The Grain Chain

Food Security and Managing Wheat Imports in Arab Countries

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Executive Summary

Arab countries face a number of food security risks due to their high dependence on wheat imports. This study explores ways in which countries can mitigate these risks. The authors evaluate the wheat-import supply chain (WISC) from the unloading port to bulk storage at the flour mill, before the wheat is milled into flour. Existing literature treats isolated topics related to the supply chain, such as strategic storage and the use of financial instruments. This study is unique in that it takes a holistic view of the supply chain by examining how strategic storage, logistics improvements, and procurement strategies can all be used to improve food security.

The food price shocks of 2007–08 and 2010–11 suggest that international wheat prices may be entering a period of increased price volatility. The volatility and upward pressure on wheat prices are probably due to a combination of factors including population growth, income growth, promotion of biofuels, high and volatile fuel prices, and depreciation of the US dollar. Climate change and low global stock-to-use ratios further contribute to increased price volatility. An increase in severe weather events can increase variability in agricultural yields, while relatively low stock levels make the international wheat market more vulnerable to supply disruptions.

Arab countries are particularly vulnerable to increased volatility in international wheat markets since they rely heavily on wheat imports, and short-term demand for wheat in the Arab world is relatively inelastic. In total, Arab countries import about 56 percent of the cereal calories they consume, the largest share of which comes from wheat. Some countries import 100 percent of their wheat consumption needs.

As net wheat importers, Arab countries are exposed to both supply and price risks through the WISC.[1] Many Arab countries are concerned that supply disruptions may threaten their national security. Such disruptions may occur due to military conflict, port closures, and civil unrest. Meanwhile, price risk is a concern due to the impact that high and volatile international prices may have on domestic food inflation.

1 Supply risk is the risk that food will not be available, even if there are sufficient funds for purchase. Price risk is the risk that international wheat prices will be prohibitively high, making purchase difficult, even though supply is available on world markets.

While governments use safety nets to try to absorb price risk at the national level, many Arab countries still have a strong pass-through effect. The poor are most vulnerable to high local food prices because they spend up to 65 percent of their income on food. In addition, poor WISC logistics can result in supply-chain bottlenecks and product loss, both of which reduce supply-chain efficiency and increase the cost of importing wheat.

This study considers three critical aspects to the WISC and proposes several strategies Arab countries may consider to mitigate import risks:

1. Strategic storage (Chapter 2): Maintain strategic wheat reserves to weather times of crisis and food supply disruptions and to contribute to domestic and international price stabilization effects.
2. Logistics (Chapter 3): Promote investments throughout the supply chain that create smooth logistics, improve security, provide a reliable supply of wheat, reduce the base cost of importing wheat, and reduce product losses.
3. Procurement (Chapter 4): Develop a procurement strategy that leverages strategic partnerships while maintaining a diversified portfolio of suppliers and mitigates import risks through the use of hedging strategies.

Currently, overall storage capacity in the region averages the equivalent of six months of consumption, and estimated ending stocks average four and one-half months. However, many Arab countries are planning to increase their strategic wheat reserves as a policy to improve food security. This can provide them with critical lead time to secure alternative wheat supplies or supply routes during times of crisis. Reserves also offer psychological benefits that may prevent hoarding and pilferage. Moreover, historical data suggest a strong negative correlation between changes in wheat stocks and changes in wheat prices. Not only could increasing strategic wheat reserves reduce domestic price volatility and the frequency of domestic price shocks, but it could also impact the global wheat market and in turn mitigate international price risks. Three factors must be considered in establishing guidelines for managing the reserves: the threshold domestic price that triggers the drawdown of wheat reserves, the target reserve level, and the rate of reserves replenishment. Of course, the benefits of strategic wheat reserves must be measured against the cost of maintaining them.

Efficient and reliable logistics support a well-performing WISC, improving food security and ensuring delivery of supplies in a timely and cost-effective manner. All segments of the WISC are interconnected and efficiency throughout the supply chain is critical. Bottlenecks in one segment or node can have repercussions all along the supply chain, increasing both transit times and the cost of importing wheat. Evidence suggests that average WISC transit time in Arab countries is 78 days, costing around US$40 per metric ton. For comparison, in the Netherlands, average transit time is 18 days and costs US$11 per metric ton, while in South Korea average transit time is 47 days and costs US$17 per metric ton. There are, however, significant differences in performance of the supply chains throughout the region. Some countries may have bottlenecks at the port while others have inefficient inland transportation systems. Each Arab country should identify the specific WISC segments that they would like to target for efficiency improvements to reduce the time it takes to import wheat, the base cost of importing wheat, and product loss, which can be as high as 5 percent in some countries.

Using various procurement methods and tools that enhance a country's risk management strategy can also improve food security. Whether Arab countries take a more conservative or a riskier approach in their tendering process, each country can develop strategic partnerships with grain traders and key grain exporting countries. These relationships would help reduce counterparty risk, which if actualized and unmitigated could lead to a temporary supply disruption. Cooperation among neighboring Arab countries may also ease the risk of supply disruptions. In addition, risk management tools, such as physical and financial hedging instruments, could be employed to reduce exposure to price volatility and shocks. A successful hedging strategy would be over a long-term horizon, using a mix of the various instruments available, and could help governments better predict their future fiscal liabilities.

There is no silver bullet to mitigate wheat-import risks. Strategic reserves would not be effective if logistics systems fail to reliably deliver the wheat from storage to the flour mills or end-consumer. At the same time, smooth logistics can keep base importing costs low and ensure timely delivery of supplies, but do not provide a supply buffer during price shocks. Finally, without an effective procurement and hedging strategy, countries are constrained in terms of mitigating their exposure to price volatility. A comprehensive approach that incorporates strategic reserves, supply-chain logistics, and procurement strategies is critical to reducing import risks and will have the greatest impact on improving food security.

Each Arab country faces constraints and risks that are common throughout the region as well as its own unique vulnerabilities, which depend on a host of factors including geography, politics, resource endowments, fiscal balances, and tolerance for risk. To address both regional and country-specific import risks, Arab countries can use targeted investments and policy reform to improve efficiency throughout the WISC, concentrating on strategic storage, logistics, and procurement. Cross-border cooperation could also be leveraged to implement regional solutions. Improvements to the WISC may generate significant spillover benefits for sectors ranging from barley (Arab countries import 57 percent of the world's traded barley) and other bulk cargo such as coal, iron ore, and fertilizer, to non-consumables that are imported through the same ports and transported on the same roads. Food security is a challenge all Arab countries face, and it is critical that country governments, the donor community and the private sector coordinate efforts closely.

1 Why is a Well-Performing Wheat-Import Supply Chain Critical for Arab Countries?

Since mid-2010, high international agricultural commodity prices have raised concerns about a repeat of the 2007–08 food-price crisis. Globally, the 2010–11 food-price shock has already resulted in an estimated 44 million more people in poverty, with 68 million net food consumers falling below the poverty line, and 24 million net producers being able to escape poverty due to higher food prices (World Bank 2011a). Arab countries are particularly concerned because they are highly dependent on international commodity markets for cereals, especially wheat.[2]

While the recent uprisings in Arab countries cannot be attributed directly to rising agricultural commodity prices, the price shock is often perceived as a contributing factor of unrest in select countries and remains a significant concern for the entire region. Moreover, it appears that many of the underlying factors behind high and volatile prices are here to stay. Structural factors, such as population and income growth and biofuel demand, may prevent real prices from sliding back to the historic lows witnessed a decade ago, while low stock-to-use ratios amplify price due to small transitory changes in supply.

There are different paths Arab countries can take to achieve food security. In terms of wheat, Arab countries can work toward food security by increasing levels of self-sufficiency, improving agricultural self-reliance, reducing the agriculture sector's climate change-induced production variance, and by optimizing their wheat-import supply chain (WISC), or some combination of these options. This study does not suggest which approach countries should pursue, but rather focuses on how improvements to WISCs in Arab countries can improve food security. The study explores import risks Arab countries are facing—including supply disruptions, food price inflation, and product losses—and identifies opportunities for infrastructure investment and policy reform. The key messages of this chapter are:

- **Internationally traded cereals may be entering a period of sustained price volatility due to more frequent weather-induced**

2 Arab countries include all members of the League of Arab States (LAS): Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates (UAE), and Yemen.

supply shocks, low stock-to-use ratios, and trade policy responses.

- **Given their high dependence on cereal imports, particularly wheat, Arab countries are vulnerable to high and volatile international prices.**
- **Supply disruptions can threaten national security, suggesting that supply chains must be efficient and reliable.**
- **Investments in wheat-import supply chains are critical to reducing Arab countries exposure to import price and supply risks.**

Are high and volatile cereal prices likely to continue?

Two price shocks in international commodity markets in the last four years have spurred much discussion on the drivers of cereal prices and the impact these drivers have on price volatility.[3] According to the United Nations' Food and Agriculture Organization's (FAO) monthly Cereals Price Index, prices peaked in April 2008 with the index reaching 274. Cereal prices then fell precipitously at the end of 2008, and the index hit 151 in June 2010 before spiking again to 265 in April 2011 (FAO 2011b). Multiple factors contribute to higher and more volatile cereal prices, and many of these factors are correlated with each other. Promoting the production of biofuels, high and volatile petroleum prices, the relative depreciation of the US dollar, and increased commodity speculation have all contributed to rising production costs and increasing volatility in international cereal markets.[4]

Climate change may contribute to more frequent weather-induced supply shocks in global wheat markets. Severe weather events increase the variability of agricultural yields, and the number of reported droughts, floods, and extreme temperatures appears to be on the rise (World Bank 2011a; CRED 2011).[5] In 2010, for example, flooding in Australia, Pakistan, and West Africa, as well as the heat waves in Russia and the United States contributed to a reduction in global cereal production. A simulation of the potential impact of climate change on wheat prices in Arab countries (Larson et al. 2011) suggests that a fourfold increase in production variance would result in higher average prices as well as more price spikes (Figure 1-1).[6]

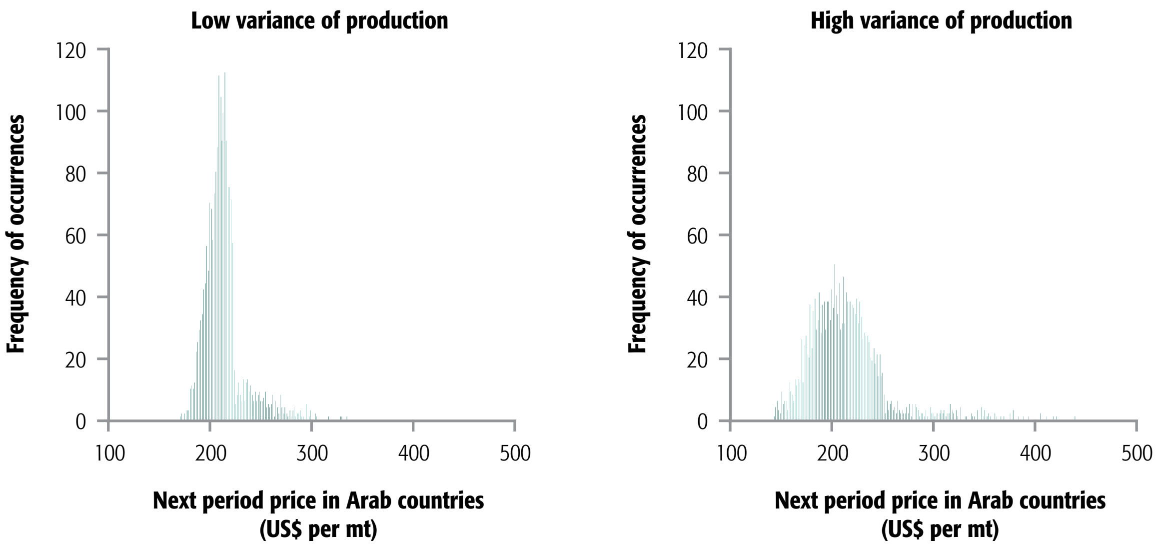
3 See for example: FAO 2009; Wright 2009, 2011; European Commission 2009; Heady and Fan 2008; FAO et al. 2011; World Bank 2011a.

4 Policies that promote the production of biofuels such as ethanol and biodiesel shift land away from production of food and pasture (FAO 2008), thereby reducing supply of land dedicated to food production. High and volatile prices of petroleum, a primary ingredient of fuel and fertilizer, are passed on to the production and transport of cereals. The depreciation of the US dollar against most hard currencies increases demand for cereals because these commodities become cheaper in real terms since they are priced in dollars. Financial speculation may also contribute to higher and more volatile prices as investors shift to real assets, including commodities, during periods of uncertainty. However, it's important to consider the possibility that speculation may be more a result of price volatility than a cause (World Bank 2011a). For further details on other factors contributing to higher and more volatile cereal prices, see World Bank 2009 and World Bank 2011a.

5 The apparent increase in extreme weather events may be due to the fact that reporting of such events has likely increased, in addition to an increase in the actual number of occurrences.

6 In the model, the realized price is based on consumption, trade, and storage decisions, given the realized production level. Arab countries included in the model are: Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco,

FIGURE 1-1 **Simulations suggest that greater uncertainty in wheat production may make prices more unpredictable**



Source: Larson et al. 2011.
Note: These results are meant to illustrate the relationship between production variance and price and do not predict actual wheat prices in Arab countries. The results from the model simulation are for 2,000 iterations. The low variance of production scenario is based on a variance of 0.015 while the high variance of production scenario is based on a variance of 0.060.

This variability will be exacerbated by the expansion of agriculture into marginal lands in response to increased demand for food from rising population and incomes (Wiebe 2003).[7] Arab countries will be doubly hit by climate change: first, their domestic production will suffer, and second, global supplies, which they rely on for imports, will also be affected.

Low global stock-to-use ratios—and policy responses in the form of export restrictions by major cereal exporters—further exacerbate market instability. Cereal prices are more likely to spike when global stock-to-use ratios are low (Wright 2009). When low stock levels are combined with more frequent weather-induced supply shocks, the international cereal market will be more vulnerable to disruptions.[8] In the event of international market instability, exporters may impose export restrictions to ensure sufficient domestic supply and to stem any domestic price increases. The use of such trade measures can contribute to a rapid escalation of global market

Oman, Saudi Arabia, Sudan, Syria, Tunisia, UAE, and Yemen. For further explanation of the model, see Chapter 2.

7 Population growth will contribute to increased demand for cereals for food, while rising incomes will contribute to increased demand for cereals for feed.

8 Thin international cereal markets may cause relatively small shifts in supply or demand to lead to large shifts in prices. Less than 20 percent of world wheat production is exported; the rest is consumed domestically (USDA 2011a). The thinner the market, the sharper the fluctuation in international prices and the higher the likelihood of future price shocks.

prices. For example, Vietnam and India, two of the world's largest rice exporters, restricted rice exports in March 2008, contributing to a price shock in the international rice market. More recently, the 2010 Russian export ban not only put upward pressure on prices, but it also led to short-term contract defaults and supply disruptions in Arab countries that relied on Russian imports.

Why are Arab countries vulnerable to what is happening in world wheat markets?

Arab countries are highly dependent on imported cereal, particularly wheat, and their dependence is expected to grow. Arab countries are the largest net importers of cereal calories in the world, importing roughly 56 percent of the cereal calories they consume. Wheat accounts for the largest share of cereal consumption and is a key part of the regional diet.[9] Demand for wheat in the Arab world is relatively inelastic, resulting in little substitution even when prices are high. In 2010, Arab countries imported 30 percent of the world's traded wheat. Arab countries' reliance on wheat imports is expected to grow due to structural factors, such as population and income growth, which are increasing faster in Arab countries than elsewhere.[10] Given the limited resources of water and arable land in Arab countries, the ratio of food imports to total exports in Arab countries is above the current international average, and projections of the region's food balance indicate that wheat imports will increase by almost 75 percent over the next 30 years (IFPRI 2010). Within the Arab world, countries with high wheat-import dependence and large fiscal deficits are most vulnerable to international market volatility.[11] Based on 2011 projected fiscal balances and 2010 wheat-import and consumption data, Libya, Jordan, Yemen, Djibouti, Lebanon, Iraq, Egypt, Algeria, and Tunisia are most vulnerable to a sustained food-price shock. The Gulf Cooperation Council (GCC) countries have both very high import dependence and fiscal surpluses, but if oil revenues fall their ability to cushion price shocks would be reduced. Syria and Morocco have strained fiscal balances, but their import dependence is lower due to higher levels of domestic wheat production.

Countries can pursue different paths to food security.[12] Self-sufficiency is sometimes considered the first best policy to addressing food price volatility, but this approach may be costly

9 Among Arab countries, Tunisians eat the most wheat (in terms of share of total caloric consumption), getting 48 percent of their total calories from wheat; Kuwaitis eat the least wheat but still get 23 percent of their total calories from wheat (data based on USDA 2011a, FAO 2011a).

10 Since 2005, the population growth rate of Arab countries has averaged 2.1 percent compared to a world rate of 1.2 percent, and the average income growth rate of Arab countries is 3.0 percent, outpacing the global average of 1.1 percent (World Bank 2011d).

11 A country's macroeconomic vulnerability to wheat price shocks (assuming price risk is absorbed as a fiscal liability) depends on two key factors: (1) wheat-import dependence provides an indication of the level of exposure to international market risks that countries face, and (2) fiscal balance provides an indication of a government's ability to mitigate the effects of a price shock. However, it should be noted that fiscal surpluses do not guarantee a country's food security. Fiscal positions can shift dramatically from year to year, especially if a country's economy is dependent on commodity prices such as oil and gas.

12 See for example the framework discussed in World Bank 2009.

(Magnan et al. 2011). First, there is a high opportunity cost to using the limited land and water resources for the production of a low-value crop such as wheat. Moreover, if a country expands its domestic wheat production into marginal areas, it becomes more susceptible to production shortfalls, ultimately driving the country to seek imports from the international market to fill the gap. Arab countries may consider alternative combinations of policies to increase food security, including pursuing a strategy of agricultural self-reliance, where agricultural export revenues can cover food-import costs (Magnan et al. 2011); reducing the agriculture sector's vulnerability to climate change-induced production variance; and improving import supply chains.

This study focuses on one policy: improving wheat-import supply chains (WISC). A well-performing WISC is critical because even if Arab countries pursue other food-security policies, their exposure to import risks is projected to increase. A well-performing WISC can help mitigate these risks by improving supply-chain logistics, including making more effective use of strategic storage and financial instruments. This will help ensure reliable and consistent access to less expensive imports, reduce both the fiscal and economic cost of importing, and reduce domestic price volatility.

What are the major import risks Arab countries are facing?

As net wheat importers, Arab countries are exposed to a number of food-security risks. One risk is that international wheat prices will be prohibitively high, making purchase difficult, even though supply is available on world markets. Another risk is that food will not be available, even if there are sufficient funds for purchase. The price and supply of a good are economically related, connecting these two sets of risks. However, these two sets of risk threaten two separate aspects of food security: availability (supply) and accessibility (price). Therefore, for the purposes of this study, these two concepts will be treated as separate, using the terms "price risk" and "supply risk."

In terms of supply risk, many Arab countries are concerned that their national security would be threatened if import supply disruptions lead to insufficient wheat supplies. The likelihood of such disruptions is higher and the consequences are likely to be more severe for countries that are heavily dependent on imports. Disruptions could occur for a number of reasons such as civil unrest, military conflict,[13] and port closures.[14] For instance, the crisis in Libya in the spring of 2011 made it difficult for the National Supply Corporation (NASCO) to resupply national

13 Unrest in Egypt, Libya, Syria, and Yemen during the Arab Spring led to supply disruptions at unloading ports and contributed to reported food shortages in these countries.

14 Arab countries with few import entry points may face higher supply risk than countries with multiple import entry points. Several Arab countries rely on a single unloading port for their wheat trade. For example, Jordan relies on the Port of Aqaba and Lebanon relies primarily on the Port of Beirut. Operations in such countries go smoothly, as long as the facilities at the port are designed to handle the current throughput. However, in the event of a disruption at the port, or if a surge cannot be handled by existing facilities, severe bottlenecks or even acute supply shortages may occur.

food stocks, and access to food was curtailed for much of the population, particularly for the most vulnerable such as those displaced by the conflict (World Bank 2011b). In May 2011, estimates by the United Nations' World Food Programme (WFP) suggested that food supplies could have run out within six to eight weeks unless plans were put in place to avoid a crisis (OCHA 2011).

In terms of price risk, rising international prices and increased volatility appear to have a significant impact on inflation. In most Arab countries, food-price inflation outpaces overall inflation (World Bank 2011c). The poor are likely to be hardest hit because they typically spend anywhere from 35 to 65 percent of their income on food (World Bank 2009). Moreover, given that there is a relatively high concentration of households living near the poverty line, rising wheat prices, and therefore the cost of wheat-based staples, may contribute to an increase in the overall incidence, depth, and severity of poverty levels in Arab countries.[15] To mitigate the effect of food inflation, particularly for the poor, Arab governments use safety nets, which could be in the form of food consumption subsidies or direct (cash and/or in-kind) transfers.[16] Understanding how safety nets, particularly consumption subsidies, impact both WISC costs and domestic food prices is crucial to helping Arab governments better manage their fiscal liabilities. Consumption subsidies are intended to insulate the population from the pass-through of international prices,[17] by transferring this cost to government. Governments' fiscal liabilities vary by country; some Arab governments are more successful than others in reducing universal consumption subsidies and targeting the poor.[18] Surging international wheat prices can place significant upward pressure on fiscal budgets, depending on the level of domestic consumption subsidies.

15 The extent to which rising wheat prices push more people below the poverty line depends on the level of domestic consumption subsidies and other country-specific factors, including infrastructure quality and exchange rates(World Bank 2011c).

16 In contrast to in-kind transfers, cash transfers may impose less fiscal burden on the government budget. However, in-kind transfers are more politically popular given that they directly address the social concern of food security.

17 From 2000 to 2011 the strongest pass-through effects of an increase in international food prices were observed in West Bank and Gaza, Iraq, Djibouti, Egypt, and the UAE, each with a pass-through coefficient above 0.4. The pass-through coefficient is smaller but still sizable, varying between 0.2 and 0.4, for Morocco, Jordan, Syria, Yemen, and the other GCC countries. This indicates a high degree of vulnerability of households to international food price increases in virtually all Arab countries. For a more in-depth assessment of food-price inflation in Arab countries and the pass-through of international food prices into domestic food prices, see World Bank 2011c.

18 Consumption subsidies that are not well targeted result in unnecessarily high public liabilities for a number of reasons. First, subsidizing wheat, flour, and bread in the domestic market contributes to greater demand within a country as well as increased smuggling across borders into countries where the domestic price is higher (Gupta et al. 2000). In turn, this contributes to higher domestic consumption levels and thereby more imports. Second, the subsidies are often universal or poorly targeted. This can lead to errors of inclusion and/or exclusion, where the government subsidizes parts of the population that may not need the assistance while sometimes inadvertently excluding the most vulnerable people from the safety net program. Third, "quasi-fiscal" subsidies, such as those for the cost of storage and transport, contribute to governments' fiscal liabilities and may stifle the efficiency gains of a competitive sector.

High WISC logistics costs further increase the base cost of importing wheat, and despite the use of safety nets, may also contribute to increased volatility of local wheat prices. First, WISC logistics are a perennial fixed-cost component of imported wheat. Improving wheat-import supply chains can reduce the base cost of importing wheat and in turn, alleviate pressure on fiscal and/or household budgets. Second, WISC logistics impact local wheat-price volatility, which is determined by both international price volatility and the reliability of the WISC. As discussed above, many Arab governments try to minimize domestic wheat-price volatility by absorbing international price shocks through consumption subsidies. However, while improving WISC logistics will not reduce the frequency or likelihood of international price shocks, an unreliable WISC may cause domestic price shocks in the event that supply-chain disruptions lead to localized supply shortages.

Product losses throughout the supply chain create an additional cost. Inefficient WISCs increase the likelihood of spillage and spoilage.[19] Wheat losses in Arab countries range anywhere from less than 1 to over 5 percent of supply per year. This figure does not include losses due to pilferage or cross-border smuggling. The latter tends to occur most frequently when international prices are high; smugglers transport wheat from countries with wheat or flour subsidies to countries where the price is more aligned with the higher international price in order to seek profits on the black market. Due to the problem of product losses, Arab countries end up importing more wheat than is needed for consumption. Therefore, stemming wheat losses could help reduce the required level of imports, thereby reducing exposure to price volatility and reducing import bills. Further discussion on product losses and how Arab countries can reduce them is also provided in Chapter 3.

What is the objective of the WISC study and how will countries' performance be measured?

The objective of the study is to assess Arab countries' WISC performance, identify possible bottlenecks, and provide recommendations to remove them. The study examines the extent to which government and/or private sector stakeholders can control costs and improve the reliability of efficiently moving wheat through the supply chain. The study includes 10 Arab countries: Bahrain, Egypt, Jordan, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and Yemen. Arab countries' price and supply risks can increase significantly if supply chains fail to perform, particularly during food-price shocks or periods of social unrest. To address these challenges, the study takes a holistic view of the WISC, examining ways in which countries can make better use of strategic storage (Chapter 2), reduce WISC logistics costs and transit times (Chapter 3), and make better use of procurement and hedging instruments (Chapter 4).

19 Spillage refers to wheat that is lost in the WISC due to grains lost during handling and transport as well as the inability to unload every last grain of wheat. Spoilage refers to wheat that is no longer of a consumable quality.

The WISC study has a narrow focus. This study only focuses on those WISC segments that are within the borders of the country being assessed. In terms of logistics, the analysis begins with the ship's arrival at the port of the receiving country and examines the handling of wheat in bulk up to storage at the flour mill. While procurement is considered, the study does not evaluate wheat production, transport to loading port in the exporting country, or ocean shipping transit times and costs. Furthermore, the study does not consider the downstream segments of the supply chain after bulk storage at the flour mill, including the milling, transport, storage, and handling of wheat flour by bakeries and retailers in the importing country. These downstream segments tend to be subsidized at different levels depending on the country, making them more difficult to measure accurately and to compare reliably across Arab countries. The disadvantage to this exclusion is that the study does not consider other potential opportunities for Arab countries to reduce downstream WISC costs and transit times of wheat flour. It is possible that substantial cost and transit-time savings may be achieved in these segments, and further analysis may be considered in a subsequent study.

To assess performance, WISCs are compared against one another and against those of the Netherlands and South Korea.[20] The Netherlands was included because it is both a major wheat-importing country and has outstanding logistics performance. The Netherlands' role in the analysis is to serve as a reference of ideal WISC performance rather than as a comparator country. However, the structure of the Netherlands' WISC is different from that in many Arab countries. South Korea was therefore selected as an Asian benchmark because, like Arab countries, it is highly dependent on wheat imports,[21] and its WISC is somewhat comparable in size and structure to that of some Arab countries.

The study provides a high-level strategic framework for Arab countries to optimize their WISC. In order to make informed recommendations to improve WISC performance, the team focused on strategic options that are feasible for all Arab countries. Due to each country's unique fiscal, geographical, and/or political constraints more specific operational recommendations are summarized in Table 3-1 and are included in country-specific presentations delivered directly to participating Arab countries.

[20] The Netherlands is the world's third largest importer of wheat by volume, although roughly three quarters of the Netherlands' wheat imports come from within the European Union (USDA 2011, Eurostat 2011). The Netherlands ranks fourth in the World Bank's 2010 Logistics Performance Index.

[21] South Korea's wheat-import dependency ratio (net imports divided by consumption) is 98 percent (USDA 2011).

2 How Can Strategic Reserves Be an Integral Part of a Country's Food Security Strategy?

There are two conceptual types of storage for wheat: operational and strategic.[22] Operational storage regulates the flow of incoming and outgoing wheat in the supply chain to create smooth logistics; it is discussed further in Chapter 3. This chapter focuses on strategic storage, which aims to mitigate both import supply and price risks. Strategic reserves can provide wheat that is ready for immediate consumption in emergency situations, providing the government critical lead time to secure alternative wheat supplies. In addition, evidence suggests that higher levels of wheat stocks can help smooth the volatility of international wheat prices and buffer against some price shocks. While operational storage is driven by logistics, strategic storage is driven by public policy.

Strategic storage is an ancient tradition in the region, and many countries currently have in place some form of strategic wheat-reserve policy. However, with heightened concerns about food security following the 2007–08 food crisis and another food-price shock in 2010–11, Arab countries are revisiting their strategies. In fact, many Arab countries are considering expanding their strategic reserves to be able to hold six months' to one year's worth of wheat stocks. Although wheat reserves offer no protection against structural, long-term price increases, they effectively serve as an insurance policy with costs and benefits that must be carefully considered. The key messages of this chapter are:

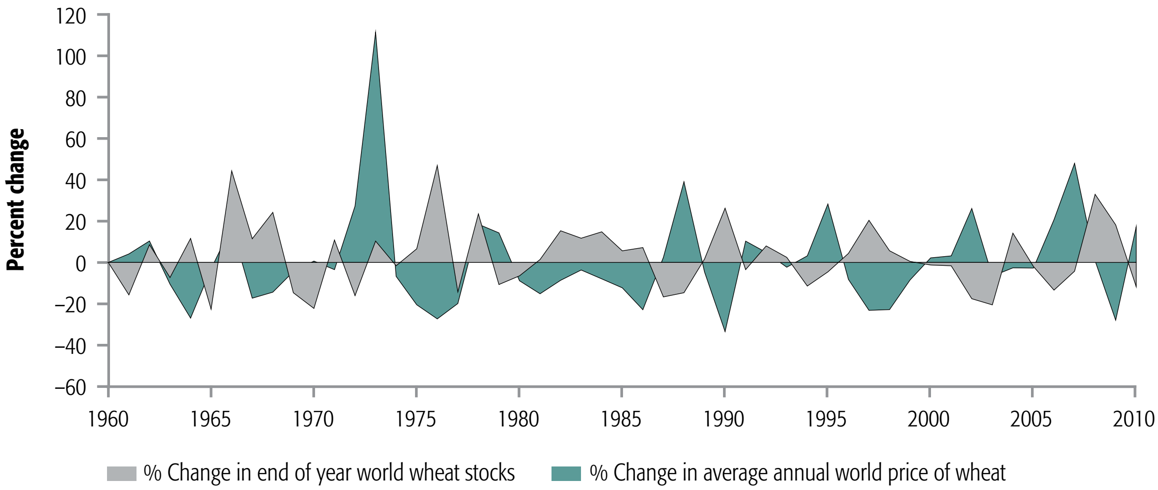
- **Strategic reserves may reduce volatility in domestic and international wheat prices, as well as the frequency of price shocks.**
- **Strategic reserves located in an importing country mitigate supply risks by providing wheat supplies in times of crisis.**
- **Many Arab countries are planning to increase existing storage capacity to increase wheat reserves and help insulate themselves from future import risks.**
- **A strategic reserve policy must be carefully designed and properly managed to be successful.**

How do strategic reserves address price risks?

Historical data (Figure 2-1) suggest there is a strong negative correlation between changes in

22 While this study treats operational and strategic storage as two separate ideas, in practice, they are frequently combined in one facility. See Chapter 3 for further explanation.

FIGURE 2-1 | **Wheat stocks are negatively correlated with wheat prices**



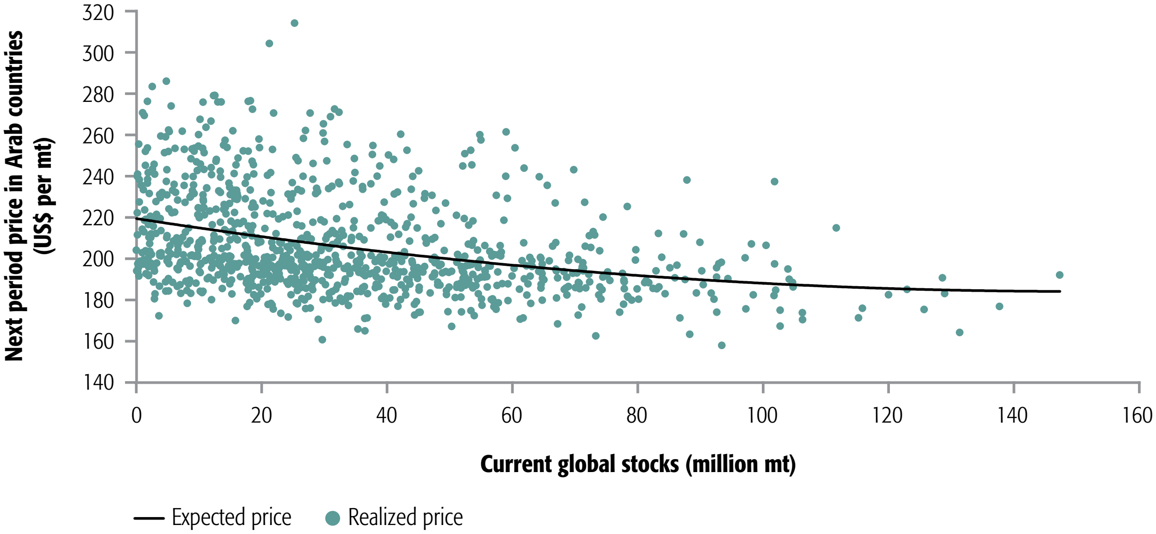
Source: Authors, based on USDA 2011a, USDA 2011c, BLS 2011.
Note: Correlation of world wheat stocks and prices is –0.8. World price of wheat was adjusted using the US Consumer Price. Index (CPI).

wheat stocks and changes in world wheat prices. This supports the notion that, holding consumption constant, world wheat prices spike when global stocks-to-use ratios are low (Wright and Cafiero 2010). What is the explanation for this relationship? Perhaps it is the psychological effect: in the event of an unexpected wheat supply shortage, if global stocks are known to be plentiful, there is less likely to be a run on wheat purchases, which would otherwise drive prices up.

Some models suggest that maintaining larger wheat stocks could reduce international price volatility and the frequency of price shocks. The increased volatility in wheat production of the past few years, which is projected to continue, has been reflected in the increased volatility of international wheat prices. A conceptual model for inter-temporal commodity storage concluded that storage of commodities was less effective in preventing high prices and more effective in eliminating low prices (Wright and Williams 1982). An applied numerical version of this same model tailors the parameters for Arab countries as a bloc and applies a distribution of supply shocks (Larson et al. 2011). The simulation suggests that increasing uncertainty regarding production may make prices more unpredictable. Storage may be one way to smooth price volatility.

Low carryover inventories can result in more volatile prices and a greater likelihood of price spikes. When production output is more variable and starting inventory levels are high, a harvest shortfall can be handled by drawing down stocks to prevent prices from rising significantly. However, when starting inventories are low, the same harvest shortfall may result in a much greater price increase. Model simulation demonstrates that not only does strategic storage reduce the volatility of

FIGURE 2-2 **Simulations suggest that higher global stock levels may provide a buffer to supply shocks and thus mitigate price risks**



Source: Larson et al. 2011.
Note: These results are meant to illustrate the relationship between global stock levels and the expected price of wheat in Arab countries and do not predict actual wheat prices.

domestic prices, but that storage is more effective in reducing volatility when stock levels are higher (Figure 2-2) (Larson et al. 2011). For example, in the late 1960s major wheat exporters began to reduce stocks, and rising global demand coupled with production shortfalls in 1972, among other factors, resulted in a major wheat price shock (Peters et al. 2009).[23] For a given set of supply shocks simulated by the model, the domestic price distribution will lean toward higher prices when inventories are low, and vice versa.

Strategic reserves in any country can have a positive effect on international prices. Increasing stocks in any country, whether the country of origin or the importer, contributes to increasing global stock-to-use ratios. Thus, even if storage in an importing country is more costly, maintaining stocks to mitigate region-specific supply risks can also have an impact on the global wheat market and in turn mitigate international price risks.

How do strategic reserves address supply risks?

Strategic reserves of physical wheat mitigate supply risk by providing critical lead time to secure alternative wheat supplies or supply

23 An alternative approach to protect vulnerable consumers from domestic price risk is a safety net program such as a cash transfer. While this policy may be less costly than maintaining strategic reserves (Larson et al. 2011), it does not protect consumers from possible wheat supply shortages.

routes during times of crisis. In the event that supplies run short, strategic reserves can provide a short-term bridge while the government considers some longer-term options (Murphy 2009).[24] Wheat accounts for a large share of the diet in Arab countries and short-term demand is relatively inelastic. Constant demand coupled with a variable short-term supply may result in a supply gap, particularly during crisis situations (Murphy 2009). If the domestic wheat supply is not sufficient to feed the population, crises such as sudden infrastructure blockages that prevent imports from entering the country, spikes in international wheat prices to levels that the government had not prepared for, and natural disasters or civil war can cause food shortages and hunger. Strategic wheat reserves provide a supply of wheat that is ready for immediate consumption in emergency situations such as these.

Strategic reserves also allow wheat buyers commercial leverage in the international market, and maintaining wheat reserves offers psychological benefits that may prevent hoarding and pilferage in times of crisis. Some wheat suppliers may see an opportunity to charge higher prices for wheat when the need is immediate since demand is relatively inelastic. By offering short-term alternatives for wheat supply, strategic reserves can help Arab countries buffer against price gouging. Without reserves, volatility in wheat markets can also encourage hoarding and pilferage, which ultimately reduces the available supply and drives up prices, hurting poor consumers and distorting market signals (Murphy 2009). By reassuring markets that supply is sufficient and thereby calming possible fears of a supply shortage, known strategic wheat reserves can reduce the inclination to hoard or steal wheat in anticipation of leaner times and may reduce future market disruptions.[25]

Are Arab countries making effective use of strategic reserves?

Despite being the largest wheat-importing region, in 2010 Arab countries held only 10 percent of the world's wheat stocks. Egypt is the only Arab country among the top-ten wheat-stock holding countries (Table 2-1). The majority of global wheat stocks are held in wheat-producing countries such as China, the United States, and India,[26] which may indicate that it is more cost effective to hold stocks close to production. In China and India, public sector stocks play a significant role, and thus changes to reserve policies in those countries may have implications for global wheat markets, and thereby for Arab countries.

As food security concerns have grown, many Arab governments have revisited the idea of strategic reserves and are planning to increase their level of wheat stocks. Overall storage capacity in the region is on average six months of consumption, and estimated ending stocks are

24 Reserves offer only a temporary solution to supply shortages and therefore importers will eventually need to purchase wheat again from the international market, possibly at a time when prices are still high.

25 This assumes that the policy is effective in releasing wheat from the strategic reserve when prices are high.

26 China, the United States, and India account for nearly 40 percent of global wheat production and merely 3 percent of global wheat imports.

27 Ending stocks for a given year are calculated by taking domestic production plus net imports, minus consumption.

TABLE 2-1 **China, the United States, and India hold more than 50 percent of the world's wheat reserves (Market Year 2010)**

Country	MY 2010 Ending Wheat Stocks ('000 mt)	% of Global Ending Wheat Stocks	MY 2010 Wheat Imports ('000 mt)	% of Global Wheat Imports
China	60,091	31%	927	0.7%
United States	23,427	12%	2,638	2.0%
India	15,360	8%	300	0.2%
Russia	13,546	7%	100	0.1%
European Union	11,766	6%	4,500	3.5%
Canada	5,896	3%	400	0.3%
Egypt	5,596	3%	10,400	8.1%
Iran	4,936	3%	506	0.4%
Australia	4,157	2%	100	0.1 %
Ukraine	3,452	2%	50	0.0%

Source: USDA 2011a.

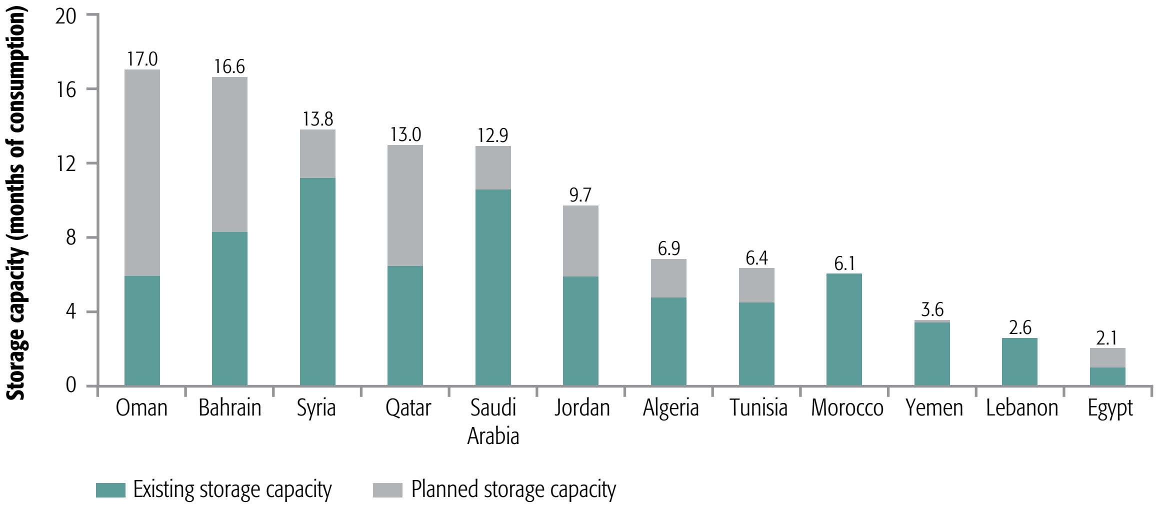
four and one-half months.[27] Syria has the largest existing storage capacity in terms of volume, while Syria and Saudi Arabia both have existing storage capacities that exceed ten months of consumption.[28] Nevertheless, Syria and Saudi Arabia—as well as many other Arab countries—plan to increase their strategic wheat-storage capacity (Figure 2-3) to accommodate wheat reserves that will last one year, or up to two years in some cases. Increasing stock levels by any amount helps mitigate supply risk.

Maintaining strategic stocks comes at a cost. Each country must decide how much they are willing to spend in exchange for the physical, financial, and psychological security that comes with strategic wheat reserves. On average, storage in Arab countries costs US$2.15 per metric ton per month, which means that increasing storage by three months would increase the overall cost of the reserve by US$6.44 per metric ton of wheat.[29] If a country that imports 3 million metric tons per year adds three months of strategic storage over the course of one year, this country would increase its annual imports from 3 million to 3.75 million metric tons. Supposing that the

28 Estimates of storage capacity in terms of months of consumption assume that all silo storage capacity is dedicated to wheat and that silos are kept one hundred percent full. While these assumptions are not realistic, given that countries also store other grains such as barley, the assumptions are used to give an idea of the maximum possible level of public stocks. These estimates also do not account for private storage for which comprehensive information is difficult to obtain.

29 This figure is based on reported storage costs. As there may be indirect subsidies that help lower the cost of storage, this figure is likely to underestimate the full economic cost of increasing storage by three months. Moreover, the figure is an average for the region (weighted by volume of imports) and varies from country to country depending on the level of domestic subsidies.

FIGURE 2-3 **Many Arab countries are planning to increase storage capacity**



Source: Authors, USDA 2010b, USDA 2011a, USDA 2011b, Carey 2011, MuscatDaily 2011, La Tribune Online 2010, World Grain 2011.
Note: These figures assume all storage capacity is dedicated to wheat and silos are kept 100% full. Qatar and Bahrain do not have concrete plans to increase storage capacity, however they have discussed increasing their strategic stocks and the authors assume for now that they will therefore double existing storage capacity. This estimate may be a lower bound, as demand is expected to grow. Egypt's goal is to add an additional 4.5 million metric tons of storage, yet only 1.5 million metric tons of capacity are currently planned to be built. If all 4.5 million metric tons of storage were included in the chart, Egypt's existing and planned storage capacity would be equivalent to roughly 3.9 months of consumption.

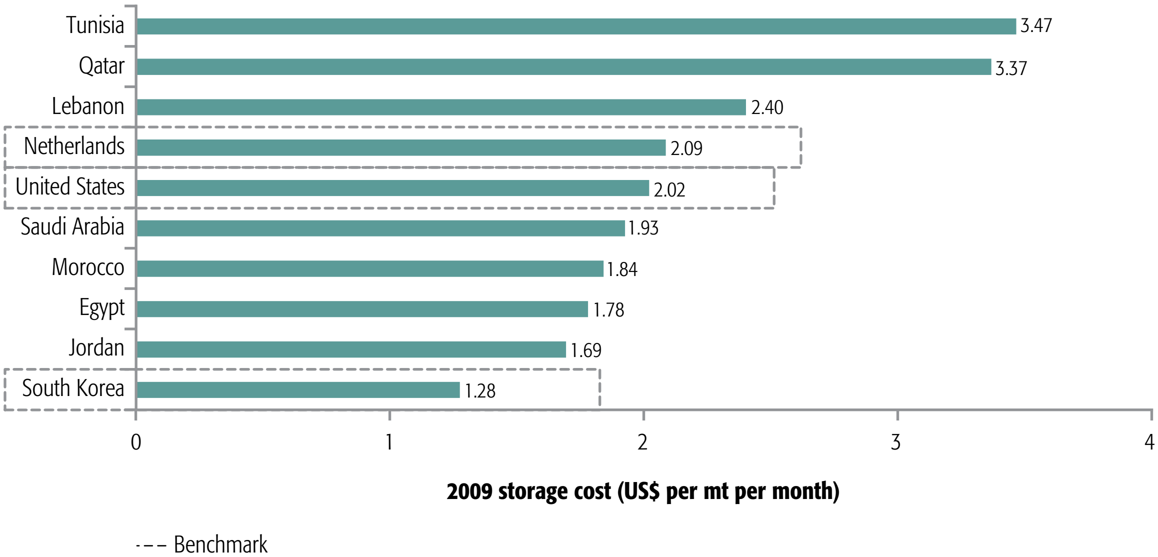
average Cost and Freight (CFR) price in 2009 was US$210 per metric ton,[30] this would increase the import bill that year by around US$158 million, plus an additional US$24 million to store this wheat, resulting in additional costs of US$182 million. But if the average CFR price in 2010 rose to US$280 per metric ton, adding these storage costs in 2009 would still be less expensive than the US$210 million it would cost to import three months worth of wheat consumption in 2010. Thus, for a country that imports and consumes approximately 3 million metric tons of wheat per year, adding three months of storage could save the country over US$28 million in a year of a price shock similar to the one from 2009 to 2010.[31] Countries may also want to consider the additional costs, such as fumigation, cost of capital, and transportation associated with increasing strategic reserves when they decide what level of stocks should be held.

However, storage costs may be underestimates in some cases as many Arab countries subsidize

30 Incoterms Cost and Freight (CFR) is specified in contracts where the delivery of goods to a named port of destination/discharge is at the seller's expense. The buyer is responsible for the cargo insurance and other costs and risks. The term CFR was formerly written as C&F.

31 This calculation assumes that the storage capacity to increase reserves already exists and an upfront investment is not required. The break-even point in this scenario is US$242. In other words, if prices fall in single year or increase but to a level less than US$242, costs of maintaining reserves may be greater than that year's savings. In other words, savings accrued in future years thanks to the strategic reserves depend on fluctuations in international wheat prices and the amount of reserves that are drawn down.

FIGURE 2-4 **Storage costs vary from one to four dollars**



Source: Authors.
Note: Data are for 2009. Bahrain, Oman, and Yemen were not included in the chart because the storage-cost data was insufficient.

the cost of storing wheat, putting further pressure on fiscal budgets. The relative size of the subsidy in Arab countries can be estimated by comparing their storage costs with the cost of storage in the Netherlands, South Korea, and the United States. In all three benchmark countries, the private sector manages the WISC in markets characterized by high competition. Assuming the long-term marginal cost of storage is approximately US$2 per metric ton per month,[32] in 2009, four Arab countries fell below this international rate, suggesting either lower land, labor or capital costs or the presence of direct or indirect subsidies (Figure 2-4). That same year, three Arab countries had storage costs above the benchmark suggesting potential for efficiency gains. For example, by multiplying Jordan's annual wheat consumption by the difference between its storage cost and the international storage cost and adjusting for Jordan's average dwell time, the cost of the quasi-fiscal subsidy to Jordan could be estimated at around US$1.3 million per year. This money could be used instead for infrastructure investments that would provide long-term benefits.

What key issues should be addressed in developing a policy for strategic wheat reserves?

While strategic reserves can help mitigate both supply and price risks, there are significant costs

32 Although the average storage cost for the Netherlands, South Korea, and the United States is US$1.79 per metric ton per month, the long term marginal cost is conservatively assumed to be US$2 per metric ton per month.

associated with implementing this policy. If existing storage capacity is not sufficient to hold the desired level of reserves, investments can be made to expand capacity by building new storage facilities. When additional storage capacity is located inland, the increase in throughput volumes during build up and replenishment of reserves places additional burden on transport infrastructure and may require upgrading transport and handling systems. Even if countries choose to build up their reserves gradually, they must be able to finance the increase in the import bill.[33] Countries also face the extra cost of storing and maintaining the reserve, including increased fumigation and rotation costs, costs for training staff in how to manage the reserve, and higher cost of capital. These costs are offset by any release of stocks which may be sold at a pre-determined price.[34] While investing in reserves can be beneficial, every extra metric ton of wheat stored costs money that could be spent on other issues such as education and healthcare.

There is no optimal level of strategic wheat reserves; the preferred size of the reserve depends on a country's level of import dependency, vulnerability to supply disruptions and price shocks, and risk tolerance. A 1987 study attempted to develop a guideline for the size of strategic reserves and suggested that the size of reserves should assume "at least 95 percent of the food-insecure population need to be protected by providing a ration of 400 grams of cereal per capita per day for a period of four months, which is considered to be the necessary lead time to import and distribute the food to beneficiaries" (Rashid and Lemma 2011). To determine optimal levels of strategic wheat reserves, a country must first consider its degree of import dependency by examining current and projected wheat consumption and domestic production, keeping in mind that consumption patterns during food shortages can be lower than normal (Murphy 2009). Second, each country must assess its relative vulnerability to supply disruptions and price shocks, and how long those disruptions may last.[35] Conducting a strengths-weaknesses-opportunities-threats (SWOT) analysis of the WISC as well as an evaluation of past supply disruptions and any corrective measures taken will help highlight potential vulnerabilities to future supply disruptions. Lastly, the size of a strategic wheat reserve is dependent on a country's own tolerance for risk. More risk-averse countries may be willing to spend more money to maintain larger reserves. Ultimately, however, the size of the reserve comes down to a tradeoff between insurance against risk and the cost of that insurance.

Strategic reserves may be considered the supply of last resort and therefore should be located within the borders of the country who owns the reserves. Some people suggest that, in terms of cost, strategic reserves should be held

33 Assuming the first-in-first-out (FIFO) principle, once strategic reserves are built up to the desired level, the country can go back to importing the volume needed for consumption, until reserves are drawn down and must be replenished.

34 Any strategic reserve policy will need to define a maximum domestic price, above which the policy is triggered to draw down reserves. This threshold price should be pre-determined.

35 Supply disruptions can take many different forms including logistical bottlenecks that delay delivery of supplies, accidents such as a dust explosion at a silo, and emergency situations in which there is a shortage of existing supplies within a country and new wheat imports are inaccessible.

in the country of production (exporting country) (Larson et al. 2011). Assuming the cost of storage is the same, and ignoring the cost of capital, storing wheat in the country of production saves the importer the cost of transportation if they choose not to draw down the stocks and import the wheat for consumption. However, if an import-dependent country is facing a supply shortage due to port closures or trade restrictions imposed by major wheat-exporting countries, reserves in another country will be of no use. Locating reserves within the importing country may be more costly, but this will keep the wheat where it is needed.

The optimal location for the strategic reserve is at the point of entry into the country, connected to—or integrated with—existing handling and storage facilities. In this way, management and operation of both existing and new silos can be in the hands of a single organization, creating economies of scale. For example, as Saudi Arabia transitions from a policy of wheat self-sufficiency to importing wheat and maintaining strategic reserves, it has carefully examined the location of existing silos. The country realized that although it had sufficient storage capacity, the storage facilities were located in sub-optimal locations. Saudi Arabia's Grain Silos and Flour Mills Organization will be adding a total of 360,000 metric tons of storage capacity at three different ports—King Abdullah Economic City, Yanbu, and Dhiba—which will allow them to import large quantities and to hold stocks (Lyddon 2011). Storage facilities at the point of entry will store strategic reserves and serve as operational silos to help regulate the flow of wheat to downstream WISC segments. Keeping the strategic reserves in these facilities at the point of entry will eliminate the need to overdesign inland transport and handling systems, which would otherwise have to be equipped to handle a surge in volume any time reserves are built up. However, there should be contingency plans in place to distribute the wheat from the reserve to vulnerable populations inland—both urban and rural—in the event that reserves are needed at a time when a country's inland transport network has been disrupted (e.g., due to natural disaster or civil unrest).

Strategic wheat reserves require sound management in order to mitigate import supply and price risks effectively. Mismanagement of strategic reserves may outweigh the benefits of maintaining wheat stocks, ultimately weakening a country's food security (Murphy 2009). To ensure a well managed reserve, each country must establish a set of guiding principles regarding when to draw down stocks and when to replenish, assuming the first-in-first-out (FIFO) principle. These guidelines must be clear and must be designed with the objective of mitigating supply and price risks, and the purchasing and selling of the wheat reserves must be done in a competitive and transparent market. In addition, to ensure that wheat is accessible when needed it is important to make sure that all stakeholders are well informed about the guidelines and that staff located both at the site of the reserves and in back offices are properly trained. Lastly, the management of wheat reserves must be adequately financed (Murphy 2009).

Three factors must be considered in establishing the guidelines for the reserves: the threshold domestic price that will trigger the drawdown of wheat reserves, the target reserve level, and the rate of reserves replenishment. A recent analysis argues (Larson et al. 2011) that selecting a higher threshold domestic price turns the reserve into more of a safety net to be used in emergency situations rather than as a tool for price stabilization; with a high threshold price, strategic reserves may not have much of an impact on domestic price volatility as long as prices remain below the threshold. The larger the targeted size of the reserve, the more costly it will be to maintain, but the more food-security coverage the reserve will provide. Lastly, a more aggressive rate of building up and replenishing the reserves is more likely to smooth domestic price volatility, as there is less chance of there being insufficient reserves. However, replenishing reserves increases demand from international markets, which may aggravate international price volatility.

Since strategic wheat reserves are intended to be a safety net, governments are responsible for setting public policy about how they will operate. Many argue that the private sector can manage wheat stocks most efficiently, while others suggest that private grain traders are driven by profit and thus have less incentive to maintain socially optimal levels of stocks (Murphy 2009, Wright and Williams 1982). The government would need to regulate the private sector's management of the reserves to ensure the target stock levels are maintained and that people do not go hungry in times of crisis. Within the public sector there are options for who could manage the reserve, such as an entity reporting to the appropriate government ministry. In Ethiopia, for example, an autonomous entity is tasked with managing and operating the country's grain reserve (see Box 2–1). Although this organizational structure worked in Ethiopia, it may be difficult to maintain a truly independent agency that manages the reserves, since food security is such a sensitive political and social issue. Moreover, it may not always be best practice to separate management of the reserve from procurement and distribution. For some countries, this separation might create market distortions leading to two types of wheat: one for commercial purposes and one for emergency stocks. This may lead to unintended consequences that would render the strategic reserve less effective.

BOX 2–1 | Ethiopia case study

The Emergency Food Security Reserve Administration (EFSRA) is an autonomous entity tasked with managing and operating the country's grain reserve. Unlike entities that manage strategic grain reserves in other countries, EFSRA is not in charge of buying, selling, transporting, and distributing grain but rather "serves as the custodian of the stock" (Rashid and Lemma 2011). It has clearly defined draw-down guidelines. The general manager of EFSRA can release up to 25,000 metric tons of grain to any recognized relief agency. Beyond 25,000 metric tons, EFSRA must get approval from a committee comprising the general manager of EFSRA and representatives from the Ethiopian Grain Trading Enterprise (EGTE), the World Food Programme (WFP), and NGOs engaged in emergency operations. This committee can approve the release of 5,000 to 25,000 metric tons of grain up to a total of 100,000 metric tons. If, however, stock levels have dropped below 25 percent of the target stock level, any decision to release stocks must be approved by the EFSRA board which includes members from Ministry of Finance and Economic Development, Ministry of Agriculture, and Ministry of Trade. Board meetings may be called in emergency situations to allow for swift action (Rashid and Lemma 2011).

The appropriate management structure of the reserve is specific to each country and should be designed to minimize costs, ensure food safety, and reduce distortive impacts of stock policies on grain markets (Rashid and Lemma 2011). Once the strategic reserve policy is established, there may be opportunities to create public-private-partnerships (PPPs) for management. The government could pay private operators to manage logistics and storage operations for strategic stocks or could play a more limited role, getting involved only during severe price and supply shocks.

3 How Can WISC Logistics Reduce the Cost and Improve the Reliability of Food Supply in Arab Countries?

Arab countries are dependent on wheat imports, and a WISC with reliable and efficient logistics is necessary to ensure critical wheat supplies. Price and supply risks can increase significantly if supply chains fail to perform. This chapter assesses WISC performance in 10 Arab countries,[36] identifies possible bottlenecks, and provides recommendations to help manage exposure to import supply and price risks. All segments of the WISC are interconnected, and bottlenecks in one segment or node can have repercussions all along the supply chain. This chapter examines ways in which countries can reduce WISC logistics costs (measured in US$/mt) and transit times (measured in days) to ensure a reliable and efficient WISC. The key messages are:

- **Improving overall WISC logistics could reduce base costs and product loss, and could increase supply-chain reliability.**
- **Reducing vessel turnaround time and removing other bottlenecks at the port could significantly reduce overall logistics costs.**
- **Improving the quality of roads and expanding transportation networks could reduce WISC transit times and costs while promoting inter-regional connectivity.**
- **Minimizing dwell time related to operational storage could reduce transit times and WISC costs.**
- **Investing in multi-grain storage facilities, grab unloaders, and other multi-purpose solutions could enhance throughput and promote savings.**

How should WISC efficiency be measured?

A well-performing WISC should ensure delivery of supplies in a timely and cost-effective manner. Regardless of the amount of wheat a country imports, the timeliness of its WISC is one key measure of efficiency. Bottlenecks in the supply chain may cause excessive transit times from port to consumer, which can lead to more spoilage and to delays in the delivery of supplies to people in need.[37] A second measure of WISC efficiency, cost effectiveness, affects a country's

36 Bahrain, Egypt, Jordan, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and Yemen. WISC data was collected from public and private sector representatives in each country. See Appendix for methodology description.

37 In the event that a supply chain bottleneck results in a disruption in the delivery of wheat, there may be alternative, albeit more costly, options. Some inefficiencies in the chain can be circumvented, for ex-

FIGURE 3-1 **The analysis covers the supply chain from the unloading port to bulk storage at the flour mill**

Source: Authors.

exposure to price risks. The cost of wheat entering the WISC is the CFR price, while the cost of wheat when it arrives at the flour mill is the CFR price plus WISC logistics costs. These costs should be minimized, yet inefficiencies such as long vessel turnaround times or assets that remain idle while waiting for delivery of wheat (e.g., trucks waiting or mills not operating at full capacity) result in increased costs. Transit time and cost are inextricably linked, and thus an efficient and reliable WISC will help mitigate both supply and price risks.

In this analysis, performance is assessed at each segment of the WISC from the unloading port to bulk storage at the flour mill (Figure 3-1). Inefficiencies at any single point in the supply chain can delay the delivery of food and increase its cost. For example, Egypt has a road network with limited connectivity in some parts of the country, and the quality of the roads, particularly those to Upper Egypt, is poor. This contributes to longer transit times and an increased need for truck maintenance, contributing to higher WISC costs. In Tunisia, limited storage capacity appears to cause bottlenecks at the port as vessels cannot unload the wheat immediately due to full silos, causing longer vessel waiting times and increasing logistics costs.

All segments are interconnected and efficiency throughout the supply chain is critical. For example, one cause of vessel waiting times may be slow vessel discharging/unloading rates: vessel discharging rates depend on the effective capacity of the vessel unloading system, the effective capacity of the conveying system to the silo, and the space available in the silo, which itself depends on outtake capacity by trucks. If there is a low outtake capacity at the silo, the whole system can get backed up, causing costly vessel waiting time at the port. Conversely, if a port becomes congested by an import surge, long vessel turnaround times (waiting time in the harbor plus discharge time) might prevent a smooth flow of wheat to flour mills. Here, an upstream bottleneck may cause insufficient supply of flour and bread downstream in the supply chain. For a country's WISC to be robust, the entire chain must be free of bottlenecks to ensure a constant flow of wheat to the flour mills.[38]

ample if there is a bottleneck at the designated grain terminal the vessel can unload at a different berth by grab and unload directly onto trucks.

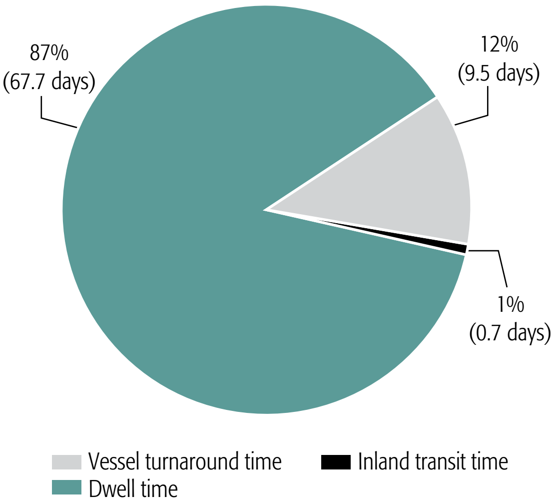
38 Ideally the mill or group of mills in the WISC should be connected to multiple entry points (or WISCs) so that in case the main WISC becomes inoperative there is a backup WISC available. This backup WISC may be within the same country, or it may be regional.

How do WISC logistics in Arab countries perform in terms of addressing supply risk?

Based on the selected corridors for each participating Arab country, the average WISC transit time in 2009 was 78 days.[39] WISC transit time can be broken down into three components (Figure 3-2): vessel turnaround time (12 percent), inland transit time (1 percent), and dwell time (87 percent). Dwell time of wheat, including both operational and strategic storage, is the major driver of overall transit time,[40] reflecting throughput volumes and logistics as well as policy decisions.[41] The second driver of transit time is vessel turnaround time. Although transport networks in many Arab countries are frequently inefficient, inland transportation does not appear to be a main bottleneck in terms of the overall transit time for an average metric ton of wheat. For comparison's sake, WISC transit time is approximately 18 days in the Netherlands and about 47 days in South Korea.

Wheat vessels arriving at ports in Arab countries had an average turnaround time of 9.5 days. Vessel turnaround time comprises both waiting time in the harbor and discharge time at the berth. While discharge time is a function of unloading capacity and the cargo volume, waiting time is largely independent of vessel size and could be minimized.[42] On average, vessels arriving at ports in Arab countries in 2009 waited about three days before they began discharging wheat.[43] Among Arab countries there was quite a range of waiting times and, depending on the country, vessels waited an average of less than one day to more than seven days, significantly impacting overall vessel turnaround

FIGURE 3-2 **Dwell time and vessel turnaround time are the two driving factors in a WISC's transit time in Arab countries**



Source: Authors.
Note: Transit times are weighted averages per metric ton for the ten participating Arab countries based on data from 2009. Inland transit time may be zero for countries whose WISC is consolidated at the port (i.e., flour mill is at the port) and all transport of wheat is by conveyors.

39 For each country the authors considered the corridor with the largest throughput volumes. See Appendix for methodology description.

40 Dwell time was combined for all points of storage throughout the chain. This could include storage of wheat at the port, inland, or at the flour mill.

41 For further discussion on strategic storage see Chapter 2.

42 The waiting time includes any time required for customs procedures, inspections and analysis, as well as any delays due to limited berthing space, priority for other vessels (container, cruise, export), inadequate handling capacity, silos being full, poor scheduling, or inclement weather.

43 This figure is based on the mean waiting time for the ten selected corridors. If vessel wait times are weighted based on volume of imports for each country, average waiting time in Arab countries is nearly 5.7 days.

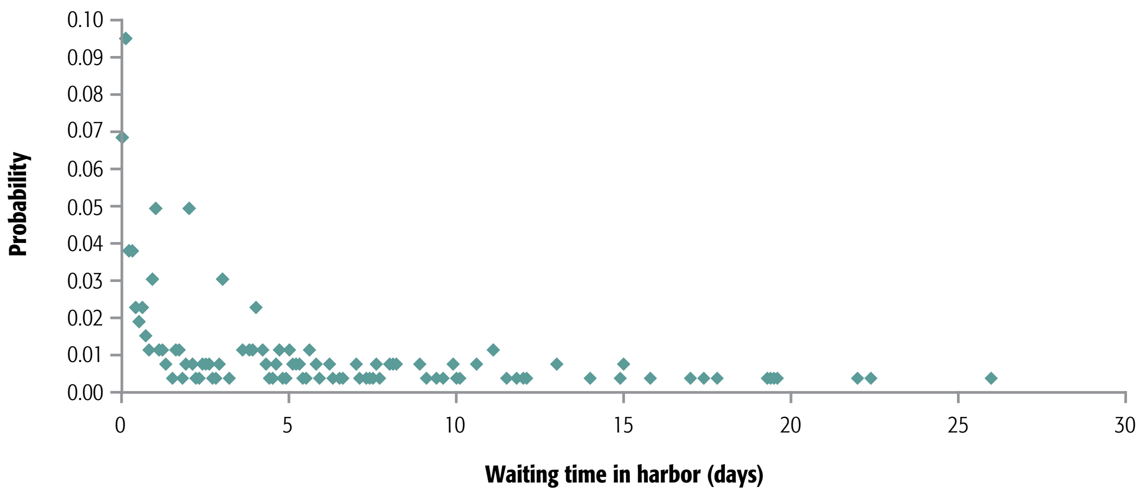
FIGURE 3-3 **Vessel turnaround times are composed of waiting and unloading times**

Source: Authors.
Note: Data are for 2009. Turnaround time in the Netherlands is indexed to 1. Waiting and unloading times for other countries represent performance relative to the Netherlands.

times (Figure 3-3). The waiting times in Arab countries can be compared to waiting times of less than one day in the Netherlands and nearly six days in South Korea. Times also varied from vessel to vessel within a single country; while the majority of vessels in 2009 spent less than two days waiting in the harbor, there were a number of ships that waited significantly longer, suggesting unpredictable waiting times (Figure 3-4). Unpredictable waiting times raise costs for shippers, and they may also impede the timely delivery of wheat to people in need. While the source of these bottlenecks can vary from country to country, reducing waiting time in the harbor for some countries could help reduce tender prices and quickly deliver supplies during emergencies.

Inland transportation time is dependent on a number of factors including the number of segments in the WISC, the geography of the country, the quality of the inland transportation infrastructure, and transportation regulations. While the networks could comprise different modes of transportation including road, rail, and waterways, the majority of wheat in Arab countries is transported by truck. This analysis considers only a single corridor for each country and therefore may not fully reflect the state of inland transportation in each country. For a single metric ton of wheat, inland transit time in Arab countries can vary from less than one hour, in countries whose WISC is fully consolidated at the port (requiring no inland transportation), up to a day and a half in countries

FIGURE 3-4 **In 2009, most vessels waited less than two days in the harbor, yet there was significant variability**



Source: Authors.
Note: Waiting time in harbor was only available for Bahrain, Morocco, Saudi Arabia, Tunisia and Yemen. Waiting time in harbor was rounded to the nearest tenth of a day. Probability is based on sample of 263 vessels.

that must transport the wheat first to a silo near the port, then to an inland silo, and then to the flour mill. This range in transit times is relatively small, amounting to a difference of only one day. Even significant improvements, in percentage terms, for countries with relatively long transit times such as Jordan, may result in only marginal reductions in supply risk.

Average dwell time in Arab countries is 68 days, reflecting both operational and strategic storage.[44] This chapter focuses on logistics, the primary driver for operational storage, which is needed to smooth the flow of incoming and outgoing wheat in the supply chain.[45] However, since operational and strategic storage are often combined in practice,[46] analyzing the efficiency of operational storage based on dwell times can be difficult. Operational storage is meant to prevent excessive turnaround times of vessels and trucks and can be minimized so that the wheat is only stored for long enough to ensure a smooth inflow and outflow. At the port, wheat imports arrive in batches on vessels, while flour mills operate more or less at a constant rate.

44 Dwell time is the amount of time an average metric ton of wheat stays in storage.

45 Operational storage is a "necessary evil" to create smooth logistics in normal situations, where predictable issues are present at the transfer points including: incidental and temporary interruptions in supply, change of transport mode, variations in arrival times of transport units, and local constraints (physical, operational, natural, etc.).

46 Strategic storage is driven by public policy. For more on strategic storage see Chapter 2.

Thus, operational storage at the port allows for unloading the vessel as quickly as possible (inflow), while releasing wheat at a constant rate from the silo (outflow) into the downstream segments of the chain. Efficient use of operational storage will help reduce bottlenecks throughout the chain and will thereby reduce supply risks.

How do WISC logistics in Arab countries perform in terms of addressing price risk?

In 2009, reported WISC costs in Arab countries added an average of US$40 per metric ton to the final cost of imported wheat delivered to the flour mill,[47] which is equivalent to 17 percent of the average CFR price.[48] Due to the quasi-fiscal subsidies that are imbedded in reported WISC costs, these figures represent a lower bound of the full economic cost. WISC costs are broken down into four main categories (Figure 3-5): port logistics (29 percent), storage (12 percent), transportation to inland silos and mills (22 percent), and WISC management (36 percent).[49] WISC management includes such costs as product loss, cost of capital, and overhead, which on average total about US$14 per metric ton. Given the different WISC structures throughout the region, total WISC costs range from US$19 per metric ton to US$47 per metric ton (Figure 3-6). This is in comparison to approximately US$11 per metric ton for the Netherlands and US$17 per metric ton for South Korea.

Of total WISC costs, 29 percent were incurred at the port,[50] 65 percent of which were driven by vessel turnaround time. This means that vessel turnaround time, one of the largest drivers of a country's total WISC costs, accounted for about 20 percent of total WISC costs in Arab countries. Generally speaking, the shorter the WISC, the greater the share cost of vessel turnaround time will be of total WISC costs. For example, cost of vessel turnaround time accounts for 37

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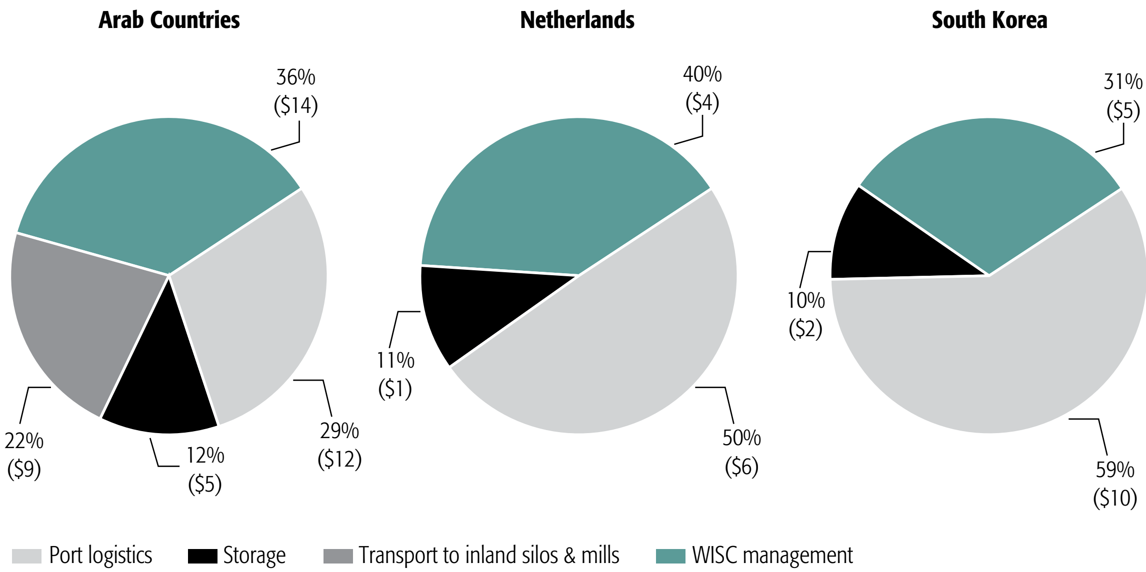
47 While this analysis is based on reported costs, hidden costs, in the form of a "quasi-fiscal" subsidy, must also be accounted for. Just as the domestic consumer price of wheat might not reflect the full economic cost of importing wheat due to government safety nets in the form of subsidized bread, flour, or wheat, the WISC costs discussed in this chapter might not be an accurate reflection of the full economic cost of logistics. Many Arab countries subsidize the cost of fuel, which effectively lowers reported WISC costs, including transportation costs and the operation costs of equipment and storage facilities. In 2009, total fuel subsidies in the Middle East and North Africa were US$150 billion (Economist 2011). Some countries, such as Lebanon, Jordan, and Tunisia have implemented reforms, but other countries such as Saudi Arabia and Egypt have significant fuel subsidies. Transportation and electricity costs are likely to be understated for GCC countries (Bahrain, Oman, Qatar, and Saudi Arabia) as well as some other oil producing countries (Egypt and Yemen).

48 WISC costs includes the cost of vessel turnaround time and thus the figure of US$40 per metric ton is not an additional 17 percent on top of the CFR price, which internalizes the cost of anticipated vessel turnaround time. Rather, the figure of 17 percent is provided to give the reader a sense of the size of WISC costs relative to the average price paid for a metric ton of wheat.

49 WISC management includes loading port costs, bank costs, insurance for the WISC, commissions, security costs, cost of working capital, overhead & administration costs, risk & profit margins, and product loss. WISC management is not directly addressed in this chapter as the focus is primarily on logistics.

50 Port logistics costs include vessel wait time in harbor, inspection/sampling/analysis, agent fees, fumigation prior to discharge, unloading/handling at the berth, and transport to port silo (if applicable).

FIGURE 3-5 **WISC costs added an average of US$40/mt to the final cost of importing wheat in Arab countries, compared with US$11/mt in the Netherlands and US$17/mt in South Korea**



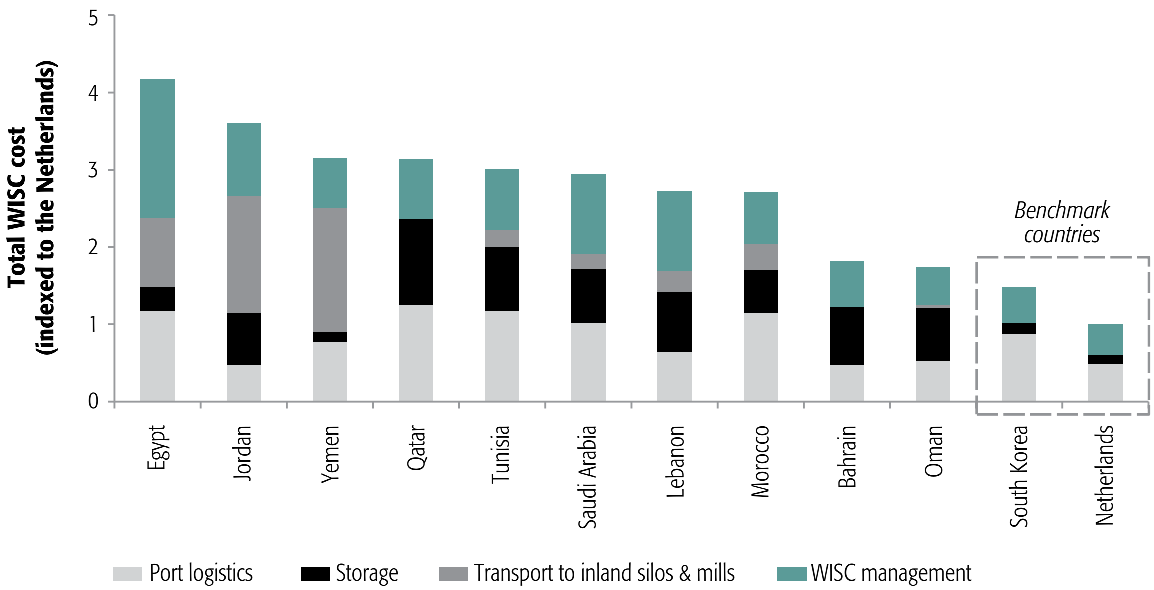
Source: Authors.
Note: WISC costs are weighted averages for the ten participating Arab countries, based on data collected for 2009. Percentages may not add to 100 percent due to rounding. The cost of capital (US$/mt) was estimated assuming an annual interest rate of 4 percent. Product losses were conservatively estimated based on 0.25 percent loss for each storage segment and 0.1 percent loss for each trucking segment. For Egypt product losses were assumed to be 5 percent.

percent of total WISC costs in Qatar, which has a short WISC that is consolidated at the port.

While transport costs represent a small share of total WISC costs for most Arab countries, inland transportation makes up a significant share of total WISC costs in some of the larger countries. Inland transport costs are driven by a number of factors including geographic size, quality of transport infrastructure, truck-waiting times, level of fuel subsidies,[51] the number of stakeholders throughout the WISC, and the relative power of those stakeholders at each segment of the WISC. But the primary driver of a country's cost of inland transportation as a share of total WISC costs is the structure of the WISC. On average, inland transportation accounts for about 22 percent of WISC costs, but this figure ranges widely across countries. For example, these costs could account for up to 51 percent of total WISC costs in countries such as Egypt, Jordan, and Yemen (Figure 3-7), adding an additional US$10 to US$18 to the cost of importing one metric ton of wheat. The

51 Among the 10 Arab countries participating in the WISC study 4 countries (Bahrain, Egypt, Saudi Arabia, and Yemen) subsidize diesel to a point that the retail price is below the price of crude oil on the world market, while another 3 countries (Jordan, Lebanon, and Oman) have retail diesel prices that are below US retail prices (GTZ 2009).

FIGURE 3-6 | **WISC Costs in Arab Countries in 2009 Were Up to Four Times that of the Netherlands**



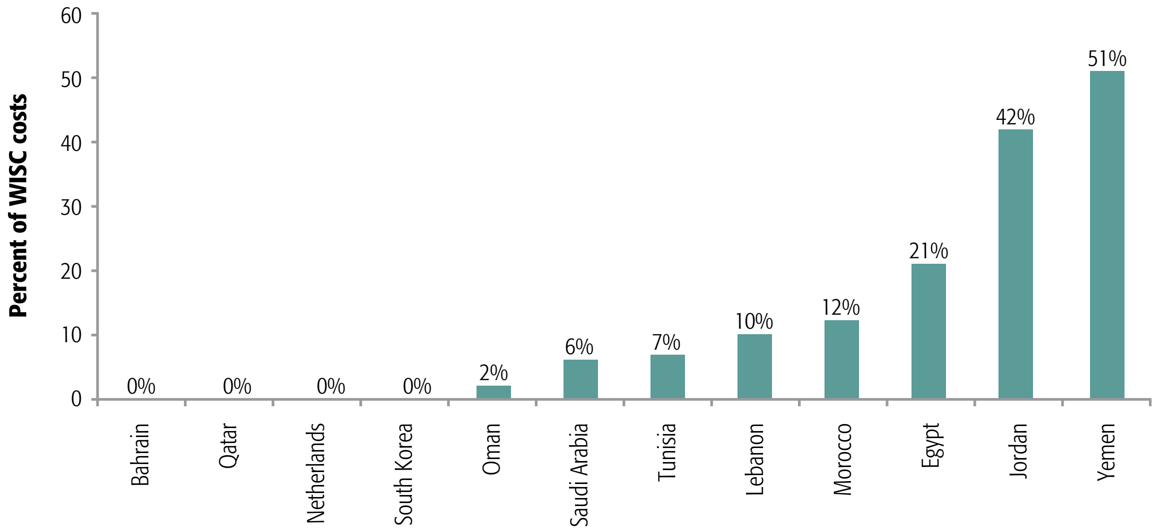
Source: Authors.
Note: Data are for 2009. Total WISC Cost in the Netherlands is indexed to 1. Total WISC costs for other countries represent performance relative to the Netherlands and each segment is estimated based on its share of the total cost for each country.

higher transportation costs in these countries are partly due to geography, which clearly cannot be changed, but they may be exacerbated by inadequate infrastructure such as poor road conditions. Countries that have flour mills located at or near the port, or have minimal transport segments, will have lower overall transport costs both in absolute terms and as a share of total WISC costs. This is more common in smaller countries such as Bahrain and Qatar, but some larger countries, such as Oman, also have consolidated WISCs. Although in the context of this analysis, which only considers costs before the wheat is milled, a consolidated WISC may result in lower inland transportation costs; one must still take into account downstream transportation costs that could be incurred in order to bring flour from the mill to population centers and to rural areas.

The cost of storage is a significant driver of total WISC costs,[52] accounting for 12 percent of total WISC costs in Arab countries. These costs are largely dependent on dwell time and can add up to an additional 2 percent of the CFR price to total wheat costs. While this study advocates the reduction of costs in other WISC segments, when it comes to storage it is critical that countries consider the tradeoff between minimizing

52 The cost of storage accounts for both operational and strategic storage, and includes handling, fumigation, and the storage itself.

FIGURE 3-7 **Inland transport costs may account for up to 51 percent of total WISC costs**



Source: Authors.
Note: Data are for 2009.

operational storage costs and financing the cost of maintaining strategic reserves.[53] Dwell times associated with operational storage, to regulate inflows and outflows of wheat, can be minimized to reduce costs. Thus, while the unit cost of storage should be minimized, the total cost of storage should be weighed against possible financial and non-financial benefits associated with a country's strategic reserve policy.

Product loss due to inefficient WISC logistics is a significant contributing factor to WISC management costs. Reported estimates of product loss suggest that there is wide variation across Arab countries, ranging from 0.5 percent to 5 percent of imported wheat.[54] Based on communications with public and private sector representatives from Arab countries, product losses in 2009 were up to US$15 per metric ton in some countries. This is equivalent, at current wheat prices, to over US$480 million annually for imported wheat to Arab countries.[55] Product loss can occur for a number of reasons: poor grain handling systems, outdated storage facilities, inadequate transportation networks, unnecessarily long dwell times, and insufficient quality control systems and procedures can all result in substantial spillage and spoilage. Product loss could also be due to pilferage and

53 For further discussion on the costs and benefits of strategic reserves see Chapter 2.

54 Product losses are estimated based on the difference between the amount of wheat unloaded from the vessel and the amount of wheat delivered to flour mills.

55 Average price of wheat in July 2011 is US$264/metric ton (USDA 2011c). It is possible that these figures are underreported and that product losses may be even higher than 5 percent.

smuggling, which tend to be more likely when international wheat prices are high.[56] While governments may be able to reduce pilferage and smuggling rates through regulation and policy decisions, product loss could be minimized with an efficient WISC.

How can improvements to the WISC help to address both supply and price risks?

Bottlenecks at the port are a significant source of increased costs, and countries should explore various opportunities for future cost and time savings. Port logistics are driven by a number of factors including port capacity, customs and inspection procedures, and vessel unloading rates. For example, a port that has not been designed to handle larger vessels will be forced to import wheat on smaller vessels, and thus will not be able to take advantage of the lower unit costs of large vessels. The largest contribution to total port logistics costs is vessel waiting times;[57] if vessel waiting times could be reduced to one day, the 10 Arab countries studied in this analysis could save over US$60 million per year or US$2.94 per metric ton. Arab countries could reduce waiting times by expanding port handling and storage capacities, adding more berths that can handle grains, changing priority rules, dredging the harbor to allow for larger vessels, harmonizing phytosanitary procedures with the exporting countries, and reducing bureaucracy in customs procedures. The variability in waiting times discussed above also suggests a need for more effective scheduling of vessels. It will be important for Arab countries to undertake further analysis of the specific causes of, and potential solutions to, bottlenecks at individual ports to help mitigate supply risks and to ease pressures on wheat prices.

The benchmarking analysis also indicates that consolidating WISC at the port might help reduce costs for small countries. Countries that have longer WISCs tend to have increased total WISC costs, while countries with a greater share of their WISC costs at the port tend to have lower average costs per metric ton. This is because close proximity between facilities enables countries to make use of more cost-effective handling and transport solutions, and because product loss is minimized due to a reduction in handling of the wheat and in total transit times.[58] While a consolidated WISC may be sensible in small countries such as Bahrain and Qatar, larger countries are faced with a tradeoff if they

56 Wheat subsidies reportedly encourage smuggling across borders, from subsidizing countries to nearby non-subsidizing countries.

57 Reducing vessel waiting time, rather than total turnaround time, was selected as an example in which Arab countries could improve port logistics because waiting time is not necessarily dependent on vessel size. Whereas the unloading time directly depends on the volume of cargo to be unloaded and the unloading capacity, waiting time can be independent of vessel size and can be determined by customs and inspection procedures, berth occupancy rates, and priority rules, among other factors. This example assumes that long waiting times are due to poor logistics and that a waiting time of one day is achievable. The example is meant to be illustrative. Each port should assess in greater detail the cause of long turnaround times and the investments required to improve port logistics.

58 A further advantage of WISC consolidation at the port might be that wheat bran, a by-product of the wheat milling process, can be sold to nearby feed mills or to overseas markets. In some cases, this may reduce truck movements between the port and the more distant hinterland.

consider consolidating their WISC at or near the port of entry. Although there are efficiency gains to be captured in a consolidated WISC, a geographically large country such as Jordan or Egypt may have higher transportation costs to deliver wheat-based products downstream.

Improving national road and rail systems can reduce WISC transit times and costs while promoting inter-regional connectivity. This study finds that inland transport can represent a significant share of total WISC costs. If these countries were to reduce their transportation costs by 20 percent by improving the quality of existing roads and building new ones, each country could save up to an average of US$12 million annually. These cost savings could be generated in a number of ways including reduced transit times and a decrease in spillage losses. Some countries may benefit from strengthening competition in the trucking sector. Others might want to assess if they are making the most of their inland transportation networks. Currently, most Arab countries rely on roadways to transport wheat, while railways and waterways are used less frequently. Investing in and expanding wheat transportation to railways and waterways may create spillover benefits throughout the transport network, including freeing up capacity on roadways for additional transport needs. Egypt, for example, hardly uses the Nile for the bulk of its wheat transportation, but with sufficient throughput levels, river transport may offer a lower cost and more reliable method of transporting wheat from the ports along the Mediterranean to Upper Egypt.

Increasing efficient management of operational grain silos may reduce transit times and WISC costs. Any silo that connects two segments of the import chain must regulate incoming and outgoing flows of wheat. Regulating flows depends on having the right equipment to take in wheat without causing bottlenecks upstream (e.g., at the berth) or downstream (e.g., discharging to trucks). In addition, operational grain silos must maintain appropriate occupancy rates to ease bottlenecks; full silos cause bottlenecks and empty silos increase storage costs unnecessarily. Analysis must be conducted for each storage location to determine what the appropriate storage capacity should be.

As countries make investments throughout the WISC, they may want to consider investing in multi-purpose solutions to enhance throughput and promote economies of scale. Using multipurpose solutions could allow for horizontal spillovers to other sectors. A one-time investment to improve logistics infrastructure will not only reduce WISC costs, but will also benefit other industries using the same transport corridors, storage facilities, and equipment. For example, a multi-user transport network would entail having infrastructure for inland transportation (trucks, railcars, and vessels) that can be used to move multiple commodities, not just wheat, through the same corridors. Similarly, storage facilities can hold several types of grains, although these may be marginally more expensive to manage. Lastly, whereas in some Arab countries pneumatic unloaders are used for wheat, ports could be equipped with multipurpose unloading equipment such as modern, high capacity, dust-free unloaders that can unload multiple types of cargo including grains, coal, iron ore, and fertilizer. As Arab countries' dependence on imported wheat is expected to grow, expansion of WISC infrastructure may allow for increased economies of scale both in terms of cost per unit and of total throughput volume. Combining imports with domestic production within the supply chain to increase throughput volumes might further help increase economies of scale.

While WISC efficiency is measured by transit time and cost, it is also important to understand the role of the private and public sectors throughout the supply chain.[59] Private sector participation differs from country to country: for example, in Yemen the private sector controls the entire WISC, while in Egypt the government is heavily involved throughout the supply chain. In other Arab countries the public sector is responsible for procurement and storage, while it is the private sector that transports and mills the wheat. Contrary to what one might expect, there is no clear evidence that either public or private management of the WISC is more efficient in terms of transit time and cost. Moreover, while food security is a government concern, both sectors can play important roles in ensuring reliable access to food supplies. Whether the WISC is managed by the public sector, private sector, or both, sound management and efficient service delivery throughout the supply chain should be a top priority.

Regardless of which sector controls the WISC, each Arab country will want to identify the WISC segments in which they can achieve the greatest improvements for the lowest investment costs. While this study provides an initial assessment across different Arab countries, our team has conducted an in-depth WISC analysis for each of the ten participating countries. Conducting a more comprehensive and detailed analysis will allow each country to identify specific bottlenecks in each corridor within its borders. Not only does the type of bottleneck vary from country to country, but they vary from corridor to corridor within the same country. In some situations, a bottleneck can be eliminated by various alternative solutions: dredging a harbor to increase water depths and constructing new storage facilities can be significantly more costly than purchasing new unloading equipment with increased capacities and streamlining customs procedures. Country-specific recommendations, based on the analysis for each selected corridor, can be found in Table 3-1. Ongoing country-specific analyses will help Arab countries identify the investments that offer the greatest returns.

59 While the government is involved throughout the WISC in Egypt, the private sector is also active, importing wheat in parallel.

TABLE 3-1 **Recommendations based on the corridor examined in each country**

Country	Recommendations
Bahrain	• Expand storage capacity for reserves and milling capacity • Explore alternative storage locations
Egypt	• Explore alternative options (location & capacity) for strategic reserves • Reduce product loss by improving handling of wheat during transport • Optimize use of different inland transport systems
Jordan	• Evaluate optimal locations for storage facilities • Explore alternative import routes from other Mediterranean ports
Lebanon	• Explore further how improvements to inland transport systems may enable an increase in throughput capacity • Evaluate the capacity of the milling industry and development of re-export markets • Assess viability of developing Beirut silo as a transshipment hub for the Eastern Mediterranean region
Morocco	• Consider eliminating seasonal import tariffs to help ease port congestion • Determine the role of the private sector regarding strategic wheat reserves
Oman	• Optimize the integration of new storage facilities in current and future port operations as well as in the supply chain • Investigate the possible expansion of logistics systems to develop Oman as a regional agri-bulk transshipment hub for the Gulf region • Evaluate milling industry capacity and explore opportunities for re-export
Qatar	• Expand storage capacity for reserves • Investigate the development of Qatar as a regional agri-bulk transshipment hub for the Gulf region • Evaluate optimal location for milling operations
Saudi Arabia	• Optimize "spacing" of ship arrivals to reduce vessel turnaround times • Conduct cost-benefit analysis to evaluate the tradeoffs between expanding storage capacity at ports and integrating inland storage facilities in the import supply chain • Upgrade existing grain unloading systems in the ports to state-of-the-art equipment with high unloading capacity
Tunisia	• Increase storage capacity at ports • Align unloading rates specified in procurement contracts with actual unloading rates based on existing equipment
Yemen	• Optimize inland wheat transport by expanding road networks and upgrading handling and transportation equipment • Conduct a study evaluating the impact of household wheat and/or flour reserves and how to optimize a national strategic reserve policy

Source: Authors.

4 How Can Procurement Strategies and Hedging Instruments Be Used to Manage Wheat Imports?

One of the most critical aspects of import risk management is a country's wheat procurement strategy. Each country will have its own approach to procurement, choosing to pursue a combination of a number of different methods and tools that are outlined in this chapter.

A country must monitor and analyze, on an ongoing basis, the fundamentals of domestic and global wheat markets to understand and quantify price and supply risks. While most Arab countries are already doing this to varying degrees, it is increasingly important that countries refine their analyses and review their procurement strategies. Given the recent increases in international price volatility and the projected variability, due to climate change, of future harvests, Arab countries should have a robust procurement approach, tailored to mitigate each country's specific wheat-import risks. In particular, countries that grow some of their own wheat will need to improve their forecasting capabilities so as to have a better understanding of what their wheat-import needs will be in the short- and long-term.[60] The key messages of this chapter are:

- **Issuing tenders that allow flexibility in country of origin while maintaining desired quality standards can allow suppliers to offer lower CFR wheat prices.**
- **Purchasing wheat from reliable grain traders may reduce risks of non-fulfillment of supply contracts.[61]**
- **In some cases, facilitating regional cooperation and importing wheat from neighboring countries may also reduce supply risks.**
- **Effective use of physical hedging contracts and financial derivatives may help protect against price shocks.**

What observations can be made about procurement strategies in Arab countries?

Countries assume different amounts of risk through their wheat tendering process, which may have an impact on the price paid for wheat imports. One approach is to issue tenders in a

60 According to USDA data, Arab countries that produced more than 10 percent of the wheat they consumed in 2010 include Algeria, Egypt, Iraq, Lebanon, Morocco, Saudi Arabia, Sudan, Syria, and Tunisia.

61 Reliable grain traders are companies with access to diverse sources of grain. Often, reliable suppliers have a global network and can obtain grains from various locations depending on availability.

FIGURE 4-1 | **Arab countries can follow different approaches to wheat procurement**

	Pros	Cons
Approach 1: Predictable & Regular Tenders	• Regular inflow of wheat • Price risk is spread across all tenders • Allows some flexibility to postpone tenders in case of extreme price shock	• Less flexibility to take advantage of lower wheat prices
Approach 2: Larger Volumes & Fewer Tenders	• Opportunity to save money by issuing tenders during low prices • May benefit from economies of scale	• Requires long term foresight regarding wheat import needs • If stocks are low, may be forced to issue tender during high prices • Infrastructure needs to be able to handle larger throughput volumes
Approach 3: Tenders "As Needed"	• Lower risk of over-or under-estimated wheat import needs for countries that produce rainfed wheat • Lower investment cost for planning and infrastructure	• If domestic needs are correlated with global shortages, countries may be less protected from price and supply shocks

Source: Authors.

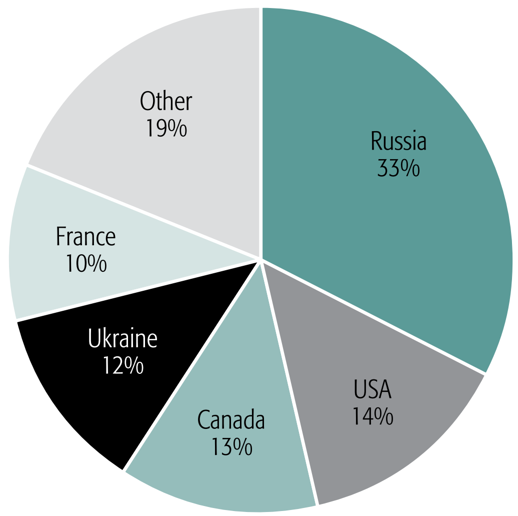
predictable fashion in order to keep a regular flow of wheat coming into the country (Figure 4-1). This is a conservative strategy in that it spreads price risk across all tenders. In the event of a severe price shock, the country may choose to postpone a wheat tender, in the hopes of riding out the price increase. However, if existing wheat supplies inside the country's borders are dwindling, the country may issue a tender even during a price shock.[62] For example, when wheat prices are relatively stable, Jordan issues tenders roughly every two months for wheat in increments of 50,000; 100,000; or 150,000 metric tons. Bahrain also seems to have a predictable tender process, tendering about 30,000 metric tons of wheat every three to six months. Other countries take a riskier approach, importing large volumes of wheat through a limited number of tenders. While countries could save a lot by issuing a tender during times of low wheat prices, there is always a tradeoff if the tender is issued during a price shock. Good planning is required to determine far enough in advance how much imported

62 The approaches outlined here, assume no financial hedging strategy in place to manage price risk. If, however, the country is using an overlying financial hedging strategy, the country can operate more freely in the physical wheat market with the knowledge that the price risk is insured by their risk management program. The use of hedging instruments for risk management is explored in the last section of this chapter.

wheat will be needed, which may be challenging, in particular for Arab countries that rely partially on their own rainfed production of wheat. To issue tenders effectively over the long-term, countries rely on forecasts for consumption and stock levels, but Arab countries that also produce some rainfed wheat domestically, such as Algeria, Morocco, Tunisia, Iraq, and Syria, will need improved forecasting methods for their domestic wheat harvests. Additionally, countries that take this long-term approach should have the appropriate infrastructure to import and store large volumes of wheat and the appropriate policies for releasing and disseminating the wheat from storage. Lastly, some countries may not have a specific strategy in place for wheat procurement, and instead issue tenders on an "as needed" basis. In Egypt and Tunisia, for example, the frequency of tenders and the volume requested is much less predictable.

Price is only one factor in determining the country of origin for wheat imports. The Arab countries participating in this study imported wheat from nearly 20 different countries in 2009. Despite a large number of supplier countries, nearly 45 percent of total imports to Arab countries came from the Black Sea region. The top five exporters of wheat to Arab countries were Russia, the United States, Canada, Ukraine, and France (Figure 4-2). Three main factors are at play for countries in choosing their sources of wheat. First, it depends on the type of wheat that is being imported. In Morocco and Tunisia, couscous made from durum wheat is a large part of the diet, and they are likely to import wheat from North America and Western Europe, where durum wheat is primarily grown. Second, it depends on price. For example, relative to what it paid Free on Board (FOB) for soft wheat imports from France in 2009,[63] Tunisia paid on average 8 percent less for soft wheat imports from Russia and 21 percent less for imports from Ukraine. Third, for some countries the quality of wheat is paramount: Saudi Arabia prefers to import high quality wheat with 12.5 percent protein content,[64]

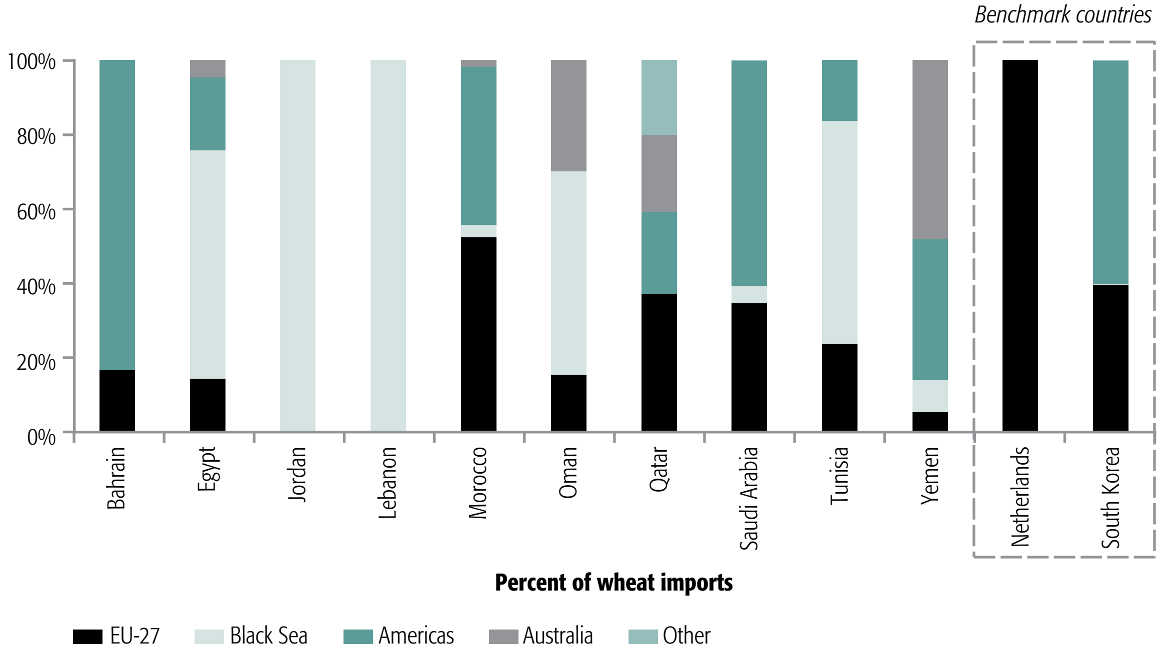
FIGURE 4-2 **The top five exporters of wheat to Arab countries were Russia, the United States, Canada, Ukraine, and France**



Source: Authors.
Note: Represents percent of regional wheat imports in 2009. Other countries that exported wheat to Arab countries included Australia, Belgium, Finland, Germany, Greece, Italy, Latvia, Lithuania, Poland, South Africa, Sweden, Turkey, and the United Kingdom.

63 Incoterms Free on Board (FOB) is specified in contracts where the buyer is responsible for the goods once the goods have crossed the ship's rail at the named port of shipment. The buyer is then responsible for the cargo shipment, insurance, and other costs and risks.

FIGURE 4-3 **Jordan and Lebanon imported nearly all their wheat from the Black Sea region**



Source: Authors, USDA 2010a.
Note: Data are for 2009.

which is produced in Western Europe, North America, and Australia, rather than lower protein content wheat from the Black Sea region.

In addition, Arab countries varied in terms of the level of diversification of the origins of their wheat imports. Some countries in this study, particularly those importing less than 300,000 metric tons in 2009, imported from only two to four countries, whereas Egypt spread its 10.3 million metric tons of imports across eight different countries. Other countries such as Jordan, imported nearly 100 percent of their wheat from Russia and Ukraine (Figure 4-3). This proved problematic during the summer of 2010 when Russia imposed an export ban on wheat due to the fires and droughts that plagued the wheat harvest throughout the Black Sea region. With contracts cancelled, many Arab countries who had relied on imports from the Black Sea found themselves scrambling to get wheat from alternative locations. Some Arab countries had to pay more for their wheat imports partly due to the shift from less expensive wheat from the Black Sea region to more expensive wheat from Western Europe, the Americas, and Australia. Although there is no clear evidence that having a more diversified portfolio of wheat sources helps mitigate price risks, it does prevent a country from being too reliant on one source of wheat.

64 Many other Arab countries will import wheat with 11.5 percent protein content, or will mix different wheat products of varying protein content.

What issues are critical to an efficient tendering process?

Access to better information regarding domestic and international wheat market fundamentals is critical to identifying and quantifying exposures to risk. In general, the first step in proper risk management is to understand the existing risks. Robust analysis of domestic wheat production, domestic wheat consumption needs, international wheat production, and forecasts of wheat prices helps countries better understand and quantify their risk exposure. However, since the international wheat market is volatile and small changes in global supply or demand can have significant price implications, it is important that Arab countries further improve upon their monitoring of wheat markets. As such, participation in the Agricultural Market Information System (AMIS) will allow Arab countries access to better information regarding wheat markets and forecasts at the international and national levels.[65] Established in 2011, the goal of AMIS is to increase agriculture information transparency by aggregating data for production, consumption, and stocks of agricultural markets. By improving the quality, reliability, accuracy, timeliness, and comparability of this data, AMIS can help limit food price volatility (Ministerial Declaration 2011), which in turn can help Arab countries better identify their exposures to wheat-import risks.

Tenders can be written to ensure desired quality standards, while allowing flexibility in getting wheat from the least expensive source. Arab countries control the quality of wheat imported by stipulating specific standards that must be met by the winning bidder. Wheat tenders usually specify quality standards regarding protein content, moisture content, and impurities, among others, but some countries also specify in the tender that the wheat must come from particular countries. The inclusion of these measures limits the flexibility of grain suppliers to obtain wheat at the lowest available price. In mid-June 2011, Egypt issued a tender for delivery of wheat from the United States, Canada, Australia, France, Germany, Britain, and Argentina (Reuters 2011), but Russia and other countries from the Black Sea region were not listed.[66] This omission may have been caused by problems that Egypt had with the quality of Russian wheat in the past,[67] but by specifying quality standards in the tender, these issues could have been addressed without restrictions on countries of origin.

Ensuring that tender documents are aligned with international standards may allow suppliers to offer lower CFR wheat prices. The CFR price frequently includes the expected

65 AMIS was established at the meeting of G20 Agriculture Ministers in June 2011. Information on maize, rice, and soybeans will also be available, while additional commodities will be added to AMIS in the future.

66 While Russia's wheat export ban was still in effect at the time of the tender, Russia had announced it would lift the ban as of July 1, 2011. Therefore, theoretically, Russia could have been a potential source of wheat imports for this tender.

67 In May 2009, well before Russia imposed its wheat export ban, Egypt had problems with Russian wheat imports. For some shipments, Egypt had to quarantine the wheat originating from Russia due to health concerns. Problems included dead bugs and other impurities above the allowed limit.

vessel turnaround time, which includes estimates for inspections and unloading. There are two actions that could be taken to reduce inflated CFR wheat prices. First, national phytosanitary requirements may be aligned with international standards developed by organizations such as the Codex Alimentarius Commission. Harmonizing these safety standards for human, animal, and plant life will allow importing countries to rely more on the documentation provided by exporters, and potentially reduce time required for inspections and analysis. Second, tenders frequently stipulate expected vessel loading and unloading rates, and these should reflect existing capacities. In some cases, the rates specified in the tenders are not aligned with either international standards or with existing port capacities. Some Arab countries often set the contractual unloading rate to be slower than is logistically feasible given the destination port's infrastructure and equipment. This may be done to build in buffer time in case there is a logistics glitch during unloading. It could also be done to help the importer appear efficient by unloading within the terms of the contract, or even earlier than expected. By doing so, the importer can avoid potential demurrage costs and may additionally earn despatch, which is only 50 percent of demurrage rates.[68] Including slower loading and unloading rates in the contract, and therefore requiring use of the charter vessel for more days than may be necessary, may come at the cost of a higher CFR price, in order to cover the additional vessel cost. Stipulating loading and unloading rates that accurately reflect port capacities may result in a lower CFR price and efficiency gains.

How can strategic relationships help mitigate supply risk?

Developing formal or informal partnerships with reliable grain traders can help reduce counterparty risk.[69] Grain traders serve as the middleman between producers and consumers. Wheat buyers are concerned with counterparty risk, which may be lower with reputable grain traders. First, more reliable grain traders have global networks with assets located across most continents. Second, as a global player, more well-established grain traders have existing relationships with wheat producers in most of the producing countries. This allows them to source wheat from numerous locations. Third, established grain traders have the financial stability that other companies may lack. All grain traders are exposed to the possibility of default on behalf of wheat producers, but the more reputable traders are better equipped to absorb such conflicts without passing it on to the wheat buyer. It is in the interest of Arab countries to procure wheat from reliable and financially solvent grain traders to manage their risk and survive major industry shocks. While having open tenders (any grain trader can submit a bid) encourages competition among grain traders, keeping price margins low, importers may consider developing closer relationships with some of the more well-established

[68] Demurrage costs are incurred when loading or unloading the charter vessel takes longer than is contractually allowed. Despatch may be received if the vessel is loaded or unloaded in less time than is stipulated in the contract.

[69] Counterparty risk is the risk that the supplier defaults and fails to deliver the wheat.

TABLE 4-1 **Arab Countries Have existing FTAs with some but not all the major wheat exporters**

Major Wheat Exporters	Arab Countries with FTAs
United States[(a)]	Bahrain, Jordan, Morocco, Oman
France & Germany[(b)]	Algeria, Egypt, Jordan, Lebanon, Morocco, Syria, Tunisia
Canada	Jordan[(c)]

Source: WTO 2011.
Note: (a) Other Arab countries, including Egypt, have Trade & Investment Framework Agreements with the United States; (b) The FTA is with the European Union, which includes major wheat exporters such as France and Germany; (c) The FTA between Jordan and Canada is yet to be put into effect.

traders. Such business relationships are mutually beneficial: grain traders have less incentive to increase price margins and cancel contracts with large customers, while the importers are more likely to select reliable grain traders when receiving tender bids. Moreover, there may be opportunities for more formal collaboration between Arab governments and grain traders via public-private-partnerships (PPPs). Private grain traders may provide the public sector with information on regional and international wheat market conditions, while governments could offer the traders greater insight on local market conditions. PPPs can also be developed with domestic companies: in one example in 2010, Saudi Arabia's National Shipping Company partnered with the Arabian Agricultural Services Company (ARASCO) to form Bahri Dry Bulk, which will import and transport dry bulk cargo (NSCSA 2011).

Developing formal trade relationships with key grain-exporting countries could further facilitate importing wheat from reliable sources. Bahrain, Jordan, Morocco, and Oman each have free trade agreements (FTAs) with the United States, while Algeria, Egypt, Jordan, Lebanon, Morocco, Syria, and Tunisia each have FTAs with the European Union, which includes France and other important wheat exporters (Table 4-1). Jordan has signed a FTA with Canada, but it has yet to be put into effect. Meanwhile, Russia and Ukraine were two of the largest wheat exporters to Arab countries in 2009, and yet there are currently no existing trade agreements between Arab countries and these two key wheat exporters. While a FTA with Russia might not have insulated Arab countries from Russia's universal wheat export ban in August 2010, FTAs can offer benefits to both consumers and businesses in Arab countries across numerous sectors, including the wheat industry. Increasing diplomatic and economic ties between Arab countries and key grain exporters can have secondary benefits for food security.

In addition to cultivating relationships with large wheat-exporting countries, strengthening WISC cooperation among neighboring countries may also ease supply risk. Currently, Arab countries each import wheat through their own national ports. Given the importance of food security and the view that importing wheat is an issue of national security, it is understandable that each country wants to have autonomous control over its wheat imports. In some instances, however, there may be gains to be had by working with neighboring countries to import wheat to the region. For example, a country such as Jordan, with only one port in the south, may be able to reduce supply-chain congestion by importing some wheat through nearby Mediterranean ports and then trucking it to silos and mills in the northern part of the country (see Box 4–1).

Arab countries may consider alternative regional cooperation solutions. First, transshipment from large vessels at deep-water ports into smaller vessels serving shallow-water ports in the region is common practice. Using a hub-and-spoke model, such as that used in the Netherlands, would allow large volumes of wheat to be shipped to a single deep water port in the region, and then the wheat could be transported to multiple destinations throughout the Arab world. Second, Arab countries can take advantage of the idea of parcel service. Specifically, smaller countries such as Qatar and Bahrain may be able to benefit from importing wheat on shared vessels, and also carrying cargo for neighboring countries.

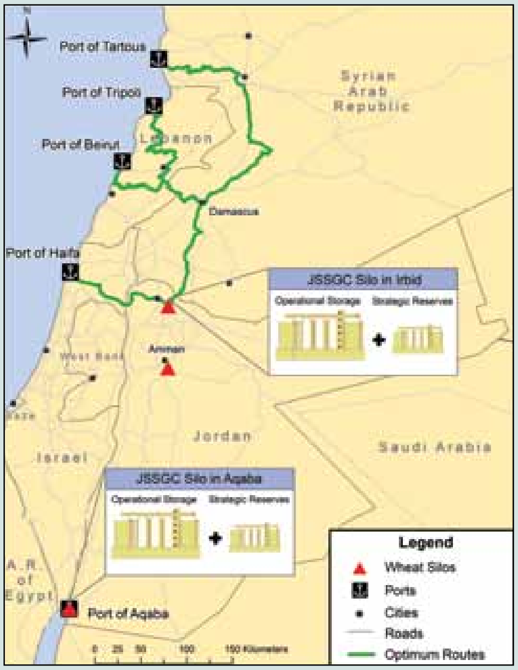
How can hedging be used as a price risk management tool?

The application of physical hedging can mitigate price risk, while addressing the need for physical wheat supplies. There are two primary instruments that Arab countries can use for a physical hedge. The first instrument, a *forward contract*, is an agreement to purchase a specific volume of the commodity on a specified date in the future, whereby the price is pre-determined.[70]

BOX 4–1 | Regional cooperation

Currently, Jordan is importing nearly all its wheat through Aqaba port. As the country considers expanding storage capacity to increase its strategic reserves Jordan might consider expanding storage capacity at the Jordan Silos and Supply General Company (JSSGC) silo in Irbid. With additional capacity in the northern part of the country, Jordan could import part of its annual wheat requirements via Tartous, Tripoli, Beirut, or Haifa and then transport it to Irbid by truck (Figure). This could help eliminate congestion and create smooth logistics during import surges by reducing the likelihood of bottlenecks, such as the unnecessary queuing of vessels and trucks at Aqaba and throughout the chain from Aqaba to inland silos. This option would require developing relationships with Syria, Lebanon, and/or Israel, and renting/contracting handling and storage capacity at the selected Mediterranean ports.

Jordan could also import wheat via nearby Mediterranean ports



Source: Authors.

70 The price is pre-determined often at a fixed level or using an average price formula.

These types of forward contracts enable the purchaser to lock in a price, effectively transferring the price risk to the seller. The purchaser bears the risk that prices may decline below the pre-determined price at the time the contract is exercised. The second instrument is a *physical call option*, which is effectively a right, but not an obligation, to purchase a commodity at a specified maximum price level (strike price). The purchaser pays a premium for this right. This effectively is a type of insurance and the maximum price cap allows the purchaser to benefit from lower prices.[71] In both cases, the purchaser can better insulate themselves from wheat price volatility and, in doing so, actively manages their fiscal exposure or liability.

While physical hedges are currently used in wheat contracts, importing countries could benefit from issuing similar contracts for wheat imports over a longer time horizon. In the Arab world, on average, wheat is delivered within three months after the initial tender is issued. While there are some cases in which wheat is scheduled to be delivered six months or even a year after the tender is issued, this occurs less frequently. Given the availability of physical hedges, Arab countries could potentially use longer-term contracts in order to lock in the volume and price of wheat imports up to 18 to 24 months in advance of delivery of the wheat. In this way, the price of the commodity can be fixed well in advance of the delivery and the expenditure can be more closely aligned with budget management. Long-term supply contracts may also mitigate counterparty risk, as suppliers will have more of an interest in ensuring delivery (Sadler and Magnan 2011). Since the quantity and delivery dates are specified in the contract, the importer will also be able to plan ahead to make sure that the supply chain is able to accommodate that level of throughput volume.

Commodity derivatives may also be used to mitigate wheat-import price risks. Traditionally, there are two types of derivatives that are commonly used in agricultural commodity markets: futures and options.[72] A *futures contract*, like a forward contract, is an agreement between a purchaser and a seller to receive or deliver a product on a pre-determined date at a negotiated price. However, futures contracts are typically traded on an exchange and have standardized delivery periods, contract sizes, and qualities. Purchasing wheat futures contracts can help smooth price volatility. However, for importers who are concerned with insulating themselves from adverse price shocks, futures contracts may not be the ideal instrument. For example, if the government purchases a futures contract but the price of wheat falls, the government will then bear the legal responsibility to fulfill that contract and pay the difference in the price movement to the market counterparty (FAO et al. 2011). Conversely, a *call option* is a contract that gives an investor the right to buy a wheat futures contract at a specific price (strike

71 If the price of the commodity increases beyond the strike price, the option is "in the money" and the purchaser will exercise the option enabling him/her to capture the commodity at the price as opposed to the higher market price. Conversely, if the price of the commodity is lower than the strike price, the option will not be exercised and the purchaser can close out the option by selling it or letting it expire.

72 This study focuses on traditional financial derivatives, yet some Arab countries may wish to explore other hedging instruments that are Sharia compliant.

price) within a certain time period. Call options act as a form of insurance to protect the buyer of the contract from price shocks by allowing them to take advantage of any increase in market wheat prices by exercising the option. When a call option contract is purchased, the buyer pays a premium for the option to purchase wheat at a pre-determined price. If market prices are below this price, the buyer is not obligated to buy wheat through the exchange and can take advantage of lower market prices. However, if market prices exceed the maximum price, the buyer can choose to settle the contract either financially or physically (FAO et al. 2011). In the former case, the buyer can sell the call option and use the cash payout (difference between market price and call strike price) to offset the purchase of physical wheat at market prices. In the latter case, the buyer can exercise the call option by paying the pre-determined price, and then sell the corresponding futures contract at the higher market price, resulting in a profit that can be used to offset against the higher physical price of wheat.

While trading derivatives can be an effective risk management strategy, careful thought should be given to who is responsible for executing the trading decisions. If the public sector wishes to include risk management within the mandate of a government institution, the scope and limitations for hedging instruments must be clearly defined, and the incentive structure for the practitioners must be aligned with the governance objectives of the designated agency. Alternatively, the government could partner with a private institution, designating an external company to manage the daily operations of the hedging strategy with protocols in place for reporting to the government. Although agricultural commodity derivatives are not frequently used in the Arab world to mitigate import price risk, other governments have successfully promoted the use of financial derivatives as risk management tools (see Box 4–2).

Financial commodity hedging instruments present challenges such as basis risk, whereas physical hedges have different challenges such as counterparty risk. Basis risk is the risk that the futures index used to price the contract may move by a different amount or in a different direction than the physical market. Essentially, this is a risk associated with uncertain movements between the futures price and the physical spot price, and the possibility that movements may not correlate exactly with one another. Since different wheat products are traded on different exchanges, governments that choose to use financial derivatives to hedge price risk must be aware of how basis risk can vary across the international exchanges.[74] Furthermore, the exchanges cover only the cost of the wheat and not the price of transport or delivery, which may potentially increase the basis risk. Physical hedges, on the other hand, are

73 US Hard Red Winter wheat is traded on Kansas Board of Trade, European Milling wheat is traded on MATIF, and a mix of US wheat products—including Soft Red Winter, Hard Red Winter, Dark Northern Spring, and Northern Spring Wheat—are traded on Chicago Mercantile Exchange.

74 Basis risk largely comprises freight and transport costs, currency exchange rates, and other logistical costs, which can vary depending on the region. Given the different locations of the exchanges, particularly in relation to Arab countries, variations in freight and logistics costs will impact the basis risk on each exchange differently.

BOX 4–2 | Mexico case study

While the private sector frequently uses financial derivatives to hedge agricultural commodity price risk, these risk management tools are still not commonly used by the public sector. Nevertheless, some governments have used financial derivatives to successfully hedge producer and consumer price risk for agricultural commodities, particularly corn.

Since 1994, the Mexican government has encouraged the adoption of risk management instruments for a number of products including corn, wheat, soy, sorghum, coffee, cotton, and livestock. In particular, the hedging facility, which is under the mandate of *Apoyos y servicios a la comercialización agropecuaria* (ASERCA), offers subsidies between 50 and 100 percent to hedge exposure to international price movements. The program was initially intended to protect Mexico's corn producers from sharp drops in international prices. In practice, producers would purchase *put options* on the Chicago Board of Trade (CBOT) to guarantee a price floor.

The program has been quite successful and has expanded both in terms of coverage of corn production and in terms of helping corn consumers mitigate the risk of price increases. From the consumers' perspective, food inflation was a serious concern in 2007, leading to massive protests known as the "Tortilla Riots." More recently, as international agricultural commodity prices sharply increased in 2010, the government was faced with the possibility of managing a 50 percent increase in the price of tortillas, a staple food for Mexicans (Blas 2010, Llana 2010). In an effort to protect against such an event, the government announced in December 2010 that, on behalf of tortilla makers, it purchased call options on the CBOT to cover 4.2 million metric tons of corn (Blas 2010). As such, the government was able to guarantee prices would not exceed a certain level, and thereby safeguard against the potential socio-economic ramifications of an adverse price increase, while also guaranteeing a share of corn supplies.

not subject to basis risk as prices are negotiated directly between buyer and seller of the physical wheat. These contracts, however, do carry counterparty risk which is not a concern for exchange-traded commodity derivatives.

A successful hedging strategy will be over the long-term and will include a mix of the various hedging instruments described above. Arab countries face a number of identifiable wheat-import risks and no single tool can be a standalone solution. If, for example, a country were to decide to manage its import risks by only using long-term forward contracts for all of its wheat-import needs, it would need to be able to accurately forecast well in advance the quantity of wheat that will be consumed, the capacity of storage infrastructure, and the capability of the supply chain to accommodate the throughput. While reasonable estimates can be made, if forecasts are made far enough in advance, they might not account for possible domestic crop failures, which may result in an insufficient supply of wheat. Theoretically, in the event of a domestic crop failure, the country would have to purchase wheat on the physical market at the spot price, and thereby expose itself to additional price risk. Alternatively, overestimating wheat-import volume for a long-term forward contract could result in surplus imports, increased strain on storage facilities, and the misalignment between the volume of wheat purchased and consumed. While commodity risk management can be complex, a lack of any risk management strategy may be an even riskier approach. A mix of hedging tools, including managing risk for a basket of commodities, can provide each country with greater flexibility to adapt its long-term risk management strategy, particularly as new risks arise. Each country can customize an appropriate combination of methods and tools to manage the specific risks it faces.

Appendix I: Methodology

This study, and in particular the discussion on WISC logistics in Chapter 3, is based on a benchmarking analysis that assesses WISC performance for ten Arab countries (Bahrain, Egypt, Jordan, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and Yemen). In addition to these ten countries, WISC data was collected for two comparator countries (the Netherlands and South Korea).

The analysis is based on a "corridor approach," in which WISC performance was assessed for a single corridor in each country. The WISC structure can vary from country to country, and from corridor to corridor within a single country. The analysis for each country is based on the WISC corridor with the largest volume throughput from unloading port to bulk storage at the flour mill (see table with corridor descriptions below). While the performance of a single corridor may not always reflect the entire wheat-import supply chain in a given country, selecting a single corridor allows for easier comparison across countries.

For each selected corridor, efficiency is measured at every WISC segment and node, using two performance indicators: cost (US$/metric ton) and time (days/metric ton). The study examines WISC efficiency in the following supply-chain segments in each country:[75]

1. Unloading port
   Cost: cost of vessel turnaround time;[76] inspection, sampling and analysis; agent fees; fumigation prior to vessel discharge; handling at berth; transport to port silo; handling at port silo; storage and fumigation at port silo
   Time: vessel waiting time; vessel unloading time; travel time to port silo; dwell time at port silo
2. Transport to inland silo
   Cost: transport to silo
   Time: travel time to silo; waiting time

75 Each country's WISC is unique, so in some countries the structure of the chain may not resemble this sequence (e.g., some countries do not have inland silos and store all wheat, including strategic reserves, at the port silo).

76 The cost of vessel turnaround time assumed the use of time-charter vessels. An average 2009 daily charter rate was calculated using weekly time-charter data for handymax, panamax, and capesize vessels. For each country, an average vessel size was estimated based on the data and the corresponding average daily charter rate was multiplied by the estimated turnaround time.

3. Storage at inland silo
   Cost: grain handling at silo; storage; fumigation
   Time: dwell time at silo
4. Transport to flour mill
   Cost: transport to flour mill
   Time: travel time to flour mill; waiting time
5. Bulk storage at flour mill
   Cost: grain handling at bulk storage at flour mill; storage; fumigation
   Time: dwell time at bulk storage at flour mill
6. WISC management
   Cost: product loss; loading port costs; overhead costs (including documents, bank costs, insurance, commissions, security, and other administrative costs); estimated profit margin; and the cost of capital
   Time: not applicable

In addition to the WISC segments and nodes outlined above, procurement of wheat and strategic reserve policies were also evaluated. For procurement, this analysis examined the tender process including the contracted CFR (Cost and Freight) price, origins of the wheat, trade barriers (import tariffs, export bans, etc.). For strategic reserves, the analysis considered existing and planned storage capacity, consumption patterns, and target reserve levels.

Selected WISC Corridors (All wheat in bulk, unless otherwise specified)

Bahrain

Unloading at Mina Salman port → Transport to port silo → Storage at the silo

Storage at the silo is the end of the WISC in Bahrain since the silo is connected to the flour mill by conveyor and hence the silo serves as bulk storage at the flour mill.

Egypt

Unloading at Alexandria/Dekheila port → Transport to port silo → Storage at port silo → Transport to flour mills in Cairo region → Bulk storage at flour mill in Cairo region

Jordan

Unloading at Aqaba port → Storage at port silo → Transport to inland silo in Juweidah → Storage at inland silo → Transport to flour mill in Juweidah → Bulk storage at flour mill

Transport to port silo is excluded as it is done by conveyor.

Lebanon

Unloading at Beirut port → Storage at port silo →Transport to flour mill in Beirut region → Bulk storage at flour mill in Beirut region

Transport to port silo is excluded as it is done by conveyor.

Morocco

Unloading at Casablanca port → Storage at port silo → Transport to flour mill in Casablanca region → Bulk storage at flour mill in Casablanca region

Transport to port silo is excluded as it is done by conveyor.

(*continued on next page*)

Selected WISC Corridors (All wheat in bulk, unless otherwise specified) (*continued*)

Oman

Unloading at Mina Qabous port → Storage at port silo → Transport to flour mill at the port

Transport to port silo is excluded as it is done by conveyor. Transport to the flour mill is the end of the WISC in Oman since the port silo also serves as storage for the mill.

Qatar

Unloading at Doha port → Storage at port silo

Transport to port silo is excluded as it is done by conveyor. Storage at the silo is the end of the WISC in Qatar since the silo is connected to the flour mill by conveyor and hence the silo serves as bulk storage at the flour mill.

Saudi Arabia

Unloading at Jeddah port → Transport to port silo → Storage at port silo → Transport to flour mill in Jeddah → Bulk storage at flour mill in Jeddah

Tunisia

Unloading at Radès port → Storage at port silo → Transport to flour mill in Tunis province → Bulk storage at flour mill in Tunis province

Transport to port silo is excluded as it is done by conveyor.

Yemen

Unloading at Saleef port → Transport to silo nearby the port → Storage (and bagging) at silo → Transport of bagged wheat to warehouse storage in Sana'a

The WISC in Yemen is significantly different from that in other countries. Warehouse storage in Sana'a was assumed to be similar to bulk storage at the flour mill.

Netherlands

Unloading at Rotterdam port → Bulk storage at flour mill at port

Wheat is unloaded directly to the flour mill at the port.

South Korea

Unloading at Incheon port → Storage at port silo → Bulk storage at flour mill at the port

Transport to port silo and to flour mill is excluded as it is done by conveyor.

Appendix II: Reported, Calculated, and Assumed Data

COSTS

WISC Segment	Description	Bahrain			Egypt			Jordan		
		Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions
Port	Vessel turnaround time		X			X			X	
	Inspection, sampling & analysis	X			X			X		
	Agent	X			X			X		
	Fumigation prior to vessel discharge	X					X	X		
	Handling at berth	X			X				X	
	Transport to port silo	X			X			X		
Storage at Port Silo	Handling at port silo			X			X		X	
	Storage at port silo			X		X		X		
	Fumigation at port silo			X			X	X		
Transport	Transport to inland silo		n/a			n/a		X		
Storage at Inland Silo	Handling at inland silo								X	
	Storage at inland silo		n/a			n/a			X	
	Fumigation									X
Transport	Transport to flour mill		n/a		X					X
Bulk Storage at Mill	Handling at bulk storage						X			X
	Bulk storage		n/a			X			X	
	Fumigation						X			X
WISC Management	Product loss			X		X				X
	Loading port costs	X				X			X	
	Cost of working capital			X			X			X
	Overhead & administration		X				X			X
	Risk & profit margin			X			X			X

(*continued on next page*)

COSTS (*continued*)

WISC Segment	Description	Lebanon Reported	Lebanon Calculated from data	Lebanon Est. using assumptions	Morocco Reported	Morocco Calculated from data	Morocco Est. using assumptions	Oman Reported	Oman Calculated from data	Oman Est. using assumptions
Port	Vessel turnaround time		X			X			X	
	Inspection, sampling & analysis			X	X			X		
	Agent			X			X	X		
	Fumigation prior to vessel discharge			X	X			X		
	Handling at berth		X		X			X		
	Transport to port silo	X			X			X		
Storage at Port Silo	Handling at port silo			X	X					X
	Storage at port silo	X				X				X
	Fumigation at port silo			X	X					X
Transport	Transport to inland silo		n/a			n/a			n/a	
Storage at Inland Silo	Handling at inland silo									
	Storage at inland silo		n/a			n/a			n/a	
	Fumigation									
Transport	Transport to flour mill	X				X		X		
Bulk Storage at Mill	Handling at bulk storage	X					X			
	Bulk storage	X			X				n/a	
	Fumigation		X				X			
WISC Management	Product loss			X			X			X
	Loading port costs	X					X	X		
	Cost of working capital			X			X			X
	Overhead & administration			X			X	X		
	Risk & profit margin	X					X			X

(*continued on next page*)

COSTS *(continued)*

WISC Segment	Description	Qatar			Saudi Arabia			Tunisia		
		Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions
Port	Vessel turnaround time		X			X			X	
	Inspection, sampling & analysis		X			X		X		
	Agent		X		X					X
	Fumigation prior to vessel discharge	X					X	X		
	Handling at berth	X			X			X		
	Transport to port silo	X			X			X		
Storage at Port Silo	Handling at port silo	X					X			X
	Storage at port silo	X				X			X	
	Fumigation at port silo	X					X	X		
Transport	Transport to inland silo		n/a			n/a			n/a	
Storage at Inland Silo	Handling at inland silo									
	Storage at inland silo		n/a			n/a			n/a	
	Fumigation									
Transport	Transport to flour mill	X			X				X	
Bulk Storage at Mill	Handling at bulk storage				X					X
	Bulk storage		n/a		X				X	
	Fumigation				X					X
WISC Management	Product loss			X			X			X
	Loading port costs			X			X	X		
	Cost of working capital			X			X			X
	Overhead & administration			X		X			X	
	Risk & profit margin			X			X			X

(continued on next page)

COSTS (*continued*)

WISC Segment	Description	Yemen Reported	Yemen Calculated from data	Yemen Est. using assumptions	Netherlands Reported	Netherlands Calculated from data	Netherlands Est. using assumptions	South Korea Reported	South Korea Calculated from data	South Korea Est. using assumptions
Port	Vessel turnaround time		X			X			X	
	Inspection, sampling & analysis		X		X			X		
	Agent	X			X			X		
	Fumigation prior to vessel discharge	X			X			X		
	Handling at berth	X				X		X		
	Transport to port silo		n/a			n/a		X		
Storage at Port Silo	Handling at port silo							X		
	Storage at port silo		n/a			n/a		X		
	Fumigation at port silo									X
Transport	Transport to inland silo		X			n/a			n/a	
Storage at Inland Silo	Handling at inland silo			X						
	Storage at inland silo			X		n/a			n/a	
	Fumigation			X						
Transport	Transport to flour mill	X			X					X
Bulk Storage at Mill	Handling at bulk storage				X					X
	Bulk storage		n/a			X				X
	Fumigation				X					X
WISC Management	Product loss			X			X			X
	Loading port costs			X	X					X
	Cost of working capital			X			X			X
	Overhead & administration			X	X					X
	Risk & profit margin			X	X					X

TRANSIT TIME

		Bahrain			Egypt			Jordan		
WISC Segment	Description	Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions
Port	Vessel time in port up to start of discharge	X				X		X		
	Vessel discharge to port silo or truck/railcar	X				X			X	
	Travel time to port silo	X			X			X		
Storage at Port Silo	Dwell time at port silo		X			X			X	
Transport to Inland Silo	Travel time		n/a			n/a		X		
	Waiting time							X		
Storage at Inland Silo	Dwell time at inland silo		n/a			n/a			X	
Transport to Mill	Travel time		n/a			X		X		
	Waiting time					X		X		
Bulk Storage at Mill	Dwell time at flourmill bulk storage		n/a			X			X	

(*continued on next page*)

TRANSIT TIME *(continued)*

WISC Segment	Description	Lebanon			Morocco			Oman		
		Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions
Port	Vessel time in port up to start of discharge	X			X				X	
	Vessel discharge to port silo or truck/railcar		X		X			X		
	Travel time to port silo	X			X			X		
Storage at Port Silo	Dwell time at port silo		X			X			X	
Transport to Inland Silo	Travel time Waiting time		n/a			n/a			n/a	
Storage at Inland Silo	Dwell time at inland silo		n/a			n/a			n/a	
Transport to Mill	Travel time		X			X		X		
	Waiting time		X				X	X		
Bulk Storage at Mill	Dwell time at flourmill bulk storage		X		X				n/a	

(continued on next page)

TRANSIT TIME *(continued)*

		Qatar			Saudi Arabia			Tunisia		
WISC Segment	**Description**	**Reported**	**Calculated from data**	**Est. using assumptions**	**Reported**	**Calculated from data**	**Est. using assumptions**	**Reported**	**Calculated from data**	**Est. using assumptions**
Port	Vessel time in port up to start of discharge	X			X			X		
	Vessel discharge to port silo or truck/railcar	X			X			X		
	Travel time to port silo	X			X			X		
Storage at Port Silo	Dwell time at port silo		X			X		X		
Transport to Inland Silo	Travel time Waiting time		n/a			n/a			n/a	
Storage at Inland Silo	Dwell time at inland silo		n/a			n/a			n/a	
Transport to Mill	Travel time	X					X			X
	Waiting time	X			X			X		
Bulk Storage at Mill	Dwell time at flourmill bulk storage		n/a			X			X	

(continued on next page)

TRANSIT TIME *(continued)*

WISC Segment	Description	Yemen			Netherlands			South Korea		
		Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions	Reported	Calculated from data	Est. using assumptions
Port	Vessel time in port up to start of discharge	X				X			X	
	Vessel discharge to port silo or truck/railcar	X				X			X	
	Travel time to port silo		n/a			n/a		X		
Storage at Port Silo	Dwell time at port silo		n/a			n/a			X	
Transport to Inland Silo	Travel time	X				n/a			n/a	
	Waiting time			X						
Storage at Inland Silo	Dwell time at inland silo		X			n/a			n/a	
Transport to Mill	Travel time			X	X			X		
	Waiting time			X	X			X		
Bulk Storage at Mill	Dwell time at flourmill bulk storage		n/a		X				X	

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