

## WATER, WHEAT, AND WAR NEXUS

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***Abstract** The purpose of this study is to analyse the nexus between water, wheat and war in Egypt. Currently, the obstructed diffusion of the wheat market in Egypt prevents it from acquiring its fair share among other countries in terms of production versus its consumption. Water and Wheat self-sufficiency, on the other hand, looks to be a pipe dream that will take a long time to materialise. The study presents the market volume, share, and segments locally in the global market lighting. Then, outline the supply and demand factors while measuring the price elasticity of its supply and demand curve. To ensure a comprehensive contextual analysis, the paper will use the top-bottom analysis approach. This framework helps to discover the primary factors causing the problems faced by the research at hand. This resulted in detecting the regulations, tactics, moves, and facilities provided to the wheat sector by the Egyptian Government while taking into consideration the global impact of the Russian –Ukraine War.*

**Keywords:** Sustainability, Water Scarcity, Population Growth, Health, Socio-Economic

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## **Introduction**

Food security is in the heart of Egypt's 2030 Vision as a national security issue and we are working on expanding agricultural land, reducing imports, and adapting to climate change, Minister of Agriculture Assayed al-Qasir said (Today, 2022). Wheat is the main food and the first cereal crop in Egypt where its grains are used as food for humans, and straw is used as fodder for animals. The average consumption is about 145 kg per capita per year, which is considered the highest in the world (The Conversation, 2022).

When urbanization takes place, externalities such as decreased water availability and drainage tend to affect yields in adjacent fields. The wheat policy is a priority for the Egyptian government. So, the government has taken measures to increase wheat production and support producers by encouraging farmers to cultivate wheat and buying wheat from the farmers at a high price. Recently, a great deal of attention has been directed toward increasing wheat productivity per unit of land, especially in newly reclaimed soils, to minimize the gap between Egyptian production and consumption (AlMonitor, 2022).

Egypt lies in a dry region of the world and management of water resources in dry areas is necessary to maintain the limited quantities of water available in these areas and to achieve an appropriate level of development, food security and stability (El-Marsafawy & Mohamed, 2021). From a water resources waste point of view, it was explained that the water resources waste due to wheat crop waste and losses are considerably high (6.0 billion m<sup>3</sup> due to the total wastage from the wheat crop available for consumption in Egypt), therefore, Egypt as a country facing water stress needs to adopt a water waste and losses reduction strategy that can partially alleviate their water scarcity problem (ElFetyany, Kamal, Helmy, & Nasr, 2021).

The concept of sustainable food systems is gaining prominence in recent years, aiming to “ensure food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition of future generations are not compromised” (Catharien Terwisscha van Scheltinga, 2021). Water plays an important role in the food system. Water quantity and quality are considered environmental drivers in the food system approach, of particular relevance in water-scarce areas (Catharien Terwisscha van Scheltinga, 2021). Water is present in the entire food value chain, from food production to processing and consumption (Catharien Terwisscha van Scheltinga, 2021). Many countries are net food importers using food subsidy systems, as water resources do not allow national food self-sufficiency (Catharien Terwisscha van Scheltinga, 2021).

As this leaves countries in a position of dependency on international markets, prices and export bans, it is imperative that every domestic drop of water is used efficiently (Catharien Terwisscha van Scheltinga, 2021). Arid and semi-arid countries are particularly sensitive to increasing population rates in connection with (lack of) economic growth, but also to droughts and climate changelike Egypt where subsidies have become embedded as a citizen's right and are therefore strongly linked to the legitimacy of a ruling regime (Catharien Terwisscha van Scheltinga, 2021).

Egypt has experienced several food crises, including a severe one in 2008 when drought and wildfires forced Russia to impose a wheat export ban, leaving major client Egypt to buy elsewhere at sharply rising prices and this shows how sensitive the issue of food self-sufficiency (Catharien Terwisscha van Scheltinga, 2021). In the context of population growth, the aspiration of Egypt to become a more self-sufficient country in the future, by expanding agricultural lands or by increasing water efficiency, will be challenged by the fact that water availability is difficult to increase in the future and Smart water allocation decisions are required (Catharien Terwisscha van Scheltinga, 2021).

The research conducted relies mainly on a desk study of a literature review including, reports and journal articles and studies to assessing the study objectives.

## 1 **Literature Review**

2 The wheat industry can be identified as a perfectly competitive market where  
3 it has many sellers and producers. As there are many producers in the wheat  
4 market, one wheat producer cannot influence the market price of wheat. While  
5 another point of view see that the wheat market does not show market leader  
6 characteristics and can better be described as a more complex oligopoly  
7 dominated by the main producers with main dominance between the United  
8 States, Canada, and Australia, where price leadership is provided by the United  
9 States.

10 Wheat policy in Egypt has been gradually reformed from one of massive  
11 government intervention to a much more market-oriented one , Nevertheless,  
12 food security concerns and the concern for an excessive dependency on  
13 imports mean that the GOE does continue to intervene in several markets,  
14 including the wheat markebut policy makers try to look ahead to design new  
15 policies which aim to achieve greater food security (Croppenstedt, 2007).

16 Water, energy and food are essential for human well-being, poverty reduction  
17 and sustainable development (Olivier Dubois, 2014). Global projections

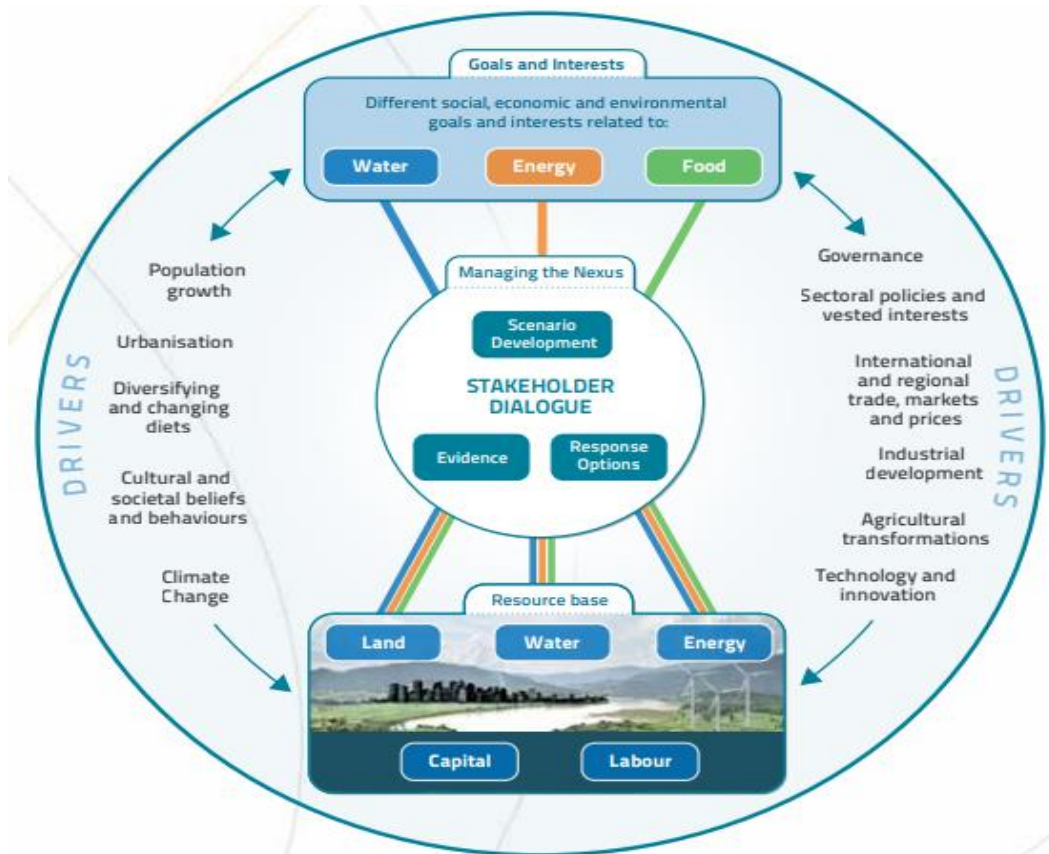
18 indicate that demand for freshwater, energy and food will increase significantly  
19 over the next decades under the pressure of population growth and mobility,  
20 economic development, international trade, urbanisation, diversifying diets,  
21 cultural and technological changes, and climate change (Olivier Dubois, 2014).  
22 Agriculture accounts for 30% of the global energy consumption and 92% of  
23 the total global water consumption [Monforti-Ferrario and Pascua, 2015]  
24 [Hoekstra et al., 2012].

25 The WEF model integrates system dynamics modeling and water, energy and  
26 food nexus in one single model it simulates the nexus of the dynamics of  
27 Egypt's consumption and production of agricultural products, and the water  
28 and energy use for agricultural production and their compounding effects on  
29 Egypt's food gap as a difference between the consumption of agricultural  
30 products and production at the domestic supply chain which is currently  
31 supplied from import. (Ali, 2019). The food gap translates into water and  
32 energy quantities by estimating and analyzing the water and energy use in  
33 agricultural production for a historical period to indicate the required water and  
34 energy to produce the food gap domestically and this approach aims to bridge  
35 a current gap between water and energy managers and policymakers (Ali,  
36 2019).

37 The advantage of using dynamic modeling in the WEF model is that it  
38 acknowledges the complexity between agricultural production and  
39 consumption, and incorporates it under one model (Ali, 2019). The food gap  
40 is the difference between the consumption of agricultural products and  
41 production at the domestic supply chain (Ali, 2019). This approach allows  
42 investigating the interdependencies between food-water and food-energy and  
43 it bridges an important gap between the food, water, energy resources  
44 managers and policymakers (Ali, 2019). It presents a conceptual approach to  
45 better understand and systematically analyse the interactions between the  
46 natural environment and human activities, and to work towards a more  
47 coordinated management and use of natural resources across sectors and scales  
48 (Olivier Dubois, 2014). This can help us to identify and manage trade-offs and  
49 to build synergies through our responses, allowing for more integrated and  
50 cost-effective planning, decision-making, implementation, monitoring and  
51 evaluation (Olivier Dubois, 2014).

52 A recurring criticism of the Water-Energy-Food Nexus is that it adds relatively  
53 little to already existing integrated approaches to resources management, such  
54 as the integrated landscape approach or integrated water resources  
55 management (IWRM) (Olivier Dubois, 2014). However, The Nexus approach

56 considers the different dimensions of water, energy, and food equally and  
 57 recognizes the interdependencies of different resource uses to develop  
 58 sustainably (Olivier Dubois, 2014).



59

60

**Figure 1 FAO approach to the Water-Energy-Food Nexus**

61 Interactions take place within the context of globally relevant drivers, such as  
 62 demographic changes, urbanisation, industrial development, agricultural  
 63 modernisation, international and regional trade, markets and prices,  
 64 technological advancements, diversification and changes of diets, and climate  
 65 change as well as more context-specific drivers, like governance structures  
 66 and processes, cultural and societal beliefs and behaviour (Olivier Dubois,  
 67 2014). Here we will apply FAO approach to Water-Energy- Food Nexus  
 68 on the Egyptian Context through approaching the factors of Supply and factors  
 69 of demand on the wheat as a main and strategic food in Egypt.

70

## 71 **Global Wheat Market**

72 The Egyptian domestic market is not in isolation from the global one which is  
73 considered a vital source to sustain and meet the local consumption baseline.  
74 Consequently, the Russian –Ukrainian War was having a mediating impact on  
75 the Egyptian Wheat market. For 2021/22, global wheat production is up by 0.3  
76 million metric tons (MT) to 778.8 million as production is revised up for  
77 Argentina (+0.5 million MT to 21.0 million) and Pakistan (+0.5 million to 27.5  
78 million) and is partially offset with a reduction to the European Union (-0.6  
79 million MT to 138.4 million) (Andrew Sowell, 2022).

80

81 Total wheat consumption is forecast up by 2.7 million MT to 788.1 million  
82 (Andrew Sowell, 2022).

83 The USDA has scaled down its estimate for global wheat consumption for MY  
84 2021-22 to 787.1 million mt, down 2.5 million mt from 789.6 million mt seen  
85 earlier (Nandy, 2021). In 2017/18, the global per capita food use of wheat stood  
86 at 66.9 kilograms per year (Shahbandeh, 2020).

## 87 ***Wheat Prices Globally and in Egypt***

88 Despite additional consumption demand, both July/June trade year (TY)  
89 imports and TY exports are lowered as global wheat prices continue to remain  
90 elevated and the trade pace is slower than anticipated (Andrew Sowell, 2022).  
91 Rising global wheat prices hit a 10-year high at US\$523 per ton on March 7  
92 (The Conversation, 2022). Ukraine and Russia account for about 30 per cent  
93 of the world's traded wheat and still have crops from last year to ship. "There  
94 is no end in sight to the upswing because 30 per cent of the world's wheat  
95 exports have been cut off from the global market," said Carsten Fritsch, an  
96 analyst at Commerzbank (Terazono & Pooler, 2022). Ukraine Invasion  
97 Threatens Global Wheat Supply where Russia and Ukraine together supply  
98 more than a quarter of the world's wheat and coming disruptions could fuel  
99 higher food prices and social unrest (Swanson, 2022).

## 100 ***Wheat In Egypt***

101 Wheat occupies about 33% of the total winter crop area in Egypt and is the  
102 major staple crop, consumed mainly as bread (Sharaf, 2008). More than one-  
103 third of the daily caloric intake of Egyptian consumers and 45% of their total  
104 daily protein consumption is derived from wheat (Sharaf, 2008). The fragile  
105 state of Egypt's food security stems from the agricultural sector's inability to  
106 produce enough cereal grains, especially wheat, and oilseeds to meet even half  
107 of the country's domestic demand (Tanchum, 2022). Cairo relies on large

108 volumes of heavily subsidized imports to ensure sufficient as well as affordable  
109 supplies of bread and vegetable oil for its 105 million citizens. Securing those  
110 supplies has led Egypt to become the world's largest importer of wheat  
111 (Tanchum, 2022). In 2021, Cairo was already facing down food inflation levels  
112 not seen since the Arab Spring civil (Tanchum, 2022).

113 Egypt's massive wheat imports are driven by the widespread consumption of  
114 the traditional round flatbread known as eish baladi (Tanchum, 2022).  
115 Egyptians consume 150-180 kilograms of bread per capita, more than double  
116 the global average of 70-80 kg (Tanchum, 2022). Keeping the price of Egypt's  
117 staple food affordable has been the bedrock of regime stability since the Free  
118 Officers revolution brought then-President Gamal Abdel Nasser to power 60  
119 years ago, then Nasser's successor acceded to World Bank and International  
120 Monetary Fund (IMF)-mandated subsidy cuts on wheat flour, cooking oil, and  
121 other staples, it triggered Egypt's infamous 1977 "bread riots" (Tanchum,  
122 2022). Now Egypt again is facing a severe wheat shortfall amid soaring prices  
123 (Tanchum, 2022). According to estimates from the United States Department  
124 of Agriculture (USDA), Egypt's wheat production in marketing year (MY)  
125 2021/22 will reach 9.0 million metric tons (MMT) while its consumption will  
126 total 21.3 MMT, leaving a 12.3 MMT shortfall to be made up with imports  
127 (Tanchum, 2022). Even prior to Russia's invasion of Ukraine, the prices for  
128 those imports were at record levels (Tanchum, 2022).

129 As detailed in a previous Middle East Institute publication, the global average  
130 price for cereal grains increased 27.3% in September 2021 compared to  
131 September of the previous year and since then it has continued to climb at an  
132 even faster rate (Tanchum, 2022). The price of soft wheat used in bread  
133 manufacture stood at \$271 per ton at the end of the third quarter of 2021, a  
134 22% year-on-year increase (Tanchum, 2022).

### 135 ***Egypt's Local Production & Imports***

136 FAS Cairo (Post) forecasts Egypt's wheat production in the marketing year  
137 (MY) 2022/23 (July – June) to reach 9.8 million metric tons (MMT), up by  
138 8.9 percent compared to 9 MMT in MY 2021/22 (USDA, 2022). In 2022  
139 cultivated area of wheat has reached about 3.6 million acres, with more than  
140 10 million tons of production (Egypt Today, 2022).

141 Post attributes the rise to an increase in total area harvested which is set to  
142 come in at 1.53 million hectares (HA) compared to 1.4 million HA the  
143 previous year (USDA, 2022). The latest US Department of Agriculture  
144 forecast (March 28, 2022) suggests that Egypt's imports in 2022 will be down

145 by 8.3% i.e., by around 1 million tones, which is more than one month of the  
146 consumer under the Egyptian Bread Subsidy Program (eric-schroeder, 2022).

Market Year	Imports	Unit of Measure	Growth Rate
2018	12354	(1000 MT)	-0.43%
2019	12811	(1000 MT)	3.70%
2020	12149	(1000 MT)	-5.17%
2021	12000	(1000 MT)	-1.23%
2022	11000	(1000 MT)	-8.33%

147

Figure 1 Egypt Wheats Import YOY (indexmundi.com, 2022)

### 148 *Egypt's Wheat Industry*

149 There are two main sources of wheat in Egypt Domestic wheat & imported  
150 wheat. Egypt produces half of the 20 million tons of wheat that it consumes  
151 with irrigation and imports the other half (Senthold Asseng, 2018). Egypt is  
152 also the world's largest importer of wheat. The population of Egypt is  
153 currently growing at 1.9% - 2.2% annually, and projections indicate that the  
154 demand for wheat will triple by the end of the century (Senthold Asseng, 2018).  
155 In Egypt, the wheat season for the supply of local wheat took place in April  
156 2022.

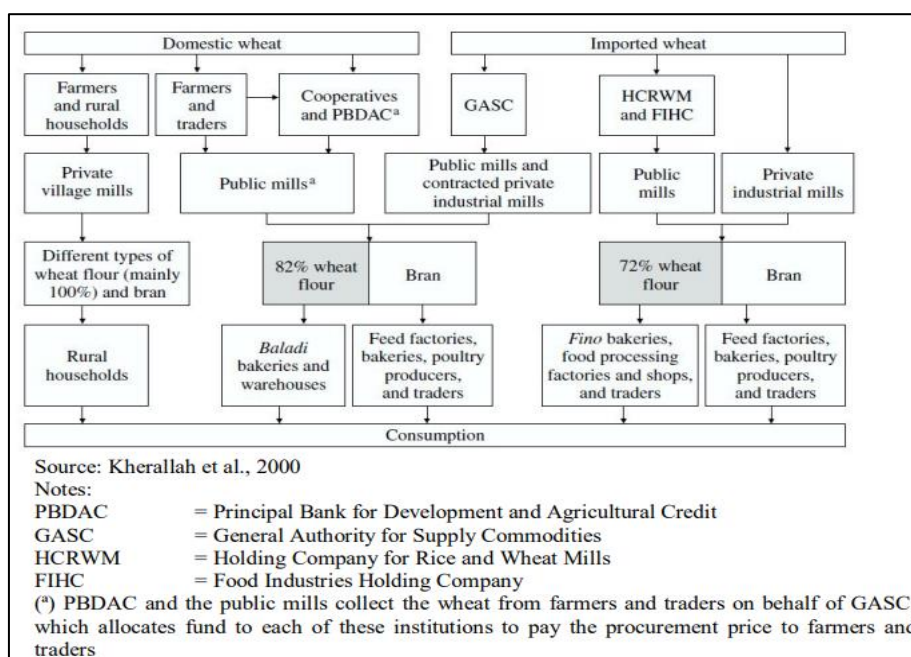
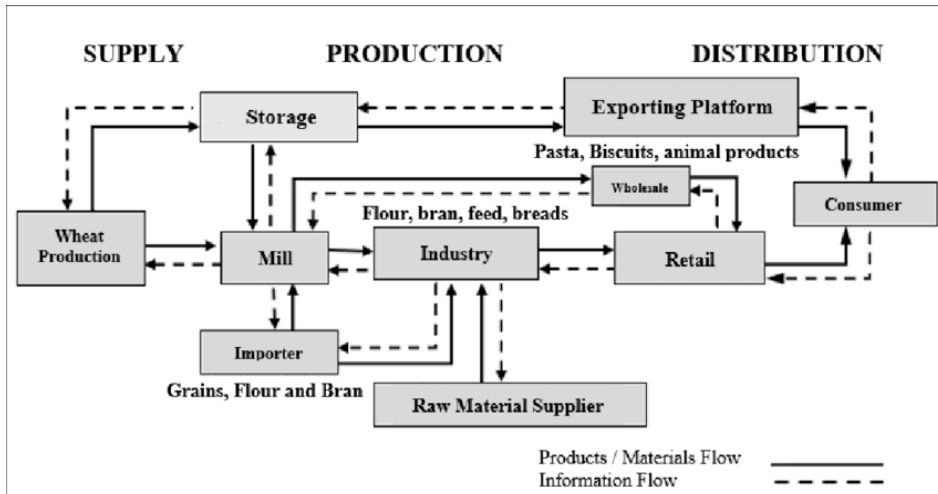
157  
158

Figure 2 Structure & Marketing Channels for wheat sector (ElAsraag, 2015)



159

160 The domestic wheat industry provides an important contribution to  
 161 employment and value-added in the agrifood sector (AGRIS, 2015).



162  
 163 **Figure 3 -Wheat Supply Chain Source (Oliveira, Araújo, & Silva, 2020)**

164 At the same time, assuring access to this important staple food by all Egyptian  
 165 citizens, a quarter of whom live under the poverty line, has also been a central  
 166 aspect of the country's social policies (AGRIS, 2015). The strategic  
 167 importance of the wheat sector has resulted in a strong involvement of the State  
 168 at all levels of the wheat value chain (FAO & European Bank, 2015). The  
 169 private grain trading and storage enterprises lack representation through  
 170 existing industry chambers, which limits effective dialogue between the  
 171 private sector and the government (FAO & European Bank, 2015).

172 It is critical to address these barriers to the more active involvement of the  
 173 private sector if a more sustainable and efficient wheat sector is to emerge in  
 174 Egypt (FAO & European Bank, 2015). Private industry became a major player  
 175 in the wheat market in Egypt during the past five years, gaining more market  
 176 share every year in the wheat trade. Wheat has many substitutes like quinoa,  
 177 Corn flour, millet..etc. and for manufacturers, food and industrial scientists,  
 178 the malleability and unstable identity of wheat is what they value about it  
 179 (Jennifer Atchison, 2009). It is easy to hide (Jennifer Atchison, 2009). Its  
 180 capacity to be broken down as different constituent parts, and recrafted into  
 181 other things is fundamental (Jennifer Atchison, 2009).

182 Egypt's Agriculture Market Overview

183 Agriculture in Egypt market is projected to grow at a CAGR of 3.2% during  
 184 the forecast period (2022-2027) (Mordor Intelligence , 2022). During the

185 pandemic, agriculture stood out to be the most resilient sector (CLEMENS  
186 BREISINGER, 2020). Impacts on Egypt's agri-food system were less severe  
187 than elsewhere in the economy and most damages were in nonfarm  
188 components of the agri-food system due to falling consumer demand (Mordor  
189 Intellegence , 2022). The government made investments and reforms in the  
190 food system in Egypt, with the country's food sector managing to address the  
191 effects of the coronavirus (COVID-19) pandemic (Mordor Intellegence ,  
192 2022).

193 Agriculture is a major component of the Egyptian economy, contributing 11.3  
194 percent of the country's gross domestic product (USAID, Middle East , Egypt,  
195 2022). The agricultural sector accounts for 28 percent of all jobs, and over 55  
196 percent of employment in Upper Egypt is agriculture-related (USAID, Middle  
197 East , Egypt, 2022). Egypt's agriculture sector is dominated by small farms  
198 using traditional practices that do not meet international standards (USAID,  
199 Middle East , Egypt, 2022).

200 Egypt aims to increase the gross domestic product (GDP) contribution of its  
201 agriculture sector to 12 percent by 2024, in addition to increasing agricultural  
202 production by 30 percent by 2024, according to the Minister of Planning and  
203 Economic Development (Egypt Today Staff, 2021). An increasing number of  
204 projects to ensure food security, government initiatives to boost domestic  
205 production, and focus on sustainable and green farming are the factors driving  
206 the market (Mordor Intellegence , 2022).

207 The Ministry of Agriculture and Land Reclamation (MALR) lead the 2020 to  
208 2023 Agricultural Innovation Project (AIP) (Mordor Intellegence , 2022). The  
209 initiative aims to promote innovations in technologies to improve several  
210 issues in agriculture such as inefficient farming techniques that lower farm  
211 output and food production, poor post-harvest facilities, and marketing  
212 infrastructure (Mordor Intellegence , 2022). The focus on creating innovative  
213 solutions would increase income for small-scale farmers in the country  
214 (Mordor Intellegence , 2022).Some of the major crops grown in Egypt include  
215 Sugrabeet, Sugarcane, Wheat, Maize, Rice, Tomato, Potato, Onion, Orange,  
216 Grapes, and Dates among others (Mordor Intellegence , 2022).

217

### 218 *Egypt's Wheat Key Market Trends*

219 Agriculture is a vital component of the Egyptian economy. The government  
220 has increased its support for the development of the agricultural sector by  
221 launching several campaigns and initiatives.

222 - *Shari:*

223 As part of the International Fund for Agricultural Development (IFAD's) rapid  
224 response during the pandemic, under the PRIDE project, the Egyptian  
225 government developed an e-marketing platform called "SHARI" which  
226 allowed smallholder farmers to market and sell their products online to reduce  
227 the risks of exposure and also secure markets for them in case of lockdown and  
228 movement restrictions (Samar Samir, 2021).

229 *1. Digital Platforms:*

230 The government also aims to introduce new solutions such as market linkages  
231 for smallholders that are fostered by improving their competitiveness in the  
232 value chain, facilitating roundtables, and developing out-grower schemes and  
233 public-private partnerships, etc. to boost production. For instance, in 2019, the  
234 Food and Agriculture Organization (FAO) and the Egyptian government  
235 launched a program to enhance agricultural productivity through digital  
236 technology (FAO- News Egypt, 2019). Implementation of digital technology  
237 helps farmers access information to better manage crops and livestock and thus  
238 help them make better agricultural decisions (FAO- News Egypt, 2019).

239 *2. Mobile Irrigation Application:*

240 New app allows Egypt's farmers to save water, boost crops through Mobile  
241 Irrigation Application (REUTER, 2021). The system, developed by the  
242 Ministry of Water Resources and Irrigation and Cairo's MSA University, uses  
243 a sensor buried in the soil to measure moisture levels and a transmitter to send  
244 the data to the user, who accesses it through a mobile app (REUTER, 2021).

245 *3. Regional Trainings & Rural Agribusiness Strengthening program*

246 Further, the government launched a campaign to boost wheat production in  
247 2017 with the main objective of increasing grain crop productivity per unit area  
248 (Feddans) by 15% in three years (2015-2017), to increase grain crop  
249 productivity by 18.5 ardebs per acre to about 20 ardebs per Feddans, thus  
250 increasing the total production (Mordor Intellegence , 2022).

251 Meanwhile to build capacity in the private sector, USAID established a  
252 regional training center to increase and improve the productivity of farmers,  
253 Labour's, packhouse managers, and buyers (Mordor Intellegence , 2022). This  
254 program contributes to rural income growth, poverty reduction, food security,  
255 and nutrition in Egypt (USAID, Middle East , Egypt, 2022). This is further  
256 likely to strengthen the importance of agriculture in Egypt (USAID, Middle  
257 East , Egypt, 2022).

258 4. *Horizontal Expansion*

259 In 2022, almost 240 feddans have been added to the wheat-cultivating plot in  
260 Egypt as a result of expansion, consequently wheat is grown on 3.6 Million  
261 feddans across the country, which will increase the grain supply to silos and  
262 storages to more than 10 million tons (AbdeulKarim, 2022). The Egyptian  
263 government has completed recent studies that it conducted to identify the  
264 obstacles to cultivating the wheat crop, which Egypt needs in huge quantities  
265 during the coming summer, as part of a state plan to add 1.5 million acres of  
266 new wheat within 3 years, by encouraging its cultivation and reclamation of  
267 new quantities of land and cultivation in quantities of wheat (Sky News Arabia,  
268 2022).

269 5. *Vertical Expansion*

270 The government is applying policies aimed to expand wheat cultivation and  
271 raise productivity per feddan [1.04 acres] within the scope of Egypt's Vision  
272 2030. These policies have already begun to bear fruit, as the area planted with  
273 wheat increased by 260,000 feddans [270,000 acres] this year to reach  
274 3,654,000 feddans [3.8 million acres] (AlMonitor, 2022). This vertical  
275 expansion by maximizing productivity per feddan using new varieties of wheat  
276 (22 types) with high productivity and disease resistance, in addition to an  
277 increase in productivity per acre by using and developing new varieties that  
278 are resistant to drought, insects, and salinity" (AlMonitor, 2022).

279 Egypt has 3 million and 600,000 acres, and that the productivity of these lands  
280 can be increased, by paying attention to developing new strains, and  
281 maintaining the health of leaves and plants, especially during the month of  
282 March and April, when the plant is exposed to diseases such as yellow rust  
283 (Akhbar ElYoum, 2022). It is also mentioned nessecary of using good  
284 fertilizers, taking into account irrigation dates, while not using nitrogen  
285 fertilizers after the stage of subtracting the ears, while planting new varieties  
286 of wheat strains, especially disease-resistant and higher productivity, to  
287 increase the average production acre in Egypt (Akhbar ElYoum, 2022).Egypt's  
288 total quantities exported from the agricultural sector recorded about 3.971  
289 million metric tons during the period from September 2020 to June 2021,  
290 compared to 3.755 million metric tons during the same period from 2019/2020,  
291 with a growth of 5.7 per cent (Mordor Intellegence , 2022).

292 The country's "Sustainable Development Strategy toward 2030" focuses on  
293 increasing self-sufficiency concerning agricultural products to make the most  
294 of the water and land resources sustainably (AlMonitor, 2022). Thereby  
295 creating additional demand for Egyptian produce. Most of Egypt's exports are

296 destined for the EU, Russia, North Africa, and the Middle East (AlMonitor,  
297 2022).

### 298 **Egypt's wheat Market Segmentation**

299 Multi-market models fall short of the complexity of GCSEs but do include  
300 direct and indirect effects in a small number of markets (Sadoulet & De  
301 Janvry, 1995). In that sense, they are an improvement over single market  
302 partial equilibrium analysis (Sadoulet & De Janvry, 1995). They typically  
303 consist of a producer and consumer core and allow for the analysis of the  
304 impact of price and non-price policies on production, factor use, prices (for  
305 non-tradable), incomes, consumption, government revenues and expenditures  
306 and balance of trade (Sadoulet & De Janvry, 1995).

307 The analysis focuses on those markets which are assumed to be strongly  
308 interlinked, either on the demand or the supply side (Sadoulet & De Janvry,  
309 1995). Prices in those markets included in the analysis are endogenous  
310 (Sadoulet & De Janvry, 1995). The bias in estimating welfare changes as a  
311 result of policy reforms is diminished but remains. It follows that multi-market  
312 (Sadoulet & De Janvry, 1995).

### 313 **Egypt's Wheat Consumption**

314 FAS Cairo forecasts Egypt's wheat consumption in MY 2022/23 at 20 MMT,  
315 down by 2.43 percent from the MY 2021/22 estimate of 20.5 MMT. Post  
316 attributes the decrease to a 2.6 percent decrease in food, seed, and industrial  
317 use (FSI) consumption. The decrease in FSI wheat consumption is attributed  
318 to an increase in the price of European and white flat bread (non-subsidized)  
319 (USDA, 2022). Consumption in 2021-22 is put at 21.3 million tonnes, up from  
320 20.8 million estimated in 2020-21 (Lyddon, 2021). The report gives the reason  
321 as increasing population, currently 102 million and expected to reach 119.8  
322 million by 2030 (Lyddon, 2021). According to the Egyptian Ministry of  
323 Supply, domestic wheat production reached 9 million tons last year which was  
324 8.9 million tons the year before (BBM, 2022).

325 It is certain that in a country the size of Egypt, which is quite dependent on  
326 wheat products, domestic production cannot be sufficient, resulting in huge  
327 investments in wheat imports. It is estimated that Egypt's wheat imports for  
328 2021 reached 13 million tons (BBM, 2022). In 2020, this figure was 12.5  
329 million tons. Russia is the main wheat supplier to Egypt. Another top client for  
330 Russia is Turkey (BBM, 2022).. Turkey and Egypt generally race to the top in  
331 Russia's wheat export (BBM, 2022). In addition to imports made directly by  
332 the private sector, wheat imported by Egypt is purchased through tenders

333 opened by the General Authority for Supply Commodities (GASC) which  
334 works under the Ministry of Supply and Internal Trade (BBM, 2022).

335 Wheat is imported from different countries, especially Russia, Romania, and  
336 Ukraine. On the other hand, while the Egyptian government is trying to reduce  
337 imports by regaining agricultural lands and increasing domestic production, it  
338 also plans to allocate an additional 4 million hectares for wheat cultivation in  
339 the next 3 years (BBM, 2022). The government is also increasing strategic  
340 storage capacity with the National Project of Grain Silos (BBM, 2022). The  
341 project aims to build new silos with a storage capacity of 1.5 million tons in 17  
342 cities across Egypt (BBM, 2022). As a result, the total storage capacity of the  
343 silos in Egypt will reach approximately 3.6 million tons (BBM, 2022).

344 During the 2021 wheat procurement season, running from 15 April to 15 July,  
345 the Ministry of Supply and Internal Trade purchased about 3.428 million  
346 tonnes of local wheat, lagging the target of 3.6 million tonnes, and slightly less  
347 than 3.483 million tonnes purchased in 2020 (GIEWS Country Brief: Egypt ,  
348 2021). Depending on quality and moisture levels, the 2021 procurement prices  
349 ranged from EGP 705 to EGP 725 per ardeb (150 kg, corresponding to USD  
350 298 to USD 307 per tonne), up from EGP 670 to EGP 700 (USD 284 to USD  
351 297 per tonne) in 2020 (GIEWS Country Brief: Egypt , 2021).

352 The procurement prices are derived from a moving average of prices paid for  
353 imported wheat in the previous two months (GIEWS Country Brief: Egypt ,  
354 2021).The government aims to increase the country's self-sufficiency from  
355 about 50 percent in 2020 to 65 percent in 2025 (GIEWS Country Brief: Egypt  
356 , 2021). While increases in planted area (from 3.4 to 3.7 million feddans) as  
357 well as increases in average yields (from 2.7 to 3 tonnes per feddan) using  
358 improved seeds and better cropping practices are foreseen, a crucial part rests  
359 on lowering average per capita consumption from over 180 kg to 150 kg. In  
360 2020, the weight of a subsidized bread was unified from 100 to 110 grams to  
361 90 grams, resulting in a decline of wheat used for production of subsidized  
362 bread from 9.6 million to 8.76 million tonnes (GIEWS Country Brief: Egypt ,  
363 2021).

364 The key staple food crop in Egypt occupies about 33 percent of the total winter  
365 crop area, accounts for 9 percent of water resources and contributes 17 percent  
366 of the total value added in Egyptian agriculture (European Bank for  
367 Reconstruction and Development is an international financial institution,  
368 2015). Consumed mainly as bread it provides, on average, one-third of the  
369 daily caloric intake of consumers and 34 percent of their total daily protein  
370 consumption (Wheat sector review, 2015).

371 ***Bread Prices in Egypt are Fixed for 30 Year***

372 In Egypt, wheat is distributed between flour mills and pasta factories. Most of  
373 the wheat goes to flour mills and is used to produce different types of flour,  
374 mainly for making the subsidized Baladi bread. There are more than 410 flour  
375 mills in Egypt (BBM, 2022). Bread is very important in Egyptian cuisine  
376 (BBM, 2022). The Egyptians use the word "Aish" for bread, which means  
377 "life".

378 The bread subsidy system remains unchanged: Egypt allocates 150 loaves of  
379 subsidized bread per month to recipients (i.e., five loaves of bread per day)  
380 (USDA, 2022). Baladi (i.e., common, traditional) bread is sold at a subsidized  
381 price of EGP 0.05 per loaf (\$0.01 per loaf), this is less than one tenth of the  
382 actual cost (USDA, 2022). The government compensates bakeries for the  
383 difference in production cost (USDA, 2022). The current cost of subsidizing  
384 one loaf of baladi bread is EGP 0.60 (\$0.03) (USDA, 2022). The current  
385 subsidy system permits beneficiaries who consume less than the quota amount  
386 to convert their bread savings into points (1 point = EGP 0.01) (USDA, 2022).

387 In fiscal year (FY) 2021/22 (June – July), the government allocated EGP 87  
388 billion (\$5.5 billion) for bread and food subsidies (Figure 2) (USDA, 2022).  
389 Of this amount, roughly EGP 51 billion (\$3.2 billion) is earmarked for the  
390 bread subsidy program (USDA, 2022). In the country, 270 million pieces of  
391 bread are produced daily in more than 30 thousand bakeries (BBM, 2022). The  
392 annual cost of the bread subsidy to the government is 45 billion Egyptian  
393 pounds (BBM, 2022). More than 70 million Egyptians hold smart cards which  
394 enable them to buy five loaves of bread daily (BBM, 2022).

395 All procedures are put into practice to ensure that Baladi bread prices remain  
396 unchanged. Indeed, bread prices in Egypt have remained unchanged for the  
397 past 30 years, making the price of this bread the cheapest in the world (BBM,  
398 2022). According to the Egyptian Grain Industry, the amount of subsidized  
399 flour used for Baladi bread amounts to 8-9 million tons per year (BBM,  
400 2022). Currently, 30,000 bakeries produce from 250 million to 270 million  
401 subsidized loaves of bread each day (USDA, 2022). The per capita share of  
402 subsidized municipal bread increased by almost 28.6 percent, reaching 3.6  
403 loaves per day in 2021, compared to 2.8 loaves per day in 2019 (USDA, 2022).

404 On the Global front, the average price for cereal grains increased 27.3% in  
405 September 2021 compared to September of the previous year and since then it  
406 has continued to climb at an even faster rate (Tanchum, 2022). The price of  
407 soft wheat used in bread manufacture stood at \$271 per ton at the end of the  
408 third quarter of 2021, a 22% year-on-year increase (Tanchum, 2022). The price  
409 in the fourth quarter of 2021 shot up further as global inventories fell after  
410 experienced crop damage due to droughts, frost, and heavy rain (Tanchum,

411 2022). As of March 3, 2022, just seven days into Russia's Ukraine invasion,  
412 the end of day settlement price for the March 2022 soft wheat contract on the  
413 Chicago Board of Trade stood at nearly \$389 per ton (Tanchum, 2022).

414 With Russia being the world's largest wheat exporter and Ukraine the fifth  
415 largest, accounting for a combined total of 30% of global wheat exports, prices  
416 are likely to remain elevated and the cost for Egypt goes beyond just the import  
417 price at 10% increase over the previous year where Egypt's new wheat  
418 purchases and subsidies will now become an even greater fiscal burden for the  
419 treasury to bear (Tanchum, 2022).

#### 420 ***COVID-19 Effect on the Egyptian Grain Market***

421 The outbreak of COVID-19 disease shows vulnerability of the supply chains  
422 when unexpected events take place (Markopoulos, 2022). Applying measures  
423 against COVID-19 the global economy faced a shock after (practically)  
424 stopping the flows of goods; it is obvious that the world is possible to face  
425 shortages in the markets even if there are no actual problems to the food  
426 production (Markopoulos, 2022). The pandemic has caused strong  
427 fluctuations and increases in price due to restrictions and shipping restraints  
428 (BBM, 2022).

429 Grain prices are quite high around the world (BBM, 2022). The impact of  
430 Covid-19 on the grain market has been deep and prices are higher compared  
431 to the same period last year (BBM, 2022). The demand for wheat flour in the  
432 country was very high in 2020, along with the effect of the pandemic, it  
433 increased by 28% compared to 2019 with a sales value of 465 million EGP  
434 (Egyptian Pound) (BBM, 2022).

#### 435 ***Egypt's Wheat Trade & Russian -Ukraine War***

436 The Russian–Ukrainian conflict has disrupted the flow of wheat from the Black  
437 Sea and caused great ambiguity in the global wheat trade (USDA, 2022). As  
438 the war between Russia and Ukraine is causing major disruptions of wheat  
439 supplies, Egypt is not isolated from these catastrophic events, which is already  
440 affecting its imports of wheat from both countries (USDA, 2022). Accordingly,  
441 FAS Cairo forecasts Egypt's wheat imports in MY 2022/23 (July – June) at 11  
442 MMT, down by 9.1 percent from Post's MY 2021/22 import estimate figure of  
443 12 MMT (USDA, 2022).

444 Egypt's imports of wheat over the last five years amounted to 62.6 MMT, with  
445 59.7 percent from Russia and 22.3 percent from Ukraine (82 percent comb (El-  
446 Marsafawy & Mohamed, 2021)ined), both major suppliers to the Egyptian  
447 market (USDA, 2022). As of the last quarter in CY 2021, wheat prices  
448 increased by an average of \$100/MT. This meant an additional cost to the



449 government budget allocated for the importation of wheat for the bread subsidy  
450 program in the current fiscal year ending in June 2022 (USDA, 2022). Total  
451 wheat imports during the first two and a half months of CY 2022 amounted to  
452 1.78 MMT (USDA, 2022).

#### 453 ***Domestic Wheat Procurement:***

454 Wheat procurement season is set to start on April 1, 2022, instead of April 15,  
455 and will last until the end of August instead of mid-July (USDA, 2022). FAS  
456 Cairo foresees Egypt in MY 2022/23 (July-June) procuring some 5 to 5.5  
457 MMT of locally produced wheat (USDA, 2022). The amount of  
458 locally produced wheat purchased by the government of Egypt was 3.5 MMT  
459 in calendar year (CY) 2020 and 3.6 MMT in CY 2022 (USDA, 2022).

## 460 **Factors Affecting Wheat Supply**

### 461 **Water Footprints**

462 ***Water Shortage:*** The Nile River is the primary source of water flows to Egypt  
463 on a fixed quantity at around 55.5 BCM by an agreement with Sudan in 1959,  
464 representing 85% of the country's renewable water resources (Ali, 2019).  
465 Egypt maximizes its water supply from the Nile River by recycling the  
466 agricultural drainage water that provided an additional 11.9 BCM in 2016  
467 (Ali, 2019). This is added to another sources of water. Environmental  
468 challenges in growing wheat and a water intensive crop both present major  
469 challenges for Egypt. As a result, low levels of arable land, growing  
470 populations and climate changes are placing more stress on critical resources  
471 such as water supply.

472 ***Water Disputes:*** Ethiopia plans to increase its energy production through its  
473 Nile-powered Grand Ethiopian Renaissance Dam (GERD) (Essam Heggy &  
474 Abotalib, 2022). While the 74-billion cubic meter (BCM) dam presents  
475 promising development opportunities for Ethiopia, the Nile's altered flow will  
476 increase the existing water deficit for Egypt—the quantification and  
477 mitigation of which are still largely unconstrained and under intense debate  
478 (Essam Heggy & Abotalib, 2022).

479 ***Water Pollution:*** Pollutants existing in the drainage system from fertilizers and  
480 pesticides used in agriculture can cause increases the water salinity, where it  
481 causes a reduction in yield (Ali, 2019). In addition, there is numerous pollution  
482 sources which include untreated and semi-treated industrial wastewater,  
483 sewage water, agricultural drainage water, and solid-liquid waste from Nile  
484 cruise activities (Ali, 2019).

**485 Energy Footprints:**

486 Desalination is the most energy-intensive water treatment process that  
487 consumes 75.2 TW h per year, about 0.4% of global electricity and 76 million  
488 ton of carbon emission (El-Hady, et al., 2021). In Egypt, the energy utilized  
489 for the desalination processes may come from many sources such as  
490 conventional fossil fuels, windmills, solar plants, and electricity grids. Not all  
491 areas that need desalination have access to electricity grid on regular basis (El-  
492 Hady, et al., 2021). Thus, the need for alternative energy resources is essential  
493 for direct community needs and for driving the desalination processes (El-  
494 Hady, et al., 2021).

495 This situation is expected to be exacerbated in the near future as 60 percent  
496 more food will need to be produced in order to feed the world population in  
497 2050 (Olivier Dubois, 2014). Global energy consumption is projected to grow  
498 by up to 50 percent by 2035 (Olivier Dubois, 2014). Total global water  
499 withdrawals for irrigation are projected to increase by 10 percent by 2050  
500 (Olivier Dubois, 2014).

501

**502 Inputs to Wheat Production**

503 Egypt has many inefficiencies in the value chain of wheat that can be  
504 classified as those controlled by the government (Wheat Storage /  
505 distribution, Technology, Water Waste and Country Economic and Political  
506 Status) and those uncontrolled by the government (Climate Change).

507 **Climate Change:** Agriculture consumes approximately 86% of total water  
508 resources in Egypt (Omar, Moussa, & Hinkelmann, 2021). Climate change in  
509 Egypt would decrease crop yields for most crops, with wheat yields expected  
510 to be reduced by up to 9% in 2030 and by close to 20% in 2060, which means  
511 that climate change would significantly affect the Nile River flow in Egypt that  
512 have an inverse relationship with the water salinity in the delta region, where  
513 such reduction in the Nile River flow would reduce the average self-sufficiency  
514 of strategic crops, net agricultural productivity, consumer-producer surplus  
515 and increase the number of laborers who lose their daily part-time income  
516 (Omar, Moussa, & Hinkelmann, 2021).

517 **Technology (R&D):** Adopting digital tools, including AI, represented in some  
518 efforts through collaborations between the Ministry of Agriculture and MCIT  
519 that cover automating land agriculture possession, farmer smart cards, crop  
520 recognition through satellite and AI, smart assistants to farmers, digitalizing  
521 agriculture documents, and creating electronic archiving (kamal, 2021). This

522 is in addition to transitioning to more modern irrigation systems. Also using  
523 AI to analyze weather and soil conditions, temperature, and water usage to help  
524 farmers optimize planning to generate higher yields by identifying the best  
525 crop choices and how to maximize the use of available resources (kamal,  
526 2021). Other AI solutions can help cut costs while significantly increasing  
527 harvest yield and quality by deploying remote sensing, cloud computing, and  
528 using simulation modeling (kamal, 2021).

529 Using the nascent technology of cellular agriculture has the potential of  
530 achieving a green and sustainable economy while contributing to food security  
531 and encouraging localized production; leading to less land and water used and  
532 a feed-free approach with expected cost reduction and fewer carbon emissions.  
533 Also providing Small farmers, using traditional agricultural practices whom  
534 represent 80 percent of the farmers, with simple digital and connectivity tools  
535 can still offer a wide range of opportunities, including using mobile phones to  
536 educate, inform, and empower them and help them change the way they work  
537 by getting access to crucial information through mobile Internet as well as the  
538 use of sensors that enable real-time data collection on the pricing of goods at  
539 the local level, weather alerts, and the efficient management of resources and  
540 the applications of the IoT to enable smart agriculture, such as irrigation  
541 systems and value chain management (kamal, 2021).

542 However, Egypt is facing lack of sufficient incentives to invest in water-  
543 conserving technology, small budget allocation for research and development  
544 and lack of coordination the different stakeholders, and institutional  
545 framework underpinning it (kamal, 2021).

546 **Storage:** Egypt suffers from the destruction of very large quantities of wheat  
547 due to lack of proper storage. Classification of silos by building type are  
548 Concrete silos (cement), Metal silos and Horizontal silos whether owned by  
549 Public or private sector. On-farm wheat storage is quite common. Almost all  
550 wheat farmers use their own house to store their wheat (the exception is the  
551 Frontier, where most farmers do not have wheat storage capacity) because  
552 farmers very rarely rent storage space (Kherallah, Minot, & Gruhn).

553 The average quantity of wheat in storage is very seasonal; it reaches a peak  
554 after harvest in April/May at about 1.1 to 1.4 mt and declines gradually down  
555 to 150 kgs just before the next harvest season of the following year. Most of  
556 the wheat (86%) is stored for consumption throughout the year rather than for  
557 sale (Kherallah, Minot, & Gruhn).

558 **Expectations:** Expecting a decrease in water availability in the coming years  
559 may discourage the growth of wheat production. Also, local currency exchange

560 rate instability and other internal and external political factors are strongly  
561 affecting our ability to import required quantities, accordingly, promotion of  
562 economic integration with other countries and adopting new strategies across  
563 different fronts is mandatory.

564 ***Producers & Procurement Prices:*** Egyptian wheat production is based on  
565 small-scale farms, yet these farms are highly commercialized. Wheat yields  
566 are high because of the intensive use of labor, fertilizer, and irrigation.  
567 Cooperatives continue to play an important role in seed distribution, but private  
568 traders have come to dominate wheat marketing and the distribution of  
569 agricultural chemicals.

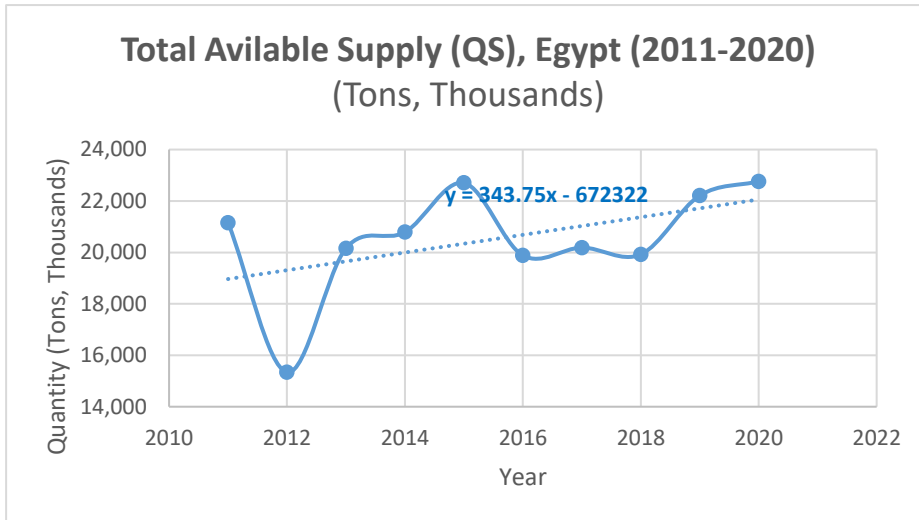
570 A recurring question among policy makers is why such a small portion of  
571 national production is available for purchase by the government. Results  
572 suggest that most of the wheat produced is consumed in the rural areas. Half is  
573 retained by wheat farmer households, 29–32% is purchased by the  
574 government, and the remainder is consumed by non-wheat-farming rural  
575 households and, to a lesser extent, wheat farmers who are net buyers. Wheat  
576 farmers sell two thirds of their marketed surplus to traders rather than to  
577 cooperatives, mills, and village banks that channel wheat directly to the  
578 government due to prices and location, where traders pay prices at least as good  
579 as other buyers (Kherallah, Minot, & Gruhn).

580 Government of Egypt would have to increase the procurement price  
581 substantially above international prices (Kherallah M. &, 2000). When  
582 procurement prices are above international prices, as they currently are, the  
583 government incurs the budgetary costs of subsidizing its wheat producers  
584 (Kherallah, Minot, & Gruhn). Increasing the incentive for farmers to sell the  
585 wheat they have set aside for home consumption will encourage them to  
586 purchase more subsidized flour and bread, resulting in higher costs to the  
587 consumer subsidy system (Kherallah M. &, 2000).

588 This finding supports conclusions of an analysis by Lofgren and Kherallah  
589 (1998) (Kherallah, Minot, & Gruhn). They found that raising the wheat self-  
590 sufficiency rate from 47% to 60 or 70% through higher producer prices would  
591 involve increased subsidy costs of LE 1.5 billion and LE 3.3 billion (0.7 and  
592 1.6% of GDP) respectively resulting in difficulty in achieving wheat self-  
593 sufficiency through price policy alone (Kherallah, Minot, & Gruhn).

594 ***Following the supply law which expresses a correlation between the price of***  
595 ***the commodity and the quantity offered, as producers offer greater quantities***  
596 ***of the commodity when the price increases, and lower quantities when the***  
597 ***price falls, it is mandatory for farmers to know the price of wheat as earlier***

598 *as possible whereas the date of the announcement of the price of wheat has*  
 599 *a fundamental impact on the volume of its production.*  
 600



601

602

Figure 5: Total Available Supply (Qs) - Tons, Thousands

603 The supply elasticity of about 0.3 is in line with our regional time-series  
 604 estimates from Egypt not reported in this paper (see Kherallah et al., 1999). It  
 605 is also consistent with estimates from other developing countries (see  
 606 Scandizzo & Bruce, 1980). Thus a 10% increase in the price of wheat would  
 607 induce farmers to expand output by 3%. This suggests that farmers will react  
 608 favorably to real and relative increases in rural wheat prices.

609 A statistical estimate of the costs functions of the wheat crop and deriving some  
 610 economic indicators, including Agricultural costs include fixed costs and  
 611 variable costs, and the fixed costs reflect the value of the fixed factors of  
 612 production which does not change by the change of production volume, while  
 613 variable costs are those which their value changes by the change of the volume  
 614 of production and include the costs of agricultural processes on the crop as well  
 615 as the costs of the production factors required to complete cultivation.

616 Studying the variable costs in the study sample and comparing them with their  
 617 counterparts at the level of Governorate and the country's level, they have  
 618 reached about 2911 pounds, for a return of about 2921 and about 2712,  
 619 respectively. The study of these costs as distributed on the most important  
 620 items of wheat, as for the costs of seeds, they have amounted to about 175  
 621 pounds per feddan in the study area in exchange for about 240 pounds and 292  
 622 pounds for El Beheira Governorate and the country's level by about 5.9%, 8.2%

623 and 10.8 %, respectively. For irrigation costs, they have amounted to about 185  
 624 pounds in comparison with 360 pounds and 298 pounds on the three levels in  
 625 the same order, each representing about 6.3 %, 12.3% and 0.11 %, respectively.  
 626 The costs of chemical fertilizer have reached about 1139 pounds per acre in  
 627 the study sample in comparison with about 605 pounds and 0.633 pounds,  
 628 respectively, by about 39.1%, 20.7 % and 23.3 %, respectively.

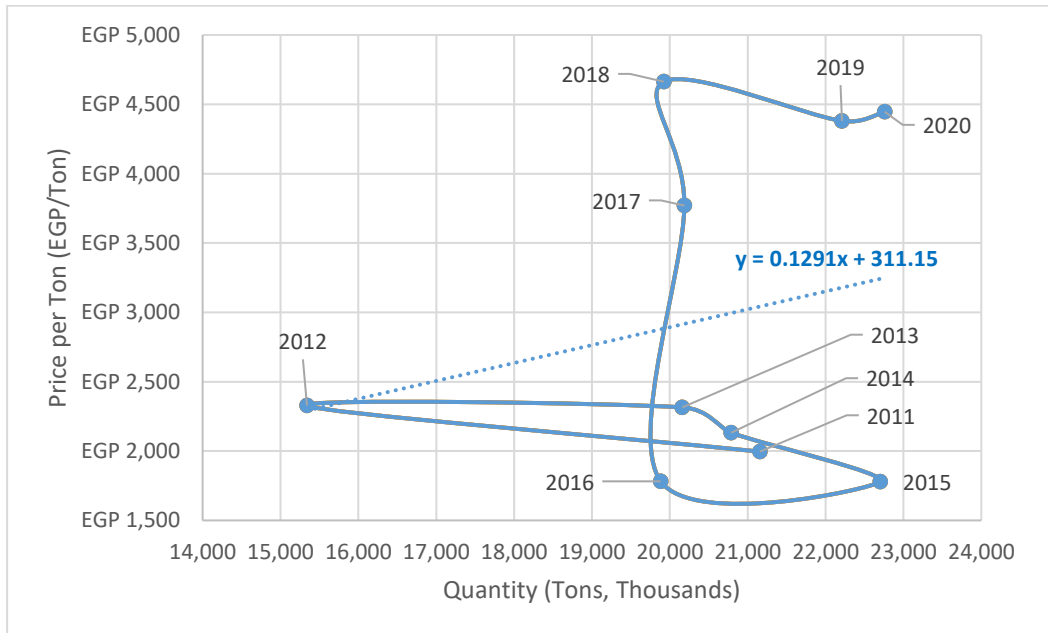


Figure 6: Wheat Supply Curve, Egypt (2011-2020)

629  
 630

### 631 Strategies Affecting Wheat Supply

632 Increasing wheat supply from domestic sources can be achieved through one  
 633 or more of the following options: (1) increasing wheat area, (2) raising  
 634 productivity per unit area, and (3) reducing food loss and wastage (Yigezu, et  
 635 al., 2021). The first option is neither practical nor sustainable any effort towards  
 636 area expansion in MENA has substantial environmental and natural resource  
 637 implications (Yigezu, et al., 2021). The second option, increasing productivity  
 638 through sustainable intensification, is feasible and desirable (Yigezu, et al.,  
 639 2021).

640 This strategy has achieved its objective of increasing the global food supply,  
 641 however food insecurity remains a major challenge in many parts of the world,  
 642 including MENA and will not be sufficient to meet the food demand of a  
 643 growing world population (Yigezu, et al., 2021). The third option is incredibly  
 644 neglected but strategically crucial because one-third of the global food

645 production, which is equivalent to 1.3 billion tons, is lost or wasted every year  
646 (Yigezu, et al., 2021). Therefore, dealing with the growing challenge of food  
647 insecurity requires the development of effective.

648 To meet the projected population growth. Egypt has adopted the strategy of  
649 decreasing the gap between production and consumption through three  
650 different avenues: expanding the wheat area into the newly reclaimed lands,  
651 increasing grain productivity (vertical expansion), and decreasing wheat losses  
652 along the wheat value chain from field to fork (Yigezu, et al., 2021). Egypt  
653 achieved good progress in developing new wheat cultivars with high yield  
654 potential and developing good agricultural practices to maximize grain yield  
655 per unit area, however Expanding wheat areas is limited due to the scarcity of  
656 water resources (Yigezu, et al., 2021).

657 Although the improvement in total production is about four times during the  
658 last four decades, there is limited opportunity for further increases due to  
659 growing scarcity in water resources which constrains both area expansion and  
660 productivity gains (Yigezu, et al., 2021)

661 Storage factors affect grain supply like moisture, temperature, and humidity of  
662 the storage environment like On-Farm Storage, Storage in Shona: (Open-Air  
663 Storage), Storage in Silos. Extra loss take place due to Transportation  
664 Processing, and Marketing cycle. Other factors responsible for deterioration  
665 are poor containers, damage by rodents, insect pests, and microorganisms  
666 (Yigezu, et al., 2021).

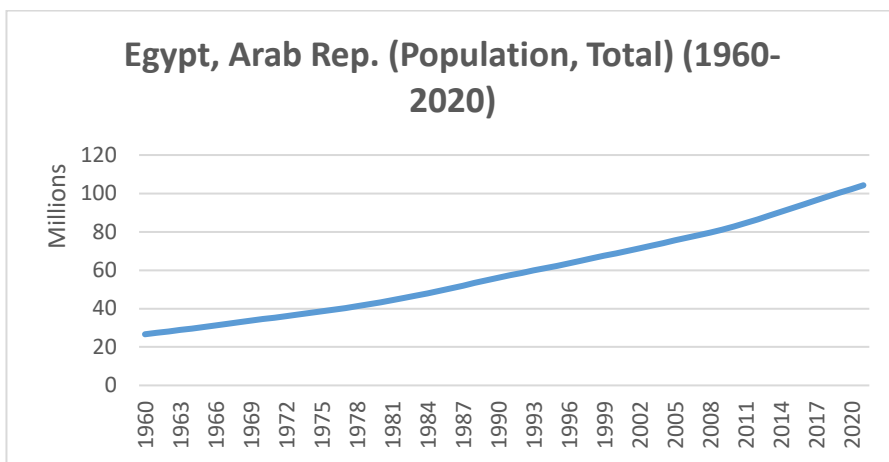
667 Economic theory indicates that, in the absence of market failure, the benefits  
668 of wheat subsidies to farmers and consumers will be less than the fiscal cost of  
669 the subsidy (Kherallah, Minot, & Gruhn). Thus, investment in agricultural  
670 research and extension would have a higher return than continued subsidies.  
671 Government investment in the development of higher yielding wheat varieties  
672 would not only increase wheat production, farmer productivity and farm  
673 income, but should also help make more wheat available for the baladi bread  
674 and flour subsidy program without increasing per unit subsidy costs.

675

## 676 **Factors Affecting Wheat Demand**

### 677 *Number of Buyers*

678 According to Central Agency for Public Mobilization and Statistics  
 679 (CAPMAS), Egypt population increased from 72.8 million in 2006 to 94.8  
 680 million in 2017 (the last census) and increased to 100 million on February 11,  
 681 2020, with an increase of 5.2 million from the last census (CAPMAS, 2020).  
 682 Egypt is facing an annual population increase of approximately 2.6 million.  
 683 The increase in the population by 1 million was the result of increasing the  
 684 quantity of consumed wheat by 0.185 million (Khalil, 2020).



685

686

**Figure 7: Egypt Population (1960-2020) (Worldbank, 2022)**

### 687 *Subsidies*

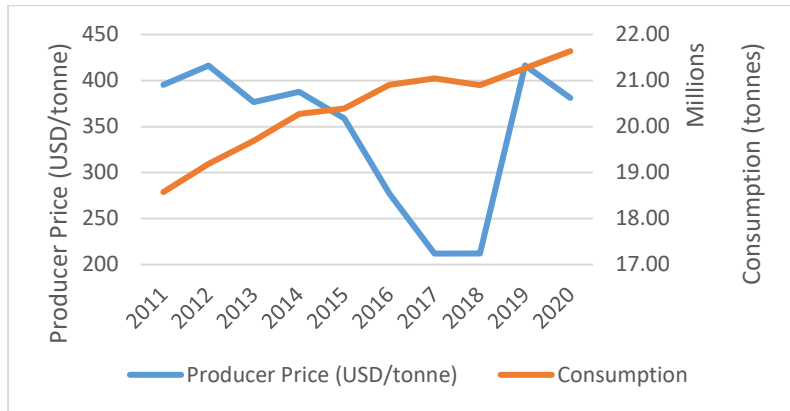
688 Egypt has one of the biggest bread subsidy programs, under which more than  
 689 60 million Egyptians, get 5 loaves of round bread daily for 50 cents a month  
 690 (Reuters, 2022). Wheat is a morally necessary commodity for the Egyptian  
 691 individual, where the extent to which the quantities consumed per capita do  
 692 not respond quickly to the change in price. However, consumption of wheat is  
 693 directly proportional related to individual income. The increase in subsidies by  
 694 1 billion pounds leads to an increase in the quantity of wheat consumed by  
 695 0.059 million tons (Khalil, 2020).

### 696 *Wheat Price*

697 Wheat is a morally necessary commodity for the Egyptian individual, where  
 698 the extent to which the quantities consumed per capita do not respond quickly



699 to the change in price. However, consumption of wheat is directly proportional  
 700 related to individual income.



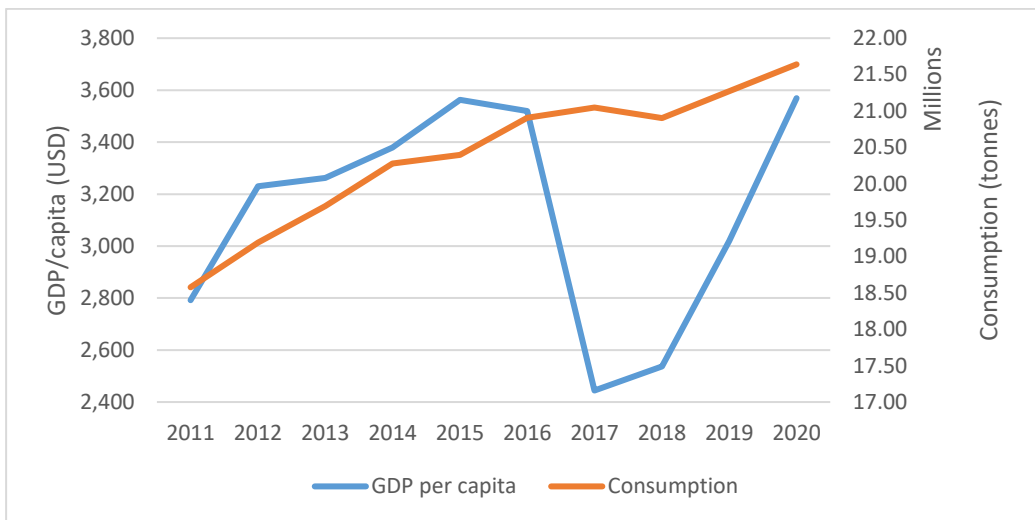
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702

Figure 8: Wheat Price vs Consumption, Egypt (2011-2020) (FAO, 2022)

703 *Household Income*

704 Wheat is a morally necessary commodity for the Egyptian individual, where  
 705 the extent to which the quantities consumed per capita do not respond quickly  
 706 to the change in price. However, consumption of wheat is directly proportional  
 707 related to individual income.



708

709

710

Figure 9: GDP per capita vs Consumption, Egypt (2011-2020) (FAO, 2022)  
 (Worldbank, GDP per capita (current US\$) - Egypt, Arab Rep., 2022)

711 *Tastes*

712 Although Wheat is very essential and considered a strategic good still one of  
713 the most obvious determinants of demand is consumers' tastes. Tastes are  
714 based on historical and psychological forces that are beyond the realm of  
715 economics.

716 *Expectations & Preferences*

717 As nutritionists claims regarding wheat saying it may be harmful to the  
718 intestine prevents the absorption of food and affects the concentration, which  
719 can lead to depression. Consumers' expectations and personal health  
720 preferences along the time may affect wheat demand in specific communities.  
721 changing consumption patterns where wheat enters the industries of pasta -  
722 vermicelli, pancakes, and many foodstuffs in addition to the manufacture of  
723 starch, grinding residues are used as feed for animals.

724 *Demand for wheat*

725 Egypt produces half of the 20 million tons of wheat that it consumes with  
726 irrigation and imports the other half. Egypt is also the world's largest importer  
727 of wheat. The population of Egypt is currently growing at 2.2% annually, and  
728 projections indicate that the demand for\_wheat will triple by the end of the  
729 century. Combining multi-crop and -climate models for different climate  
730 change scenarios with recent trends in technology, we estimated that future  
731 wheat yield will decline mostly from climate change, despite some yield  
732 improvements from new technologies.

733 The growth stimulus from elevated atmospheric CO<sub>2</sub> will is overtaken by the  
734 negative impact of rising temperatures on crop growth and yield. An ongoing  
735 program to double the irrigated land area by 2035 in parallel with crop  
736 intensification could increase wheat production and make Egypt self-sufficient  
737 shortly but would be insufficient after the 2040s, even with modest population  
738 growth. Additionally, the demand for irrigation will increase from 6 to 20  
739 billion m<sup>3</sup> for the expanded wheat production, but even more, water is needed  
740 to account for irrigation efficiency and salt leaching (to a total of up to 29  
741 billion m<sup>3</sup>). Supplying water for future irrigation and producing sufficient  
742 grain will remain challenges for Egypt.  
743

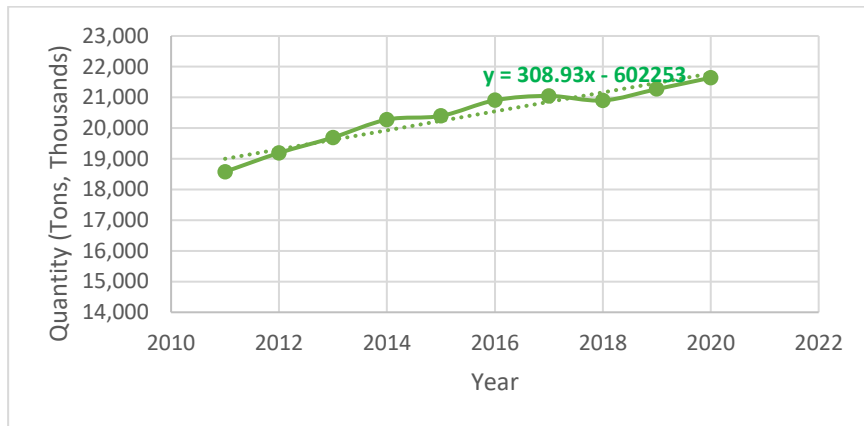


Figure 10: Total Quantity Demanded (Qd) - Tons, Thousands

744  
745

Consequently, to ensure food security and fulfil the domestic wheat demand Egyptian government relies heavily on imported wheat. The wheat subsidy, population pressure and lower domestic production are the reasons for high wheat import in Egypt, Egypt is one of the largest wheat importers in the world and imports over half of its total wheat consumption. Egyptian wheat imports declined during 2019-20 to 12.68 million tonnes from 13.3 million a year before. The wheat import decreased due to a rise in domestic wheat production during 2019-20, wheat production increased from 8.77 to 8.9 million tonnes in 2019-2020, compared to 2018- 2019. The aggregate domestic wheat consumption in Egypt rose from 20.3 million tonnes to 20.8 million tonnes from 2020-to 21, which is due to high population growth.

Main findings indicate that the Russian Federation, Ukraine, and the United States of America represent the largest wheat exporters to Egypt, with export quantities amounting to 6.51, 2.13 and 0.219 million tons in 2017, respectively, indicating that wheat imports from the three countries accounted for 73.67% of Egypt's total wheat imports during 2017, estimated at 12.025 million tons. On the other hand, Argentina, Brazil and the USA represent the largest corn exporters to Egypt, with export quantities amounting to 2.64, 2.11 and 0.257 million tons in 2017, respectively, indicating that corn imports from the three countries accounted for 56.85% of Egypt's total corn imports during 2017, estimated at 8.807 million tons ( Foreign Trade Database, Foreign Trade, 2017).

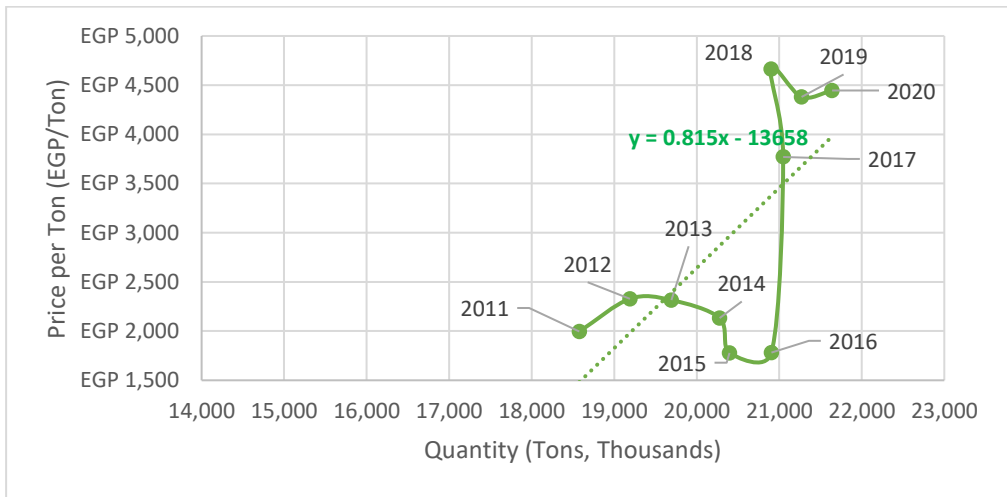


Figure 4: Wheat Demand Curve, Egypt (2011-2020)

Wheat is the main food crop in Egypt. The growing increase in population at a rate higher than the rate of increase in wheat and maize planted areas resulted in domestic production that fails to meet national consumption from the two crops. As a result, the Government of Egypt resorts to imports from abroad to cover domestic demand, which poses a burden on the Balance of Payments, where the imports value of the two crops reached US\$ 2.65 and 1.74 billion, respectively, representing 20.37% and 13.38% of the total value of food imports in 2017, estimated at US\$ 13 billion (Foreign Trade Database, Foreign Trade, 2017).

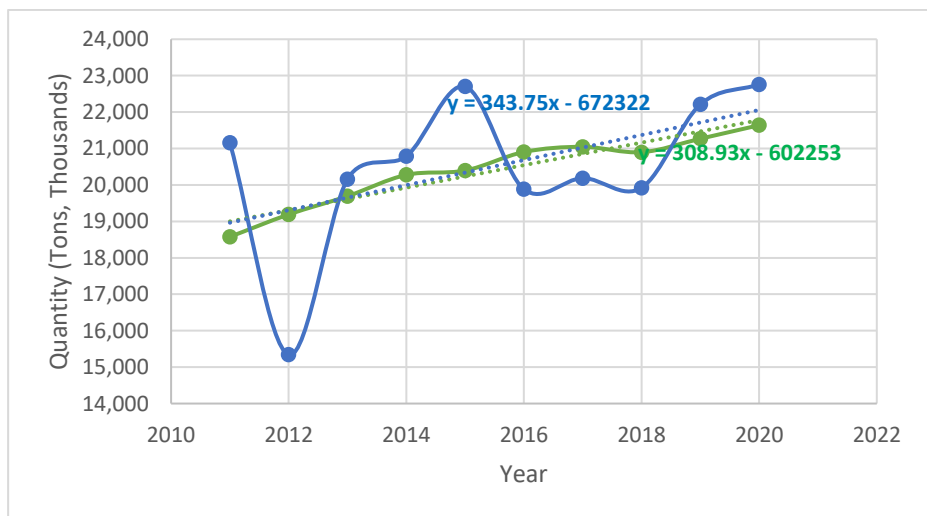


Figure 12: Total Quantity Supplied (Qs) Vs Quantity Demanded (Qd)

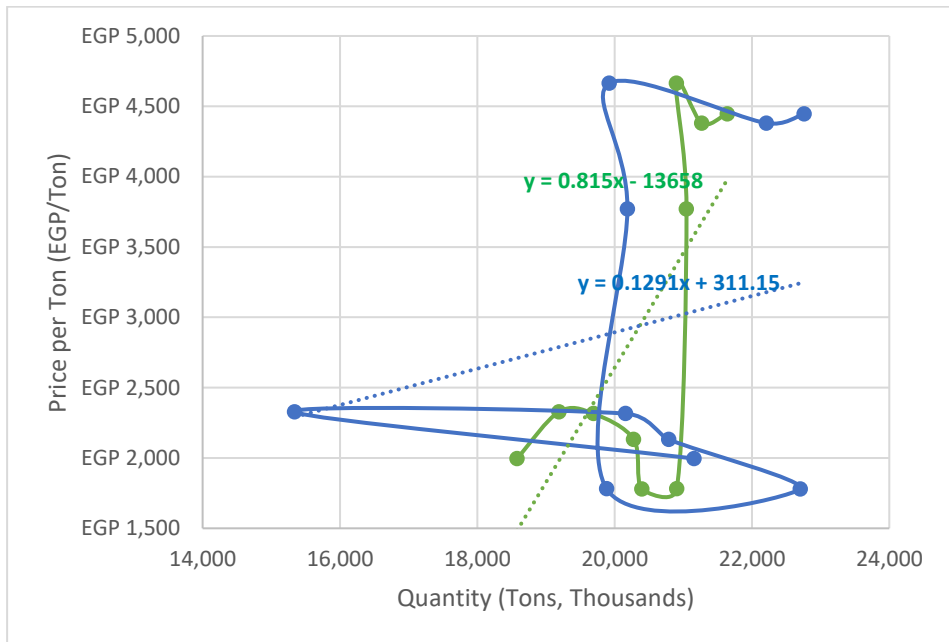


Figure 13: Wheat Supply and Demand, Egypt (2011-2020)

## Elasticity of Wheat

The Russian Federation, Ukraine and France represent the top wheat exporters to Egypt in 2020, with export percentages amounting to 61%, 24% and 6%, respectively, indicating that wheat imports from the three countries accounted for 91% of Egypt's total wheat imports during 2020, estimated at around 11 million tons (Statista, 2022). Data in table 1 indicate that the estimated model is statistically significant, with no estimation problems that might negatively affect the model's efficiency. The validity of the estimated model has also been verified. The estimated price elasticities of demand for Russian wheat in the Egyptian market, presented in table 2, indicate that a 1% increase in wheat export prices leads to reducing demand for the crop by 11.89%, which means that demand for wheat in the Egyptian market is elastic (Estimation of Demand for Major Crops in Egypt, 2019).

### *Price Elasticity of Supply for Wheat*

The price elasticity of supply measures how much the quantity supplied responds to changes in the price. The supply of a good is said to be elastic if the quantity supplied responds to changes in the price. Supply is said to be inelastic if the quantity supplied responds only slightly to changes in the price (Mankiw).

### *Computing the Price Elasticity of Supply*

Price elasticity of supply = Percentage change in quantity supplied / Percentage change in price. Since the government mainly relies on imported wheat to supply its bread and as we can see from the below table, the Supply of wheat was affected in Q1 2020 for both substitutes and that was due to a factor other than price, it was due to COVID-19 outbreak, And it's elastic also in 2016 due to Shortage in wheat supply, Imports were increased to fill the deficit with a slight price increase.

Table 1: Price elasticity of supply (AGRIS, 2015)

Year	Supply	Price EGP	Supply Change	Price Change	Elasticity of Supply	Elasticity Status
2011	21,157	1,996.16				-
2012	15,340	2,327.99	-0.32	0.15	2.08	<b>Elastic</b>
2013	20,160	2,315.21	0.27	-0.01	49.33	<b>Elastic</b>
2014	20,788	2,132.37	0.03	-0.08	0.37	Inelastic
2015	22,702	1,778.53	0.09	-0.18	0.49	Inelastic
2016	19,883	1,781.65	-0.13	0.00	75.54	<b>Elastic</b>
2017	20,187	3,770.02	0.02	0.72	-0.02	Inelastic
2018	19,923	4,663.53	-0.01	0.21	0.06	Inelastic
2019	22,211	4,380.35	0.11	-0.06	1.73	<b>Elastic</b>
2020	22,760	4,446.00	0.02	0.01	1.64	<b>Elastic</b>

#### *Price Elasticity of Demand for Wheat*

The price elasticity of demand measures how much the quantity demanded responds to a change in price. Demand for a good is said to be elastic if the quantity demanded responds substantially to changes in the price. Demand is said to be inelastic if the quantity demanded responds only slightly to changes in the price (Mankiw).

It depends on some factors as follows,

- Availability of Close Substitutes.
- Necessities versus Luxuries.
- Definition of the Market.

### Computing the Price Elasticity of Demand

Price elasticity of demand = change in quantity demanded / Percentage change in price. Since The product is necessary and as we can see from the below table, the price of wheat was increased with Increasing demand except for 2016 due to devaluation in Q4 2016 with a slight increase in price and 2020 due to Covid 19.

Table 2: Price elasticity of demand (AGRIS, 2015)

Year	Demand	Price	Demand Change	Price Change	Elasticity of Demand	Elasticity Status
2011	18,577	1,996.16				-
2012	19,191	2,327.99	0.03	0.15	0.21	Inelastic
2013	19,693	2,315.21	0.03	-0.01	4.69	<b>Elastic</b>
2014	20,277	2,132.37	0.03	-0.08	0.36	Inelastic
2015	20,397	1,778.53	0.01	-0.18	0.03	Inelastic
2016	20,905	1,781.65	0.02	0.00	14.03	<b>Elastic</b>
2017	21,047	3,770.02	0.01	0.72	0.01	Inelastic
2018	20,900	4,663.53	-0.01	0.21	0.03	Inelastic
2019	21,270	4,380.35	0.02	-0.06	0.28	Inelastic
2020	21,640	4,446.00	0.02	0.01	1.16	<b>Elastic</b>

### Conclusion

Based on the analysis and the estimates, the following policy suggestions need to be addressed to accomplish the country's demand for wheat:

1. A necessary policy is required for substitutable consumption of wheat regarding rice, corn, and barley.
2. Government should focus on alternative wheat production policies to fulfil the wheat consumption domestically.
3. Egypt's government should concentrate on exploring additional water resources for irrigated agriculture and alternative wheat production technology especially the use of saline water and biochar soil amendments to offset the salinity effect.
4. In the future, the Egyptian government should manage the annual domestic wheat production above the population growth to maintain or reduce wheat imports.
5. Government should control the consumer price index; attain higher GDP per capita for wheat consumption accessibility for the low-income group.

6. The appropriate policy is required for wheat imports and wheat production to fill the gap between demand and supply for wheat.
7. Indonesia shifts the consumption pattern from rice to wheat due to high-income growth and urbanization a similar shift is required in Egypt to change the wheat consumption pattern to other domestically produced substitute commodities (like rice, corn, and barley).
8. It is also suggested that the Egyptian government must focus on pro-poor agriculture growth to meet the wheat demand and alternative staple food.
9. Wheat imports can also be reduced by imposing import tariffs and shifting the population to substitute commodities.
10. It is also suggested that mapping is required to fill the wheat consumption so the ministry of food and agriculture should cope with the increasing wheat consumption.
11. Adopting innovative production techniques with new wheat varieties will be beneficial to enhance wheat production.
12. The global wheat market does not show market leader characteristics and can better be described as a more complex oligopoly involving a shared dominance between the top wheat global producers where price leadership is controlled.
13. The wheat industry in general can be identified as a perfectly competitive market as the wheat market may have many sellers and producers. If any producer leaves the market, there is no effect on the market price. However, the Wheat Market in Egypt is an example of a homogeneous oligopoly, where the government in addition to several large companies has almost an identical share in the market. (50% each).
14. Wheat is a product of critical importance to Egypt and wheat policy is a priority for the government. In the light of the Russian-Ukraine conflict, Egypt shall diversify wheat suppliers from around the globe to maintain food security, while incentivizing local wheat production and supporting scientific research to produce new varieties of high productivity and resilience to future harsh climate conditions (Increasing temperatures and water scarcity).
15. The government is heavily involved in the wheat value chain, controlling most of the buying, trading, storing, milling, bread production and distribution for “Baladi” bread. The government operates inefficiently via



multiple entities lacking transparency, which opens the opportunity for increasing the private sector involvement and reducing subsidies.

The amount of food loss and wastage in Egypt is estimated at 20.62%, associated with the loss of 4.79 billion m<sup>3</sup> of water and 74.72 million G.J. of energy. If Egypt managed to eliminate the loss and wastage of wheat-based food, it would have been able to reduce imports by 37%, from which it would save about 1.1 billion USD every year.

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