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ECONOMICS AND MARKETING

Effect of the Southeastern Anatolia Project (GAP) on Cotton Markets of Turkey and the World

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ABSTRACT

In Turkey, the government initiated an irrigation project in the Southeastern Anatolia region, which is expected to irrigate an additional 1.07 million hectares of land. This study estimates the consequence of increased Turkish cotton production area on the world cotton market. We use a multi-market, multi-region partial equilibrium model to simulate the impact of increasing cotton harvest area in Turkey. Results suggest that with the increase in cotton production area in Turkey the world cotton price would decrease by about 9.5 percent. Effects on prices and area planted in other countries depend on whether the project converts non-agricultural lands to cotton, or reallocates area currently planted to grains.

Cotton has an important role in the Turkish economy, and imports have accounted for a rising share of the market. The broader context indicates that Turkey accounts for a modest share of total cotton supply and demand, so an increase in planted hectares could be of limited consequence as regards global markets and prices. This context is important as decision makers in business and government assess how the Southeastern Anatolia Project (GAP), a new program intended to increase the area planted to cotton, could affect cotton markets. The potential that the change in cotton area could come about by shifting land from other crops, such as wheat and barley, raises the possibility of unintended consequences in these markets.

According to a United States Department of Agriculture (USDA) Global Agricultural Information Network (GAIN) report (2014), the textile and garment industries are crucial to Turkey's economy, accounting for eight percent of the total GDP, 16% of industrial production, and around ten percent of manufacturing jobs. Turkey is the second largest supplier of apparel and textiles to the European Union (EU), preceded by China (ibid). Turkey is the eighth largest textile exporter in the world and fifth largest exporter of apparel (USDA, 2014). Turkish apparel and textiles are even more competitive in export markets because of the increase in domestic consumption and cost of production of those products in many of the competing cotton producing countries, including China and India (ibid). In 2013, Turkey exported $ 25.8 billion in textiles and apparel, about $ 2 billion more than in 2012 (ibid). Due to its geographical proximity to the EU, most of the textiles exported from Turkey go to the EU (USDA, 2014).

Until recently, Turkey was the sixth largest cotton producing country in the world, after China, the United States (U.S.), India, Pakistan and Uzbekistan (Basal and Sezener, 2012). During the last twelve years (2003-2014), the cotton area harvested ranged between 280,000 ha and 710,000 ha (Table 1). Turkey was the fourth largest consumer of cotton in the world after China, India and Pakistan (Basal and Sezener, 2012). Domestic cotton consumption during the marketing years from 2009/10 to 2012/13 was 1.28, 1.22, 1.22, 1.32 million metric tons (MT) respectively. Consumption is expected to increase in the coming years (USDA, 2015). However, farmers switched recently to other crops resulting in less cotton area and production. Domestic production accounted for 30-61% of domestic consumption in the four marketing years ending in 2012/13 (USDA, 2015). In 2012/13, Turkey imported 804,000 MT of cotton (ibid). In recent years, Turkey was the second largest cotton importer, with only China importing more (ICAC, 2012). The U.S., Turkmenistan and Greece are the main cotton suppliers to Turkey. Turkey could remain one of the largest markets for U.S. cotton exports due to a lack of local supplies (USDA, 2014).

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Table 1. Country-specific land planted to cotton production

Year	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
						(Million Hectares)					
Argentina	0.25	0.37	0.31	0.40	0.31	0.30	0.44	0.61	0.53	0.36	0.56
Australia	0.20	0.32	0.34	0.15	0.07	0.17	0.20	0.58	0.66	0.45	0.44
Bangladesh	0.05	0.04	0.05	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.04
Brazil	1.10	1.17	0.85	1.09	1.08	0.84	0.84	1.40	1.40	0.90	1.12
China	5.30	5.90	5.35	5.95	6.20	6.05	5.30	5.25	5.50	5.30	4.80
EU-28	0.46	0.47	0.45	0.43	0.41	0.34	0.26	0.31	0.35	0.36	0.31
India	7.63	8.79	8.87	9.17	9.44	9.41	10.31	11.14	12.20	12.00	11.70
Indonesia	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Pakistan	2.99	3.19	3.10	3.25	3.00	2.90	3.00	2.80	3.00	3.00	3.00
Turkey	0.07	0.70	0.60	0.63	0.52	0.34	0.28	0.32	0.49	0.41	0.33
United States	4.86	5.28	5.59	5.15	4.25	3.06	3.05	4.33	3.83	3.77	3.05
Uzbeckistan	1.40	1.42	1.43	1.43	1.43	1.42	1.30	1.33	1.31	1.32	1.29
Rest of World	7.39	8.03	7.83	6.89	6.16	5.77	5.17	5.42	6.65	6.48	6.13
World total	32.34	35.70	34.77	34.59	32.90	30.63	30.19	33.53	35.96	34.39	32.78

Source: USDA (2015).

Until 1992, Turkey was a net exporter of cotton. However, with the removal of all the quotas on the textile and clothing trade between Turkey and the EU following a WTO agreement in 1995, Turkey became a major exporter of textile products to the EU markets, resulting in a rapid increase in the demand for cotton yarn in the domestic market (ICAC, 2012), and the increasing cotton demand outpaced domestic production. Turkey started importing cotton from the world market, and the domestic textile industry started to rely on imported cotton yarn. Currently, Turkey has no quantitative restrictions on cotton exports or on imports. Turkey does not charge any duty or levy on cotton exports or imports. Therefore, Turkey is mostly free of direct commodity market interventions that target cotton trade. Cotton trade and prices are determined by the economic principles of supply and demand, depending on both the domestic and international conditions (ICAC, 2012).

Cotton is mainly produced in three regions of Turkey, Southeastern Anatolia, Aegean and Cukurova, while Anatalya also contributes a small amount to Turkish cotton production (Basal and Sezener, 2012). Until the 1980's, Aegean and Cukurova were important production regions, accounting for almost 90 percent of total production in Turkey. However, the center of cotton production moved from Aegean and Cukurova to Southeastern Anatolia due to the decision of the government to initiate the GAP in the 1990's (Basal and Sezener, 2012). With the implementation of the GAP, cotton production in this region increased as the amount of irrigated farmland rose. In 2010/11, the share of Southeastern Anatolia dedicated to total cotton production reached 60%, up from an eight percent production share in 1980/81 (ibid).

The GAP was designed as a program to develop water and land resources of the region. The initial program comprised 13 projects, envisaging irrigation schemes and hydraulic power plants in the basins of the Euphrates and the Tigris (Őzgül, 2004). As a whole, the package included 22 dams, 19 hydraulic power plants and irrigation covering an area of 1.7 million hectares (ibid). According to the GAP Action Plan released by the Office of the Prime Minister (2008), 272,972 hectares of land were brought under irrigation as of 2008. This land accounts for about 16% of the total planned projected area of 1.7 million hectares. Basal and Sezener (2012) pointed out that, depending on the price of cotton, 90% of the new irrigated land in the GAP region would be used for cotton production. Along with many other initiatives, Turkey has initiated an investment plan of $12 billion to be spent on GAP to expand irrigable land area up to 780,000 hectares by 2016 (USDA, 2014) that could be used to increase cotton production in the country.

There are many economic studies that investigate the cotton market of Turkey, reflecting its importance to the local economy as a whole, for the Turkish agricultural sector, and in the world cotton market.

Several of these studies are relevant because they focused on cotton production or the market more generally. Şengűl and Erkan (1999) analyzed the structural interdependence of cotton and textile industries in the region in Turkey targeted by the GAP using an input-output model. Those authors found that GAP, once completed, would increase the total value of output from the cotton and textile industries in this region by 2.3 times. Gazanfer (2004) pointed out that the completion of the GAP might reduce cotton imports. The GAP region is becoming the top cotton-producing region in Turkey mainly because of heavy investment in irrigation and infrastructure by the Turkish government (Konduru et al. 2014). Hudson (1997) projected Turkey's cotton production, consumption and trade. This work determined that the GAP irrigation project could double cotton production in Turkey. Altinbilek and Tortajada (2012) found that the irrigation projects in the GAP could transform the region into a major cotton producing area in Turkey to such an extent that this region might account for nearly 50% of the total Turkish cotton production. Earlier studies have pointed out the potential importance of the GAP region to cotton production for Turkey. However, none of these studies estimated the consequences of increased cotton production due to the GAP in Turkey on the world cotton market, as well as the potential for unintended effects on other crop markets.

The objective of this study is to estimate the impact of the GAP in Turkey on domestic and international cotton markets. By using a structural economic model that represents other commodities that compete for land area, possible side effects for wheat and barley markets will also be assessed. The results will be expressed in terms of how the policy could affect market quantities and prices in Turkey and elsewhere.

MATERIALS AND METHODS

A multi-market, multi-region, non-spatial partial equilibrium model was used to solve for the international cotton market (Meyers et al., 2010). This approach has been used for similar purposes in the past. Umboh et al. (2014) used a structural model approach to analyze the maize tariff policy in Indonesia. Pan et al. (2006), and Pan, Hudson and Mutuc (2011) used a partial equilibrium model to estimate U.S. cotton policy impacts on world markets. Welch et al. (2008) assessed the side effects of growing ethanol production on global cotton markets using this modeling approach. In this case, an international cotton model is linked with a set of models representing other agricultural commodity markets.

Data. Cotton production and consumption data used in the development of the international cotton model are primarily obtained from the USDA Foreign Agricultural Service (FAS) Production, Supply, and Distribution data set. Macroeconomic data are obtained from the International Monetary Fund and IHS Global Insight. Commodity price data are obtained from USDA attaché reports, and other sources.

Model. The Food and Agricultural Policy Research Institute (FAPRI) model for agriculture includes the world cotton market representing country specific models and other agricultural commodity markets. Country-specific cotton markets are modeled for the major cotton producing and consuming countries, including the U.S., Brazil, China, India, Pakistan, and Turkey (Figure 1).

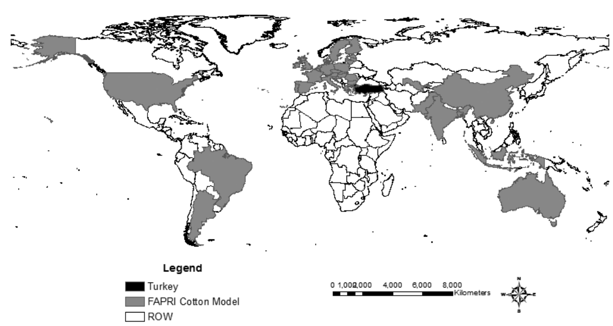

Figure 1. Cotton model by country coverage

The cotton market model operates within a broad, multi-market, multi-region partial equilibrium modeling system of global agricultural commodity and related markets. The model is developed based on basic economic principles of supply and demand. The model is used to establish ten-year projections for a baseline. Policy effects are estimated by changing the baseline assumptions to reflect the policy, simulating the results, and comparing the simulation output of the policy scenario to the baseline. In general terms, then, this approach is consistent with other recent scientific studies used to assess market impacts of various policies (Pan et al., 2006; Welch et al., 2008).

A general summary of the cotton model provides a brief introduction. The model is solved for the market-clearing price, taking into account the existing domestic and trade policies of the main cotton producing countries (Figure 2). In all cases, the following identity is satisfied for each country-region combination and the world and in each year (t):

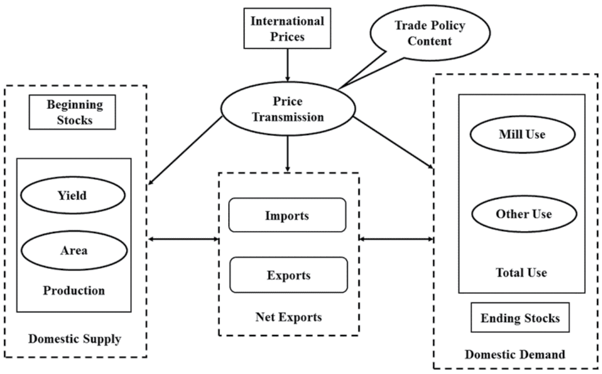

Figure 2. Schematic diagram of a representative country in the cotton model

$$\textit{Beginning Stock}_t + \textit{Production}_t + \textit{Imports}_t = \textit{Ending Stock}_t + \textit{Mill and other Use}_t + \textit{Exports}_t \ (1)$$

The model includes behavioral equations for area harvested, cotton yield, per capita mill and other (including industrial) use, and stocks for each of the major countries. The synthetic fiber market is not explicitly modeled, but the own-price elasticity of per capita demand can implicitly reflect the broader impacts as cotton price changes. The product of yield and harvested area estimates cotton production.

In countries where domestic prices are closely linked to world prices, domestic prices are modeled as a function of the world price using a price transmission equation. In these cases, net trade is modeled as the residual of demand, supply and stocks:

$$\textit{Net Trade}_t = \textit{Beginning Stock}_t + \textit{Production}_t - \textit{Mill and other Use}_t - \textit{Ending Stock}_t \ (2)$$

In cases where there are policies or other factors that can cause the domestic market price to deviate from the world price over time, domestic price can clear the domestic market. In these cases, trade can be set by policy or by some response to the difference between domestic and world prices.

Equilibrium world market prices are determined by equating excess supply and excess demand across countries. When solved, the interaction of world and domestic prices, behavioral equations representing decisions to produce, buy or store cotton, and clearing identities ensure an internally consistent market representation.

The international cotton model is further linked with a broader modeling system that represents the markets for other agricultural commodities and key products (Figure 3). The system simultaneously solves prices and quantities of each commodity and commodity product. Key agricultural annual crops, crop products and livestock products are modeled, including wheat and rice; maize, barley and other coarse grains; soybeans and other oilseeds; soybean meal and soybean oil, as well as other oilseed meals and vegetable oils; ethanol and biodiesel; beef, pork and poultry; and milk, cheese, butter and other dairy products. For example, in the case of crops in Turkey, cotton, wheat, barley, and sunflower seed have been modeled.

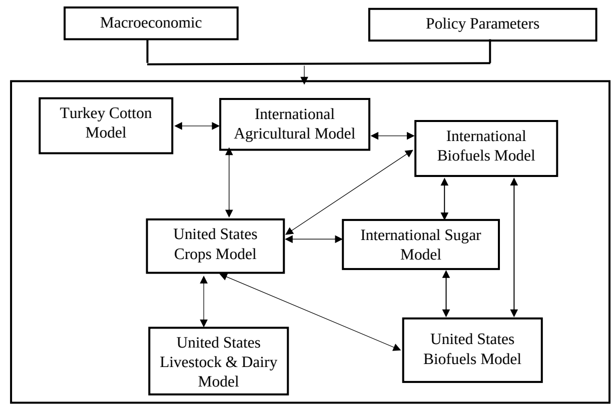

Figure 3. Linkages between Turkish cotton model and other components of the model system

Agricultural and trade policies in each country are included in the models to the extent that they affect the supply and demand decisions of the economic agents. The models assume that the existing agricultural and trade policy variables will remain at existing or announced levels over the outlook period. We assume other countries maintain current or existing policies, regardless of the impacts of the GAP on world markets. Macroeconomic variables, such as gross domestic product, population, and exchange rates, are exogenous variables. All models are calibrated on 2014/15 marketing year data for crop supplies and 2013/14 marketing year data for the demand-side variables. The models are used to generate ten-year annual projections (2014/15 and 2023/24) of prices and supply and use quantities. The calibrated model was further used to simulate the following scenario analysis.

Scenario Analysis. According to the literature, the irrigation project under GAP could irrigate 1.7 million hectares of agricultural land (Őzgül 2004). Basal and Sezener (2012) pointed out that over the last three decades (1980/81−2010/11) cotton planting area in the GAP region has increased from 50,000 ha to 300,000 ha. However, in this study we assumed that out of the total proposed addition of agricultural land in the GAP region, 500,000 hectares of land (less than a third of the 1.7 million hectares) could be planted to cotton. To estimate the market impacts of an area change of this magnitude, we simulate the following two scenarios (Figure 4):

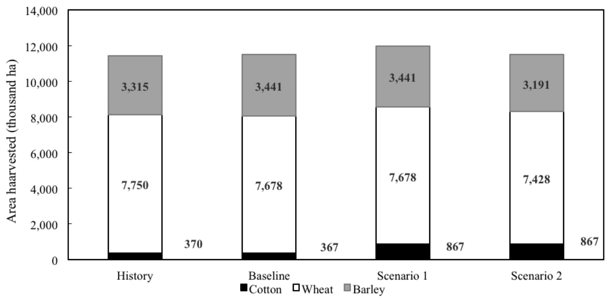

Figure 4. Cotton, wheat and barley area harvested in Turkey

1. Over the next ten years, in Turkey, an additional 500,000 hectares of non-agricultural land would be planted to cotton; and
2. Over the next ten years, 500,000 hectares of non-irrigated crop land currently used for wheat and barley production would be irrigated and used to produce cotton.

The key distinguishing characteristic is the source of the 500,000 hectares of additional cotton area: the increase drawn from land that was not previously used for agriculture, or the new cotton planting on land that was used for competing annual crops.

We compare the total production, price and trade of cotton, wheat and barley that are simulated in each scenario with the baseline. Sensitivity analysis was performed by simulating two alternative baselines (i) a case with low world cotton demand and price; and (ii) a case with high world cotton demand and price. Scenario 1 was simulated over each of these alternative baselines to test if the market impacts are contingent on initial conditions.

RESULTS AND DISCUSSION

Scenario 1 represents the case that cotton production is increased without a direct negative effect on area planted to wheat or barley. The results show that, with an increase in the cotton area harvested in Turkey due to the GAP, cotton production in Turkey could increase by 3,839 thousand bales (each bale weight 480 pounds) by the end of crop year 2023-24 (Table 2). The increase in cotton production area would results in more than doubling output. Greater cotton production decreases the cotton A-index (price) by 9.5% according to these estimates (Table 3), causing global cotton use to rise by 1.3%. Because Turkey is considered to be integrated with the world market through rapid adjustments in trade flows, this price effect feeds back to Turkey. With lower domestic price, cotton consumption rises by 2.2% in Turkey. By 2023-24, Turkish net imports decrease by 3.7 million bales, or 85%.

The increase in cotton area in Turkey could have minor effects on the production, use and trade on other commodities, including wheat and barley (Table 2). In scenario 1, there are no direct effects on other crop area planted because the GAP does not convert grain production areas into cotton production. However, there are still price effects. The project increases the amount of total agricultural land in the world, and crop prices are consequently at least somewhat lower. The price effects have consequences. The lower cotton prices cause some adjustments in planting, with land reallocated from cotton to other crops. Even in Turkey, some of the additional land in the region targeted by the GAP that would have been planted to cotton is reallocated to other uses, so the actual increase in cotton area in Turkey is less than the initial amount assumed.

There are only very limited price changes in world wheat and barley markets. The reallocation of area toward these crops as cotton prices fall does lead to lower wheat and barley prices, too. However, the magnitude of impact relative to global crop markets is not very large, and other crop price effects remain very modest in scenario 1.

The scenario 2 simulation results show that the source of the new cotton land matters. If agricultural land currently in use for other crops is brought under irrigation and then used for cotton production, then the market impacts are larger. Here, it is assumed that 250,000 ha of land previously used for wheat production and 250,000 ha of land previously used for barley, are replaced by 500,000 ha of land for cotton production in Turkey. Total agricultural area is not increased in this scenario. Instead, existing area is reallocated.

In scenario 2, global wheat and barley prices could increase by 0.49% and 0.80%, respectively (Table 3). Again, the domestic cotton production in Turkey increases, but by 3.2 million bales. This change is lower than the increase in cotton production in scenario 1 (3.8 million bales) (Table 2). The smaller effect results from the combination of initial shift associated with the policy and subsequent response to changing prices. With greater wheat and barley prices, some existing cotton area is switched to wheat and barley production. The cotton market results are consistent with those of scenario 1, but smaller in magnitude.

Table 2. Turkey and world quantity effects if the GAP causes an increase in cotton area in Turkey

Cotton: Production, Use, Stocks and Trade (Thousand bales)								
Country	Baseline		Scenario 1			Scenario 2		
Turkey	Average 2012/13-13/14	Average 2022/23-23/24	Average 2022/23-23/24	Absolute change	Percentage Change	Average 2022/23-23/24	Absolute change	Percentage Change
Production	2,475	2,831	6,670	3,839	-	6,008	3,176	-
Net Import	3,758	4,305	632	-3,673	-85.32%	1,267	-3,038	-70.57%
Domestic Use	6,175	7,109	7,262	154	2.17%	7,238	129	1.82%
World	Baseline		Scenario 1			Scenario 2		
Production	122,013	132,337	134,167	1,829	1.38%	133,854	1,516	1.15%
Domestic Use	108,441	131,268	132,914	1,645	1.25%	132,648	1,380	1.05%
Ending Stocks	95,819	120,073	121,603	1,530	1.27%	121,321	1,247	1.04%
Wheat: Production, Use and Trade (Thousand metric tons)								
Turkey	Baseline		Scenario 1			Scenario 2		
Production	16,750	19,206	19,206	0.12	0.00%	18,679	-527	-2.75%
Net Import	-112	-149	-149	0.02	-0.01%	372	521	-
Domestic Feed Use	775	987	987	0.02	0.00%	987	-0.64	-0.06%
Domestic Food Use	16,800	18,055	18,055	0.04	0.00%	18,054	-1.77	-0.01%
World	Baseline		Scenario 1			Scenario 2		
Production	686,700	776,096	776,110	14.09	0.00%	775,883	-212.4	-0.03%
Domestic Feed Use	133,699	161,652	161,632	-19.91	-0.01%	161,538	-114.2	-0.07%
Domestic Food Use	557,049	610,923	610,937	13.89	0.00%	610,847	-75.5	-0.01%
Ending Stocks	180,109	212,132	212,261	128.80	0.06%	211,926	-206.6	-0.10%
Barley: Production, Use and Trade (Thousand metric tons)								
Turkey	Baseline		Scenario 1			Scenario 2		
Production	6,400	6,702	6,701	-0.35	-0.01%	6,290	-411.64	-6.14%
Net Import	170	126	127	0.32	0.25%	520	393.14	-
Domestic Feed Use	5,650	5,862	5,862	-0.04	-0.00%	5,859	-2.88	-0.05%
Domestic Food Use	925	960	960	0.01	0.00%	959	-0.16	-0.02%
World	Baseline		Scenario 1			Scenario 2		
Production	137,583	146,799	146,790	-9.49	-0.01%	146,557	-242.37	-0.17%
Domestic Feed Use	93,166	99,506	99,498	-7.95	-0.01%	99,309	-197.19	-0.20%
Domestic Food Use	43,824	46,578	46,577	-0.98	-0.00%	46,553	-24.91	-0.05%
Ending Stocks	22,905	27,120	27,123	3.16	0.01%	26,922	-198.10	-0.73%

Note: Scenario 1: cotton area in Turkey increases by 500,000 hectares; Scenario 2: cotton area in Turkey increases by 500,000 hectares and wheat and barley area decrease by 250,000 hectares each by the end of the projection period (2023/24). Source: authors' calculations.

Wheat and barley market impacts are more pronounced in scenario 2 than in scenario 1, and tend to go in the opposite direction. Turkey's wheat production decreases by 2.8% (Table 2). The higher wheat price results in slightly lower domestic food and feed use. The impacts on the world wheat production, food and feed uses and stocks are even more modest, reflecting the small share of Turkey's production and consumption in the broader market. The result suggests that Turkey could shift from being a net exporter of wheat to a net importer of wheat, in this case 250,000 ha of wheat production land was replaced by cotton production. In either scenario, the share of net trade in the domestic market remains on the order of 2% or less.

In the case of barley in scenario 2, the global barley price increases by 0.8% (Table 3). The higher barley price decreases food and feed use in Turkey by 0.02% and 0.05%, respectively; and the world barley food and feed consumption are reduced by 0.05% and 0.20%, respectively (Table 2). Turkey's net barley imports increase by 393,000 MT as production falls with the area reallocation far more than domestic consumption.

Table 3. World price effects if the GAP causes an increase in cotton area in Turkey

Average 2022-24 Cotton, Wheat & Barley Price Changes		
Crops	Scenario 1	Scenario 2
Cotton	-9.51%	-9.42%
Wheat	0.00%	0.49%
Barley	-0.02%	0.80%

Note: Scenario 1: cotton area in Turkey increases by 500,000 hectares; Scenario 2: cotton area in Turkey increases by 500,000 hectares and wheat and barley area decrease by 250,000 hectares each by the end of the projection period (2023/24).

Source: authors' calculations.

Table 4 shows that the expansion in cotton area in Turkey causes greater world cotton area harvested in total. The initial increase in Turkish cotton production area drives down the price despite partially offsetting reductions in cotton area in other countries in response to the decrease in the world cotton price. In both scenarios, the cotton hectares harvested in the competing cotton-producing countries decreases and the U.S. and Brazil responses are the largest shown here. When the additional 500,000 hectares of cotton area in Turkey, new land that is not previously used for crops (scenario 1), then the cotton area in the U.S. and Brazil decrease by 3.63% and 3.04%, respectively. When the greater cotton area in Turkey is offset by an equal amount of land taken out of wheat and barley production (scenario 2), the cotton area in the U.S. and Brazil decreases by 2.74% and 2.56%, respectively. The decrease in cotton production area under scenario 2 is lower than that of scenario 1 because of the different price changes at a lower rate in case of scenario 2 over scenario 1 associated with the assumption about whether new cotton area is drawn from land used for other crops or from new crop land (table 3).

Cotton production, domestic use and trade in the major cotton producing countries respond to the lower cotton price as expected (Table 5). With the decrease in world cotton price in both scenarios (Table 3), the production is decreased among the major producing countries. The cotton exporting countries, including the U.S., Brazil and India, respond to a lower world cotton price and reduce their net cotton exports. Results suggest that there is no major change in the Chinese cotton market, even though China is the largest cotton producing, consuming and importing country. This apparent lack of response is mainly caused by Chinese cotton policies that isolate their market from the world market. The underlying assumption is that China does not change its policy regime in response to the estimated price shock.

Sensitivity of results to the exact initial conditions is a point of some concern. It could be the case that markets or policies respond substantially differently at different price ranges. This possibility is partly captured in the model: stocks cannot be negative, so rising prices can tend to be associated with increasingly inelastic aggregate demand; and some policies, like the U.S. marketing loan program, can have different impacts at different price levels. To test this possibility, we generated two alternative baselines. In one case, world demand for cotton is high, so cotton prices are driven higher. In the second alternative baseline, world cotton demand and price are weak.

Figure 5 shows that the findings derived from scenario 1 (Table 4) do not change with higher or lower world cotton demand. If cotton area is expanded in Turkey, the results are broadly similar regardless of the initial conditions. While there are some distinctions among results, the general patterns remain quite similar. While this experiment falls short of a complete test of the sensitivity of results to all possible factors, the experiment does lend some support by showing that the results are not extremely sensitive to initial conditions.

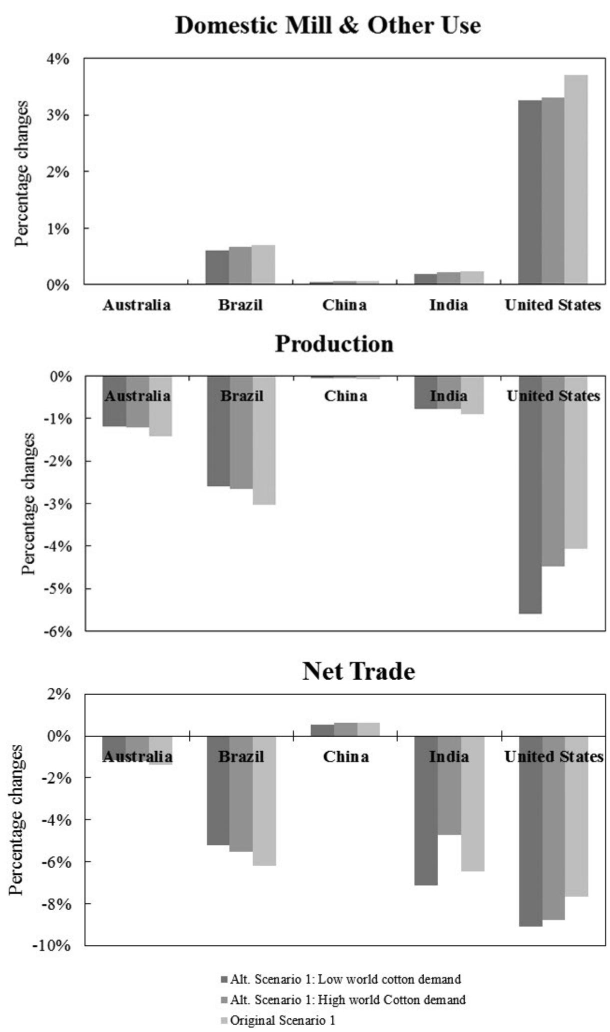

Figure 5. Sensitivity of changes in production, domestic use, and net export to initial conditions

Table 4. Cotton area effects if the GAP causes greater cotton area in Turkey

Area Harvested in World and Competing Countries (Thousand hectares)								
	Baseline			Scenario 1		Scenario 2		
Country	Average 2012/13-13/14	Average 2022/23-23/24	Average 2022/23-23/24	Absolute change	Percentage Change	Average 2022/23-23/24	Absolute change	Percentage Change
World	33,585	34,446	34,922	475	1.38%	34,842	396	1.15%
Australia	441	299	295	-4	-1.41%	295	-4	-1.34%
Brazil	1,010	1,009	978	-31	-3.04%	983	-26	-2.56%
China	5,050	4,588	4,584	-3	-0.07%	4,585	-3	-0.06%
India	11,850	13,346	13,225	-120	-0.90%	13,244	-102	-0.76%
United States	3,413	3,128	2,999	-128	-4.10%	3,032	-96	-3.07%

Note: Scenario 1: cotton area in Turkey increases by 500,000 hectares; Scenario 2: cotton area in Turkey increases by 500,000 hectares and wheat and barley area decrease by 250,000 hectares each by the end of the projection period (2023/24).

Source: authors' calculations.

Table 5. Cotton market effects if the GAP causes greater cotton area in Turkey

Production, Use & Trade in Competing Countries (Thousand bales)								
Country	Baseline			Scenario 1		Scenario 2		
Australia	Average 2012/13-13/14	Average 2022/23-23/24	Average 2022/23-23/24	Absolute change	Percentage Change	Average 2022/23-23/24	Absolute change	Percentage Change
Production	4,350	3,131	3,086	-44	-1.41%	3,089	-42	-1.34%
Domestic Use	40	40	40	0	0.00%	40	0	0.00%
Net Export	5,510	3,178	3,133	-45	-1.40%	3,136	-42	-1.33%
Brazil	Baseline			Scenario 1		Scenario 2		
Production	7,000	8,955	8,683	-272	-3.04%	8,726	-229	-2.56%
Domestic Use	4,150	4,222	4,251	29	0.70%	4,246	24	0.58%
Net Export	3,163	4,831	4,531	-299	-6.20%	4,579	-252	-5.21%
China	Baseline			Scenario 1		Scenario 2		
Production	33,875	35,265	35,240	-26	-0.07%	35,244	-22	-0.06%
Domestic Use	35,250	43,194	43,219	25	0.06%	43,215	21	0.05%
Net Import	17,188	8,335	8,388	52	0.63%	8,379	44	0.52%
India	Baseline			Scenario 1		Scenario 2		
Production	29,750	38,286	37,941	-345	-0.90%	37,995	-292	-0.76%
Domestic Use	22,600	31,205	31,278	73	0.23%	31,266	60	0.19%
Net Export	7,577	6,655	6,224	-431	-6.48%	6,292	-363	-5.45%
United States	Baseline			Scenario 1		Scenario 2		
Production	15,112	13,858	13,295	-563	-4.1%	13,432	-426	-3.07%
Domestic Use	3,525	3,789	3,929	140	3.7%	3,906	117	3.10%
Net Export	11,767	10,493	9,686	-807	-7.7%	9,873	-619	-5.90%

Note: Scenario 1: cotton area in Turkey increases by 500,000 hectares; Scenario 2: cotton area in Turkey increases by 500,000 hectares and wheat and barley area decrease by 250,000 hectares each by the end of the projection period (2023/24).

Source: authors' calculations.

CONCLUSION

This study estimates what would happen if the government of Turkey was able to implement the GAP irrigation project successfully and 500,000 hectares of additional land is allocated to cotton production. We use multi-market, multi-region partial equilibrium model to simulate the consequences of increasing cotton area in Turkey. The results are sensitive to the exact source of the new area, as discussed below, but might also depend on the analytical tool used in this analysis. The broad scope of a global model with multiple crops, is required to trace how the area changes in Turkey affect world cotton prices, area and production, as well as the impacts on other crop markets, and how those price changes rebound on cotton markets.

Results show that by the end of the ten-year projection period (2023/24), the completed GAP would increase cotton area in Turkey by 500,000 ha and represent a large shock to domestic production. The global cotton price would decrease by 9-10%, at least in the scenarios we explored. The impacts on global cotton production is fairly limited, and greater in countries that have historically been more open to trade. For example, the indirect impact of Turkey's production expansion on cotton area in major cotton-producing countries varies from nearly zero to well over 3%, consumer effects would also differ among countries. This result could be sensitive to how countries choose to respond to a price change. For example, we assume that Turkey's project would not induce policy changes in other countries and, more generally, that current policies represent well the policies that will be in place in the next ten years. If policies changed, particularly in China, then the market-wide impacts of these scenarios could be different. However, given existing policies, the impacts of growing cotton output in Turkey would be transmitted to other cotton producing and consuming countries unevenly.

The results show that the impact of the cotton area increase also depends on key details of how the policy works. Cotton market and broader crop market impacts depend on whether the cotton area increase is associated with new lands being brought into agricultural production or a reallocation of land previously planted to other crops. If the GAP converts land in Turkey, which is currently used for non-irrigated wheat and barley production (scenario 2), then it could increase world wheat and barley prices. In contrast, if the project brings in land that had not previously been allocated to crop production (scenario 1), then the overall impact is to increase crop supplies and lower prices more generally. These price changes are less than 1% for wheat and barley, owing to the small share of this area change relative to global crop area. However, the differences in directional impacts can cause cross-crop effects that compound the impact of falling cotton price on cotton area in other countries. Our findings suggest that a project intended to bring new lands into cotton production can have noteworthy impacts on the broader market, and that the results depend at least partly on cross-commodity impacts that take into account the overall impacts on global crop markets. Moreover, if other countries consider borrowing lessons from Turkey's experience with the GAP and engage in similar irrigation projects at a larger scale, then the potential for indirect market impacts would presumably be larger.

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