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Mathematical programming for optimal sustainable growth in agriculture: Results of agricultural sector model in Syria

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Abstract

Syrian agriculture faces multiple challenges that threaten the state of food security in the country. More than a decade into the conflict, food production is severely affected by the crisis outcomes like damaged agriculture infrastructure, disrupted food value chains, and fluctuation in food prices and exchange rates. Moreover, severe drought episodes have regularly hit the country which further weakened the agricultural sector. While relative stability is slowly returning to major parts of the country, the question that remains is what are the policy interventions that would not only help households smooth their income and help agriculture to recover from the conflict, but also promote sustainable growth in the post-war time in Syria? To address this question, the study adopts the agricultural sector model (ASM) as an analytical tool to simulate policy scenarios in the post-conflict era. The research was conducted in 2019 in Syria, where data was collected from 1,430 households distributed across the country. Gross margins and details about on-farm activities were collected, and data were analysed using GAMS software. The mathematical programming model assumes that Syrian farmers have the objective of profits maximisation subject to multiple constraints of fixed farm resources (land, water, family labour), collective constraints (roads and extension services and other exogenous features such as weather and distance from markets), and risks (stochastic events related to prices and yields). The model further depicts the technology used at the farm level (i.e. how much physical inputs and other resources are needed to cultivate one unit of land with a particular crop using the alternative technologies) and agricultural practices (rotations pursued, the existence of intercropping, and the presence of policy-imposed constraints or incentives). The model simulates different scenarios that mainly address the impact of different cropping patterns and the adoption of modern irrigation techniques on effective water use in agriculture in Syria. The results of this study have important implications not only for the successful cultivation of food crops but also for encouraging the use of sustainable technologies which ultimately results in better food security outcomes in the long run.

Keywords: Agricultural sector model, conflict, food security, mathematical programming, policy scenarios, Syria, water

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