SCIENCE BRIEF 4

Impacts of crop rotation on the performance of cotton growing farmers in Central Asia

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Summary

Cotton monoculture inherited from the former Soviet cultivation system led to the decline of soil fertility and reduced cotton yields in irrigated areas of Central Asia. Adopting a diversified crop rotation approach is a viable solution to maintain soil quality and long-term economic benefits. This science brief explores the factors influencing farmers' decisions to adopt crop rotation and how its adoption affects cotton yields and net returns in two contrasting regions of Central Asia. The empirical findings highlight these two countries' differing institutional contexts surrounding cotton farming. Kazakhstan farmers' decision to adopt crop rotation is positively related to age, participation in farm training, farmer's opinion about the quality of irrigation canal, and share of adopters in a village. In Uzbekistan, farmers who perceive greater land tenure security are more inclined to adopt crop rotation. Compared to conventional crop cultivation, crop rotation in Uzbekistan increases cotton yields and net returns. However, the opposite effect is observed among cotton growers in Kazakhstan.

Background

Globally, the cotton sector engages over 100 million farming households in 75 different countries, and those countries produce around US$ 51.4 billion of raw cotton (FAO, 2015). During the Soviet time, Central Asia was the leading cotton producer, and the Soviet planners demanded the fulfillment of cotton production plans, disregarding environmental consequences. Farmers relied on the intensive use of fertilizers and machinery. Cotton cultivation in irrigated regions of Central Asia expanded as "conventional cotton" monoculture through the extensive application of fertilizers, irrigation water, and machinery. The tradition of cultivating only cotton on the same agricultural land leads to land degradation and a decline in cotton yields in Central Asia (Kienzler et al., 2012). Central Asia's cotton-producing areas are hotspots of cropland degradation, causing a loss of US$ 6 billion in 2001-2009, with desertification and agricultural abandonment costing US$ 1 billion each (Mirzabaev et al., 2016). Instead of using conventional practices, adopting sustainable agricultural practices, such as crop rotation or sequentially growing cotton with leguminous crops on the same plot, can be an option to improve soil fertility and reduce land degradation (Ball et al., 2005). Adopting crop rotation, particularly by including alfalfa, sorghum, or mung beans as cover crops, within an organic-based agricultural framework in Uzbekistan increases net present value and reduces expenses. Despite several advantages of crop rotation, the adoption level still needs to improve among farmers in Central Asia. Our investigation explains the main determinants of cotton farmers' crop rotation adoption decisions and the impact of crop rotation on farmers' performance in Central Asia.

Methodology

We have utilized data from a farm survey conducted during the AGRICHANGE[1] project in Turkistan and Samarkand provinces in March-April 2019. The dataset consists of 592 cotton-growing farmers, 285 farmers in the Turkistan province of Kazakhstan and 307 farmers in the Samarkand province of Uzbekistan. We randomly selected two districts within each province according to cotton specialization: Maktaaral and Shardara districts in Turkistan and Pastdargam and Payarik districts in Samarkand. According to the farmers' answers, we divided them into two groups, i.e., adopters and non-adopters of crop rotation. An adopter is a farmer who responded "yes" about crop rotation. In our sample, 66 cotton growers in Turkistan province and 64 cotton growers in Samarkand province answered that they use crop rotation. Our empirical approach first measures the relationship between farm and farmer characteristics, institutional factors, and locational settings with crop rotation adoption decisions. After that, we estimate the impact of crop rotation on farmers' cotton yields and revenues.

Results

Our result puts forward the effect of land tenure security for Uzbekistan, where cotton growers perceiving higher land tenure security are more likely to adopt crop rotation. This is particularly true since Uzbekistan farmers experienced several farm optimization programs that damaged their trust in farm business security (Zorya et al., 2019). The findings indicate that farmers' views about irrigation canals impact their choices regarding adoption. Enhancing the condition of irrigation canals

can promote the adoption of crop rotation. Additionally, the variable of the share of adopters across villages in Kazakhstan implies that the likelihood of crop rotation is enhanced when a farmer's neighbors are more inclined to adopt this practice (Figure.1).

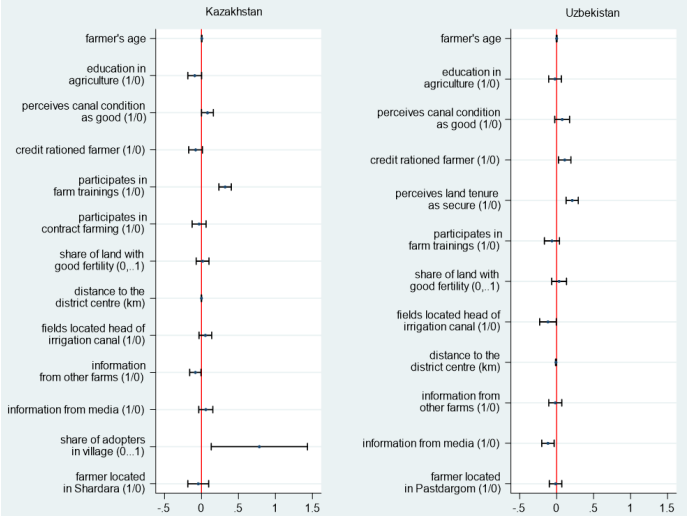

Figure 1. Determinants of farmers' crop rotation adoption decision (Source: AGRICHANGE farm survey, 2019)

The obtained results reveal that crop rotation adoption's influence on net returns and cotton yields varies between farmers in Kazakhstan and Uzbekistan. In the case of Kazakh farmers, adopting crop rotation leads to unfavorable outcomes. The surprising consequences of crop rotation on the performance of cotton farmers in Kazakhstan can be explained by the fact that Kazakhstan's current institutional framework and infrastructure after the cotton sector reform provide an advantage to farmers who practice 'conventional cotton' monoculture. In our sample of Kazakh respondents, cotton is cultivated in 85% of farmers' sown areas. This can be elucidated by the terms stipulated in contract farming agreements with private cotton processing facilities, which promote the cultivation of cotton monoculture to guarantee a consistent supply of raw cotton (Petrick et al., 2017). Hence, Kazakh farmers opting for sustainable crop rotation may risk delayed access to the ginnery's supply of inputs such as seeds, fertilizers, pesticides, and machinery services. In contrast, the adoption of crop rotation positively impacts both outcome variables of Uzbek cotton growers.

Recommendations

To improve crop rotation and sustainable cotton production adoption in irrigated areas of Central Asia, consider these recommendations:

- Promote Sustainable Practices: Educate farmers about the economic benefits of crop rotation, as shown by successful Uzbek cotton growers, and urge policymakers to endorse it for increased productivity.
- Revise Contracts: Rethink contracts between farmers and cotton processing facilities to facilitate access to inputs and machinery for crop rotation. Align incentives for both parties, learning from Kazakhstan's negative experience.
- Expand Extension Services: Create additional services to inform cotton growers about new technologies and agronomy. Encourage peer knowledge-sharing and involve farm unions and local authorities in promoting crop rotation in Uzbekistan.
- Improve Infrastructure and Information Distribution: Invest in better irrigation systems and efficient information distribution to motivate cotton growers to adopt crop rotation. Ensure secure land tenure to support sustainable land management in Uzbekistan.

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