain weight	Decrease in price of about 20 to 30%	UGS with walls covered with plastic	Recovery in animal feed	+ Improve UGS + use of adequate chemicals for insect control
Storage at collectors' level	Yes 100%	Always	Impact negatively profits	5 to 7%	+ Poor storage conditions + No ventilation system, + No control of humidity at the start of storage, + Presence of insects and rodents + lack of information on storage techniques	resale as animal feed	+ Farmers + Transporters	+ Grain cleanliness level	Reduce the price	+ Use of chemicals for insects and rodents + avoid bulk storage	No	+ Improve the storage conditions + Adequate level if humidity at storage entry + Control of temperature + Organize trainings on storage

	Is reducing wheat losses an important issue	If yes, since when?	Why?	What is the wheat loss in %	What are the causes of losses	Recovery methods used	Other players involved in these losses	Regular issues with product rejections by your customers?	What do you do with the rejected products?	Measures are in place to reduce these losses	Measures are in place to value these losses	Recommended Measures to reduce losses
Storage at CAMs	Yes 100%	Always	Impact negatively profits	1 to 2%	+ Old buildings/silos/equipment, + Lack of maintenance of the ventilation system, + High humidity at the start of storage, + Presence of insects and rodents + Lack of staff	No	+ Farmers + Transporters	+ Yes, % of humidity + Grain cleanliness level + 1000-grain weight	lost	+ Use of chemicals for insects and rodents	No	+ Stabilize humidity; + Adequate level if humidity at storage entry + control of temperature
Storage at flour mills	Yes 100%	Always	Impact negatively profits	0,8 to 1%	+ Humidity variations, + Temperature increase, + Presence of insects and rodents + Mechanical transfers	No	+ CAMS + Farmers + Transporters	+ Yes, % of humidity + Grain cleanliness level + 1000-grain weight	lost	+ Stabilize humidity + Minimize mechanical transfers, + Reduce storage period (4 to 3 months)	No	+ Stabilize humidity + Minimize mechanical transfers, + Reduce storage period (4 to 3 months)

	Is reducing wheat losses an important issue	If yes, since when?	Why?	What is the wheat loss in %	What are the causes of losses	Recovery methods used	Other players involved in these losses	Regular issues with product rejections by your customers?	What do you do with the rejected products?	Measures are in place to reduce these losses	Measures are in place to value these losses	Recommended Measures to reduce losses
Storage at traders	Yes 100%	Always	Impact negatively profits	0,8 to 1%	Humidity variations, + +Temperature increase, + Presence of insects and rodents +Mechanical transfers	No	+ Transporters	+ Yes, % of humidity + Grain cleanliness level + 1000-grain weight	lost	+ Stabilize humidity + Minimize mechanical transfers, + Reduce storage period (4 to 3 Weeks)	No	+ Stabilize humidity + Minimize mechanical transfers, + Reduce storage period (4 to 3 months)
Storage at ports	Yes 100%	Always	Impact negatively profits	0,4 to 0,5%	Humidity variations, + +Temperature increase, + Presence of insects and rodents +Mechanical transfers	No	+ Labour and person handling the unloading and loading operation + Transporters	+ Yes, % of humidity + Grain cleanliness level + 1000-grain weight	lost	+ Stabilize humidity + Minimize mechanical transfers, + Reduce storage period (1 to 2 Weeks)	No	+ Stabilize humidity + Minimize mechanical transfers, + Reduce storage period (1 to 2 Weeks)
Transport	Yes 100%	Always	Relationship problem (sometimes suspicion of theft)	1 to 2%	+ Loading and unloading, + Piling and heating of the air surrounding the grains	No	+ Labour and person handling the unloading and loading operation	No	lost	no	No	Improvement of transport conditions by sensitizing producers and other marketing players on good practices.

	Is reducing wheat losses an important issue	If yes, since when?	Why?	What is the wheat loss in %	What are the causes of losses	Recovery methods used	Other players involved in these losses	Regular issues with product rejections by your customers?	What do you do with the rejected products?	Measures are in place to reduce these losses	Measures are in place to value these losses	Recommended Measures to reduce losses
Marketing (sale on the unorganized circuit)	Yes 100%	Always	Negative Impact on the income	5%	+ Multitude of intermediaries, markets (souks) not well equipped, + Lack of conservation units	No	farmers	no	Recovery in animal feed	no		Improvement of soft wheat storage conditions with traders. Sensitization of traders on stock management and grain quality preservation.



## C. Matrix summarizing the data on losses for dates

	Is reducing wheat losses an important issue	If yes, since when?	Why?	What is the date loss in %	What are the causes of losses	Recovery methods used	Other players involved in these losses	Regular issues with product rejections by your customers?	What do you do with the rejected products?	Measures are in place to reduce these losses	Measures are in place to value these losses	Recommended Measures to reduce losses
Farm level (traditional plantation)	Yes 60%	Recent years	+ Improve income + Losses are lost money	+ Unharvested dates 2% + Date falls 1% + Scalded or distorted dates 3% + Losses caused by birds 15% + Storage 15%	+ Harvest cost/sale price, height of palms + wind, + Attack by the corn borer 10% + Temperature and humidity control + Insects attacks + Lack of sorting	Recovery in animal feed	No	+ Clean and uninfected dates + Good packaging	Decrease in price of about 30 to 70%	Bagging of date bunches	No	+ Improve production techniques and promote adequate harvesting practices; + Do not leave harvested dates in the fields for a long time + Bagging of date bunches + Packaging of dates in presentable packaging + Reduce the share of bulk compared to packaged dates + Clean the storage areas at the end of the campaign + Treat dates in palm groves as soon as possible to eliminate insect larvae and eggs before they hatch. sorting The dates harvested must be processed by the in different categories of identical maturity and in homogeneous batches

	Is reducing wheat losses an important issue	If yes, since when?	Why?	What is the date loss in %	What are the causes of losses	Recovery methods used	Other players involved in these losses	Regular issues with product rejections by your customers?	What do you do with the rejected products?	Measures are in place to reduce these losses	Measures are in place to value these losses	Recommended Measures to reduce losses
Storage, refrigeration units	Yes 100%	Always	Impact negatively profits	2 to 3%	Absence of relative humidity regulators in cold rooms	No	+ Farmers	+ Yes, Clean and uninfected dates + Good packaging	lost	No	No	+ Equip the units with humidity regulators for a better control of humidity
Local marketing (souk)	Yes 10%	Always	Impact negatively profits	0,5% to 1%	Unclean point of sale (dust)	Picked up by people for resale as cattle feed	+ Farmers	+ Different varieties and quality of dates are purchased and categorized	No rejected product	No	No	improve the points of sale

# References

---

- Agricultural Credit of Morocco (2021). Retrieved from <https://www.fellah-trade.com/fr/filiere-vegetale/chiffres-cles-phoeniculture/>.
- ANDZOA (2021). Retrieved from <http://andzoa.ma/fr/contrats-programmes/filiere-du-palmier-dattier/contrat-programme/>.
- AFED (2014). *Food Security Challenges and Prospects* (pp. 9-10). Beirut: AFED. Retrieved from [https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/AFED\\_food\\_security.pdf](https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/AFED_food_security.pdf).
- Agriconsulting Maroc S.A (2015). *Rapport de l'étude sur le positionnement commercial des variétés de dattes marocaines* (2015).
- Alderman, H., Gentilini, U., and Yemtsov, R. (2018). *The 1.5 Billion People Question* (p. 113). Washington: World Bank Group. Retrieved from <http://www.indiaenvironmentportal.org.in/files/file/The%201.5%20Billion%20People%20Question.pdf#page=135>.
- ANP (2021). Retrieved from <https://www.anp.org.ma/fr/services/port/casablanca/page/PortActivites>.
- Bartali, E.H. (1998). Systèmes de stockage traditionnels « Matmoras » et « Sellas ». *Revue Hommes, Terres et Eaux*, pp. 16-22. Anafide.
- Betaprocess (2021). Betaprocess. The value-pyramid. Retrieved 24 November 2021 from <http://www.betaprocess.eu/the-value-pyramid.php>.
- Bishaw, Z., Yigezu, Y., Niane, A., Telleria, R. and Najjar, D. (2018). Political economy of the wheat sector in Morocco: seed systems, varietal adoption, and impacts. Beirut: International Center for Agricultural Research in the Dry Areas (ICARDA).
- Dahmali, S. (2001). Apport du SIG dans le secteur de stockage des céréales pour l'installation d'une unité de stockage (région Chaouia Ouardigha). Mémoire de troisième cycle de l'IAV Hassan II, option Génie Rural.
- DDFP, Direction de Développement des Filières de Production, Ministère de l'Agriculture.
- Eker, M. (2014). Interview with the Turkish Minister of Food Agriculture and Livestock Mehmet Mehdi Eker [In person].
- ESCWA (2021). Our Member States. Retrieved 31 October 2021 from <https://www.unescwa.org/about/member-states>.
- FNCL (2021). *Fédération Nationale des Négociants en Céréales et Légumineuses*. Retrieved 24 November 2021 from <https://www.fncl.ma/>.
- FAO (2009). Technical assistance for the cold storage needs for palm dates projects in Morocco. IOS Partners, Inc. USAID. Ministry of Agriculture. Rabat.
- \_\_\_\_\_ (2012a). Expert Consultation Meeting on Food Losses and Waste Reduction in the Near East Region: Towards a Regional Comprehensive Strategy. Sharm El Sheikh: FAO. Retrieved from <https://www.fao.org/3/i3218b/i3218b.pdf>.
- \_\_\_\_\_ (2012b). FAO Regional Conference for the Near East. FAO. Retrieved from <https://www.fao.org/3/md457E/md457E.pdf>.
- \_\_\_\_\_ (2015a). *Regional Overview of Food Insecurity Near - East and North Africa: Strengthening Regional Collaboration to Build Resilience for Food Security and Nutrition*, Cairo: FAO. Retrieved from <https://www.fao.org/3/i4644e/i4644e.pdf>.

- \_\_\_\_\_ (2015b). *Regional Strategic Framework Reducing Food Losses and Waste*. Cairo: FAO. Retrieved from <https://www.fao.org/3/i4545e/i4545e.pdf>.
- \_\_\_\_\_ (2019). *The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction*. (p. 7). Rome: FAO. Retrieved from <https://www.fao.org/3/ca6030en/ca6030en.pdf>.
- \_\_\_\_\_ (2021). *Food Loss and Food Waste*. FAO. Retrieved 31 October 2021 from <https://www.fao.org/food-loss-and-food-waste/flwdata/#:~:text=In%202011%2C%20FAO%20presented%20the,lost%20or%20wasted%20every%20year.&text=Target%2012.3%20of%20the%20Sustainable,the%20production%20and%20supply%20chains>.
- FAO Metadata of Indicator 12.3.1 Global Food Loss Index (p. 3). FAO. Retrieved from <https://www.fao.org/3/CA2593EN/ca2593en.pdf>.
- FAO Regional Implementation Plan of the NENA Soil Partnership: towards sustainable management of soil resources. FAO. Retrieved from <https://www.fao.org/3/bl105e/bl105e.pdf>.
- FNM (2021). *Fédération nationale de la minoterie*. Fnm.org.ma. Retrieved 24 November 2021 from <http://www.fnm.org.ma/>.
- Gustavsson, J., Cederberg, C., and Sonesson, U. (2011). *Global food losses and food waste— Extent, causes and prevention*. Retrieved from <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>.
- Harrak, H. and Boujnah, M. (2012). *Valorisation technologique des dattes au Maroc*. Editions INRA, 157 pages.
- Lundqvist, J., de Fraiture, C., and Molden, D. (2008). *Saving Water: From Field to Fork – Curbing Losses and Wastage in the Food Chain* (p. 5). Stockholm International Water Institute. Retrieved from [https://www.siwi.org/wp-content/uploads/2015/09/PB\\_From\\_Filed\\_to\\_fork\\_2008.pdf](https://www.siwi.org/wp-content/uploads/2015/09/PB_From_Filed_to_fork_2008.pdf).
- OECD and FAO (2014). *OECD-FAO Agricultural Outlook 2014*. OECD. Retrieved from [http://dx.doi.org/10.1787/agr\\_outlook-2014-en](http://dx.doi.org/10.1787/agr_outlook-2014-en).
- Oneissi, F. (2014). Food Waste in Lebanon: some interesting initiatives to tackle it. *Watch Letter*, 30, 61-63. Retrieved 20 October 2021, from [https://www.ciheam.org/publications/50/WL\\_30.pdf](https://www.ciheam.org/publications/50/WL_30.pdf).
- ONICL (2015). Filière focus: Marché des céréales \_ campagne 2014-2015 Commercialisation des céréales et des légumineuses au Maroc. Bulletin d'information No.1/2015.
- \_\_\_\_\_ (2020). *Fiche relative a la capacité de stockage détenue par les organismes stockeurs février 2020*.
- \_\_\_\_\_ (2021). ONICL. Retrieved 24 November 2021 from <http://www.onicl.org.ma/>.
- \_\_\_\_\_ (2021). *Circulaire relative à la commercialisation-des céréales et des légumineuses de la récolte 2021*. No. 4/DC-DCML 2021.
- \_\_\_\_\_ (2021). *Circular relating to the flat-rate premium for common wheat any period from November 2021 to 30 April 2022*. No. 6/ONICL/OC-DCML-DA 2021.
- Razzaz, S., Konandreas, P., Nejdawi, R., Al-Hamdi, M., Sedik, D., and Ahmed, M. (2017). *Arab Horizon 2030: Prospects for Enhancing Food Security in the Arab Region*. Beirut: FAO. Retrieved from [https://www.fao.org/fileadmin/user\\_upload/rne/docs/arab-horizon-2030-prospects-enhancing-food-security-summary-english.pdf](https://www.fao.org/fileadmin/user_upload/rne/docs/arab-horizon-2030-prospects-enhancing-food-security-summary-english.pdf).
- Recycling.com (2021). *Waste Hierarchy: Step Up and Go Green*. Recycling.com. Retrieved 12 October 2021 from <https://www.recycling.com/downloads/waste-hierarchy-lansinks-ladder/>.
- Reiling, J. (2021). Ansoff Matrix Model: Explanation, Advantages, and Disadvantages | The Strategic Project Manager. [online] The Strategic Project Manager | Just another WordPress site. Retrieved from <https://bethestrategiccpm.com/ansoff-matrix-model-explanation-advantages-and-disadvantages/>.
- Stuart, T. (2009). *Waste: Uncovering the global food scandal*. New York, NY: W.W. Norton and Company.

- The World Bank (2010). *Egypt's food subsidies: benefit incidence and leakages* (p. 8). The World Bank. Retrieved from <https://openknowledge.worldbank.org/bitstream/handle/10986/2913/574460ESW0P12210disclosed0101211101.pdf?sequence=1&isAllowed=y>.
- Terre-net 2020. Retrieved from <https://www.terre-net.fr/marche-agricole/actualite-marche-agricole/article/comprendre-le-marche-marocain-en-7-points-cles-1395-167353.html>.
- United Nations Environment Programme (2021). *Food Waste Index Report* (p. 70). Nairobi: United Nations Environment Programme. Retrieved from <https://wedocs.unep.org/bitstream/handle/20.500.11822/35280/FoodWaste.pdf>.
- Venkat, K. (2012). The Climate Change and Economic Impacts of Food Waste in the United States. *International Journal on Foodsystem Dynamics*, 2(4), 431-440. Retrieved 15 October 2021 from [https://www.researchgate.net/publication/267557944\\_The\\_Climate\\_Change\\_and\\_Economic\\_Impacts\\_of\\_Food\\_Waste\\_in\\_the\\_United\\_States/link/546daa850cf26e95bc3cc2fa/download](https://www.researchgate.net/publication/267557944_The_Climate_Change_and_Economic_Impacts_of_Food_Waste_in_the_United_States/link/546daa850cf26e95bc3cc2fa/download).

