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Economy-Wide Impact Assessment of Home Gardening as an Adaptation Strategy to Climate Change in Kenya

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Abstract

Home gardening plays a critical role in enhancing food security and nutrition, particularly among vulnerable populations. With climate change, home gardens act as an adaptation strategy easing the impacts and enhancing households' resilience. In the context of a Computable General Equilibrium (CGE) model, home gardening can be introduced as a distinct agricultural activity that produces both marketed and non-marketed (home-consumed) goods. We analyse the effects of government expenditure of subsidizing the inputs on home gardening, evaluating the costs and benefits of such a strategy. Additionally, we assess the implication of increasing the level of household consumption or income based on empirical studies done in Kenya. The results indicated that increasing government expenditure on home gardening positively impacts household welfare, especially the poor. Improvement in welfare can consequently, result in reduced inequality and poverty levels. Through ripple effects, related sectors such as food are positively affected leading to its growth as well as a slight increase in economic performance. Overall, home gardens reduce dependence on food purchases and enhance food security and nutrition.

Keywords: Home gardening, CGE, agriculture, adaptation, Kenya

1. Introduction

Climate change poses significant threats to global agricultural productivity, jeopardizing food security, livelihoods, and economic stability, particularly in developing countries where agriculture constitutes a large share of GDP and employment (Calzadilla et al., 2014; IPCC, 2022). Disruptions in agricultural yields due to climate variability drive up food prices, alter trade balances, and disproportionately affect smallholder farmers and marginalized communities, exacerbating existing inequalities (Mulwa & Kabubo-Mariara, 2022).

To address these challenges, different adaptation strategies have been examined to enhance agricultural yields under the challenges of climate change. These strategies include the use of drought-tolerant crop varieties (Sahoo et al., 2016), improving irrigation and drainage systems (Bosello et al., 2018; Calzadilla et al., 2014), adopting climate-smart agriculture (Komarek et al., 2019), utilization of insurance schemes (Thirawat et al., 2017), and home gardening (Hansen et al., 2023). Home gardens, in particular, play a vital role in local food systems in developing countries. As a practical, household-level strategy, they provide a promising pathway to mitigate the impacts of climate change on vulnerable populations. These gardens demonstrate resilience to climate variability while improving food security, enhancing nutrition, boosting household income, and promoting biodiversity (Asante et al., 2024; Galhena et al., 2013; Musotsi et al., 2008).

Rural home gardening initiatives in Kenya have shown promising potential as an independent food source for local populations (Hansen et al., 2023). However, gardeners frequently encounter substantial challenges in establishing and maintaining these gardens — particularly water scarcity, limited financial resources, and inadequate knowledge or support. Such obstacles reduce fruit and vegetable yields and undermine the long-term viability of home gardens. This study evaluates the economy-wide implications of adopting home gardening as a public adaptation strategy to mitigate the adverse effects of climate change on agricultural production and economic stability.

Computable General Equilibrium (CGE) models have been used widely to analyse different policies. However, specific studies focusing on home gardening as an adaptation measure to climate change are limited. Most existing CGE analyses focus on broader agricultural sectors, economic impacts, and general adaptation policies (eg., Kilimani et al., 2018; Komarek et al., 2019; Sahoo et al., 2016). Given this backdrop, its paramount to incorporate and analyse the role of home gardening activities, especially considering their significance for food security among rural and urban poor populations. The use of the CGE model can simulate the effectiveness of policies such as government subsidy on input or extension services aimed at enhancing home gardening as a climate adaptation strategy.

2. Research methods

We use a comparative-static single-country CGE model calibrated to an updated SAM based on the 2019 SAM for Kenya (Elnour et al., 2023). This SAM includes agricultural, industrial, and service activities producing different commodities. Agricultural activities are disaggregated into activity-specific (e.g., maize, rice, vegetables, etc.). Here, we update and extend this SAM to include a new production account called home gardening. This activity uses land, labour (often family labour), and capital (tools) to produce vegetables. The total output is split into two parts: Marketed commodities sold at purchaser prices and non-marketed commodities consumed directly by the producing households. The share of non-marketed output can be fixed using a parameter or made responsive to relative prices and household preferences through a CES or LES utility specification. On household specification, home gardening is limited to only two household groups: rural poor and urban poor. Only these households allocate resources to the home gardening activity and consume the non-marketed portion. This is implemented by setting production and consumption coefficients to zero for other household types. However, the marketed commodity is consumed by all households. For production factors, labour is disaggregated based on skills (skilled and non-skilled) and gender (male and female). The land is disaggregated according to farming systems as irrigated and non-irrigated, and capital as agricultural and non-agricultural. Household categories include region (rural and urban) and income level (poor and non-poor). Other accounts include enterprises, government, capital, and the rest of the world.

Modelling considerations: Non-marketed output (own-consumption) enters directly into the household consumption function, either as minimum consumption (in an LES) or as a dedicated consumption commodity reducing the need for market purchases. Household utility is modelled as a nested LES-CES system allowing minimum consumption and substitution of marketed and non-marketed commodities. Home gardening uses family labour mostly female and unskilled (possibly with shadow prices if household labour is not fully employed). This activity is labour-intensive with limited capital requirements.

Scenarios: We develop two counterfactual scenarios, a cost scenario and a benefit scenario as well as a reference scenario. The first scenario (GOV) simulates the cost of implementing a home garden strategy through increased government expenditure of subsidizing the inputs (zero production cost). The second scenario (INC) increases the level of household consumption or income based on empirical studies done in Kenya.

Model closure rules for investment-driven savings, fixed government savings, full factor mobility, the small country assumption and a flexible exchange rate apply.

3. Expected outputs

The preliminary analysis reveals that climate change has a negative impact on the Kenyan economy and home gardening is an effective adaptation strategy, buffering households against economic shocks such as crop failures and market fluctuations arising from climate-induced agricultural declines. Home gardening is expected to enhance domestic food production, especially vegetables, contributing to improved food security and nutrition as well as livelihoods among rural households. Wages for unskilled labour especially women could increase, driven by demand for agricultural labour. On a macroeconomic level, GDP improves slightly driven by increased agricultural production and related economic activities. Similarly, the domestic currency appreciated, driven by reduced demand for imports and an increase in exports, especially for vegetables.

In the short term, increased government expenditure on agriculture substantially lowers the price of agricultural inputs for home gardening activities, leading to increased adoption of home gardening. This in turn enhances food security and self-sufficiency. However, if the expenditure is financed through taxation, then consumption may go down due to a reduction in real income. In the long run, households' incomes are expected to increase due to the sale of surplus production. Consequently, consumption increases are driven by increased production and increased real income and thus improvement in household welfare. Overall, home gardening has a positive impact contributing to increased domestic production with rural households experiencing more welfare gains. Sensitivity analysis helps in assessing the best option for financing this strategy such as taxes or foreign grants. This analysis helps policymakers with an assessment of the implications of home gardening. These findings could assist in developing and implementing policies that minimize the negative impact in the short run eg., increasing transfers to the poor and taxing the nonpoor more, providing subsidies for gardening supplies, training programs, and integration into national adaptation plans, which is important to maximize the potential of home gardening.

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