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POLICY BRIEF No.1

CCGA
Changing Course in Global Agriculture

# Impacts of Fertilizer Subsidies and Alternative Policies on Small Scale Agriculture in Kenya

## INTEGRATED ASSESSMENT AND POLICY RECOMMENDATIONS

## EXECUTIVE SUMMARY

This policy brief examines the impacts of fertilizer subsidies and alternative policy options on small-holder agriculture in Kenya. The policy analysis utilizes the Threshold-21 (T21) model developed for Kenya. The T21 Kenya model was customized by the Ministry of Agriculture, Livestock and Fisheries (MOALF) and the Millennium Institute to inform the Kenyan Government of the effects of agricultural policies while simulating the inner-dependent economic, social, and environmental impacts of interventions over time.

Simulations with the T21 model show that increasing government expenditure on chemical fertilizer subsidies can bring immediate positive change in average crop yields and for socio-economic indicators such as agricultural employment, poverty and undernourishment levels. This, however, comes with unintended environmental effects from fertilizer dispersion and degradation of soil fertility. Also, the benefits of the fertilizer subsidy policy are also shown to be vulnerable to system shocks (for example abrupt withdrawal of the fertilizer subsidy. On the other hand, simulations that increase government expenditure for training small-scale farmers in sustainable ecological agriculture result in greater crop yields than under fertilizer subsidies, and show more substantial improvements in socio-economic indicators at approximately half the cost of funding fertilizer subsidies. Fertilizer dispersion is much lower and soil nutrient levels actually regenerate under sustainable ecological farming. Also, the ecological farming system is more resilient to shock (in this case abrupt reduction of the budget for the sustainable agriculture training). The findings of the policy analysis lead to recommendations to increase government support for training in sustainable ecological agriculture for small-scale farmers.

## CONTENTS



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T21® is an integrated and dynamic planning tool developed by the Millennium Institute. For further information, see www.millennium-institute.org.

*Cover Photo:* Tea pickers in Kenya's Mount Kenya region. © Neil Palmer (CIAT).

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# INTRODUCTION

The Kenyan Government's Vision 2030 and Agriculture Sector Development Strategy (ASDS) aim to transform small-holder agriculture from subsistence to innovative, commercially oriented, modern agriculture (Kenya Vision 2030, 2007; ASDS, 2010). The Kenya Institute of Public Policy Research Analysis (KIPPRA, 2014) has identified increased fertilizer use as a key driver of small farm productivity, citing evidence that low-input, small-scale agriculture has not been productive compared to larger scale agriculture systems that use chemical fertilizers. For example, in Kenya the highest maize yield observed is 47 90 kg bags per hectare with increased chemical fertilizer utilization, while the national average is 30 90 kg bags/ha (KIPPRA, 2014). However, other research has shown that increasing chemical fertilizer increases yields in the near term, but at a cost of generating negative environmental impacts that subsequently constrain yields in the longer run (Kotschi, 2015; Ayenew, 2015; Pedercini et al., 2015).

This policy brief responds to a need by the Government to examine the impacts of fertilizer subsidies and related alternative policies for small-scale farmers. Policy scenarios were simulated and assessed using the T21 Kenya model.[1] The analyses considers policies, in isolation and in a variety of combinations: investing in fertilizer subsidy, training in sustainable agriculture practices for small-holders, combining investments in fertilizer subsidies with sustainable agriculture training, increasing the agricultural budget to 10 % of overall national budget (recommended by the Comprehensive Africa Agriculture Development Programme), and improving women's economic opportunities (e.g., through improved access to credit, training, subsidies, land, and encouragement of women's organizations). The resilience of these policies to shocks, such as a sudden withdrawal of government funding for fertilizer subsidy or training, was also assessed. Finally, policy impacts on cereal yield, agricultural GDP, environmental indicators (fertilizer dispersion and soil nutrients), crop production, agricultural employment, poverty, and undernourishment were assessed.

# POLICY SCENARIO ANALYSIS

## Description of Policy Scenarios

***Business as usual (BAU):*** The underlying assumption in the BAU scenario is that current policies and practices will continue through year 2030 (see Table 1 for BAU values of key policy assumptions). Details of this scenario are described in detail in Züllich et al (2014).

***Fertilizer subsidy for small-scale farmers:*** This scenario simulates the effects of increasing the share of agricultural expenditure for fertilizer subsidy above the business-as-usual case. Impacts on the economy, society and environment were simulated.

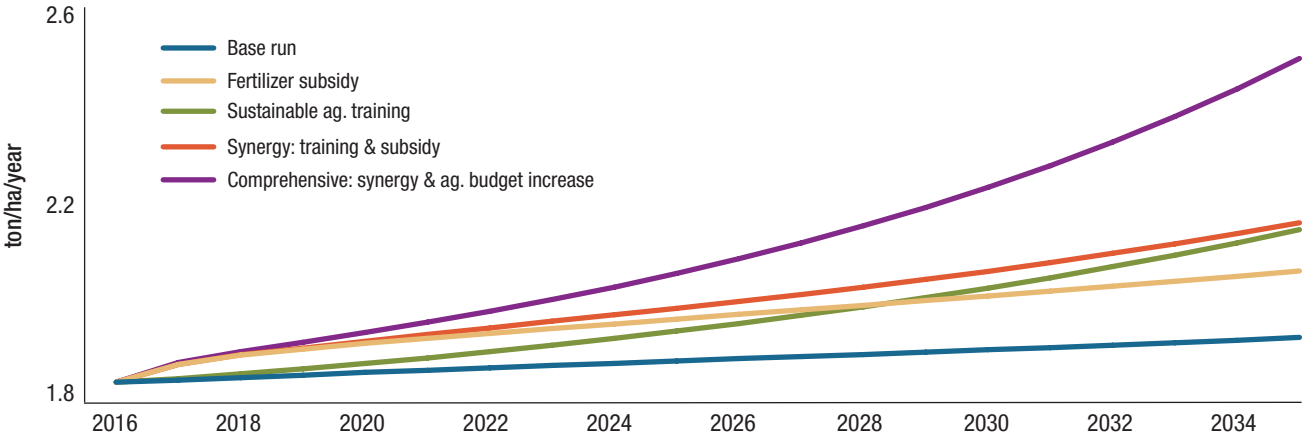
***Sustainable agriculture training for small-scale farmers:*** This scenario simulates the effects of increasing the share of agriculture expenditure on farmers' training, over the business as usual case, in natural fertilizer use, conservation agriculture, biological insect control, etc. (see Table 1).

***Synergy scenario:*** This scenario combines the '*Fertilizer subsidy for small-scale farmers'* and *'Sustainable agriculture training for small-scale farmers'* scenarios

**Table 1: Model parameters and assumptions for policy scenarios**

| Policy scenarios<br>Variable | Business as usual (BAU)<br>% | Fertilizer subsidy (small scale)<br>% | Agriculture sustainability training (small scale)<br>% | Synergy: fertilizer subsidy combined with training<br>% | Agriculture budget combined with synergy policy<br>% |
|---|---|---|---|---|---|
| Expenditure for training (% of agriculture budget) | 13.7 | 13.7 | 30 | 30 | 30 |
| Share of agriculture training expense for sustainable practices | 20 | 20 | 60 | 60 | 60 |
| Expenditure for fertilizer subsidies (% of ag. budget) | 5.4 | 20 - 60<br>linear increase (from 2016 - 2035) | 5.4 | 20<br>(2016 - 2020), then linear decrease to 5.4% | 20<br>(2016 - 2020), then linear decrease to 5.4% |
| Agriculture (% of total budget) | 3.4 | 3.4 | 3.4 | 3.4 | 10 |
| Small scale agriculture (% of ag. employment) | 83 | 90 | 90 | 90 | 90 |

Figure 1: Simulation results of average cereal yield under BAU and various policy options




in order to boost production in the immediate term (five years) and promote sustainability over the longer term. Considerable time is required to realize the social, economic, and environmental benefits of training small-scale farmers in sustainable agriculture. On the other hand, subsidized fertilizer can be accessed and utilized in a short period of time and its effects on production are quickly observable. This scenario increases the fertilizer subsidy for five initial years while simultaneously increasing expenditure for farmers training, then smoothly phases out the fertilizer subsidy to the business as usual level.

***Agriculture budget increase and synergy scenario:*** This scenario examines the effects of increasing the share of the total agricultural budget from the business as usual case to 10% of the total budget (see Table 1). The impacts of the agricultural budget increase under the conditions simulated in the synergy scenario for the combined fertilizer subsidy and training of small-scale farmers in sustainable agriculture were examined.

The following table presents the values of key model parameters for the four policy scenarios presented above.

***Introduction of shocks:*** The fertilizer subsidy and the sustainable agriculture training policy scenarios were subjected to shocks in order to test the resilience of the agricultural systems under these policies. The shocks may take the form of sudden withdrawal of government expenditure for fertilizer subsidy (from 35% to 0 %), and for agricultural sustainability training (from 20% to 0 %) in 2025.

***Support distribution scenarios:*** Three additional scenarios were compared regarding the distribution of government support:

- The Agriculture budget & synergy small-scale scenario assumes stronger support for small-scale farmers compared to BAU by increasing small-farmers' share of employment.
- The agriculture budget & synergy large and small-scale scenario assumes equal support for small-scale and large-scale farmers as in BAU.
- The agriculture budget & synergy-gender scenario assumes stronger support of small-scale farmers and female farmers compared to BAU, by both increasing small-scale farmers' share in agricultural employment and women's economic opportunities (such as improving women's access to subsidized fertilizer, credit, and land). This scenario assumes intuitively that the economic opportunity index increases from 47.5% to 70% between 2016 and 2035 reflecting Government policies promoting gender equity.

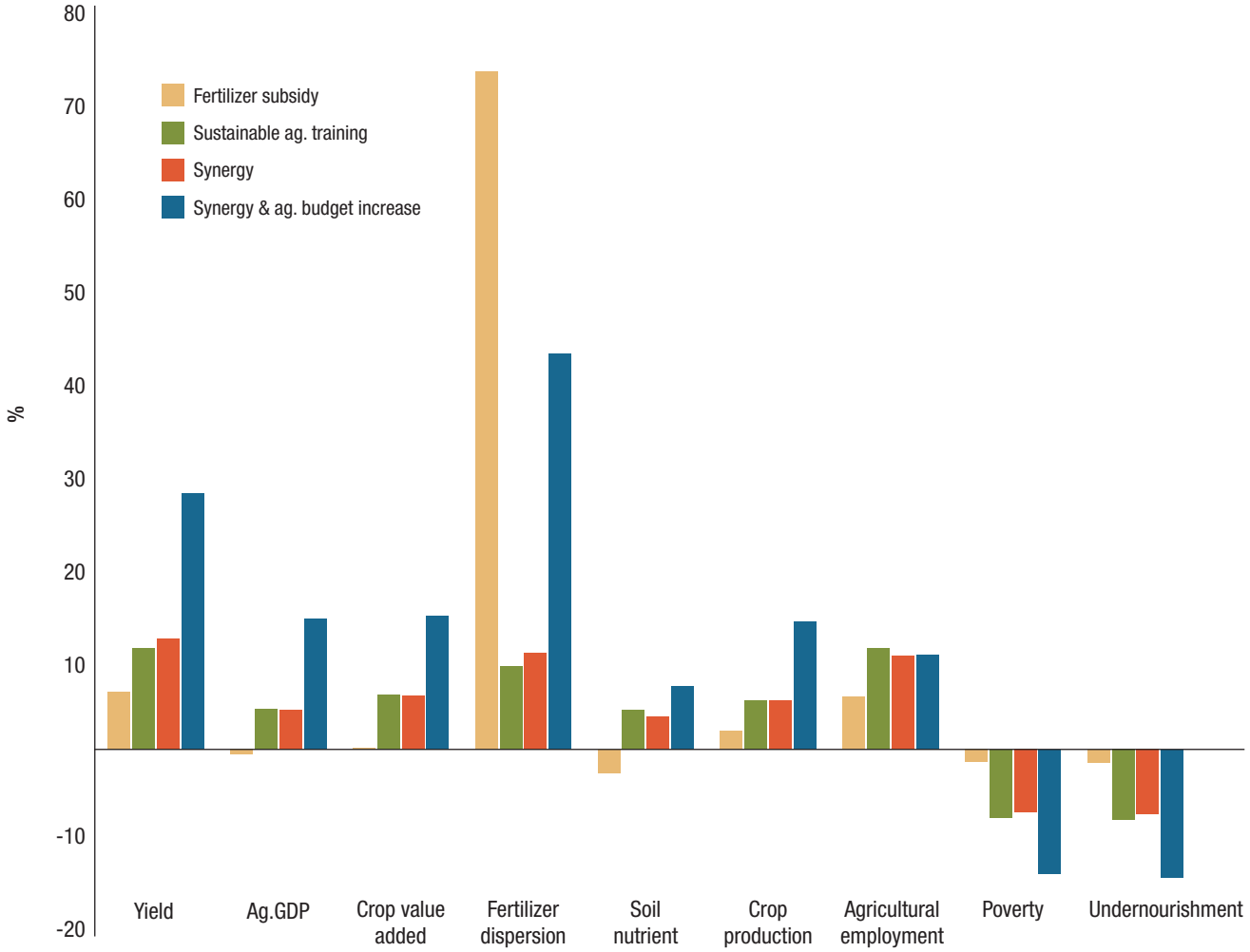
## Simulation of Scenarios

The T21-Kenya model generates simulations from 1980 to 2035 while scenario interventions are premised to start from 2016. The simulation analyses and results obtained are presented in Figures 1-4.

Figure 1 compares the simulations of the base run (BAU), fertilizer subsidy, sustainable agriculture training, synergy with training and subsidy, and synergy with agriculture budget increase for the average yield of cereals from 2016 to 2035. All the four policy scenarios demonstrate an increase in cereal yield over the BAU by 2035 (Fertilizer subsidy scenario, 7%; sustainable agriculture training, 11%; synergy scenario, 12%; and agriculture budget & synergy scenario, 30%).

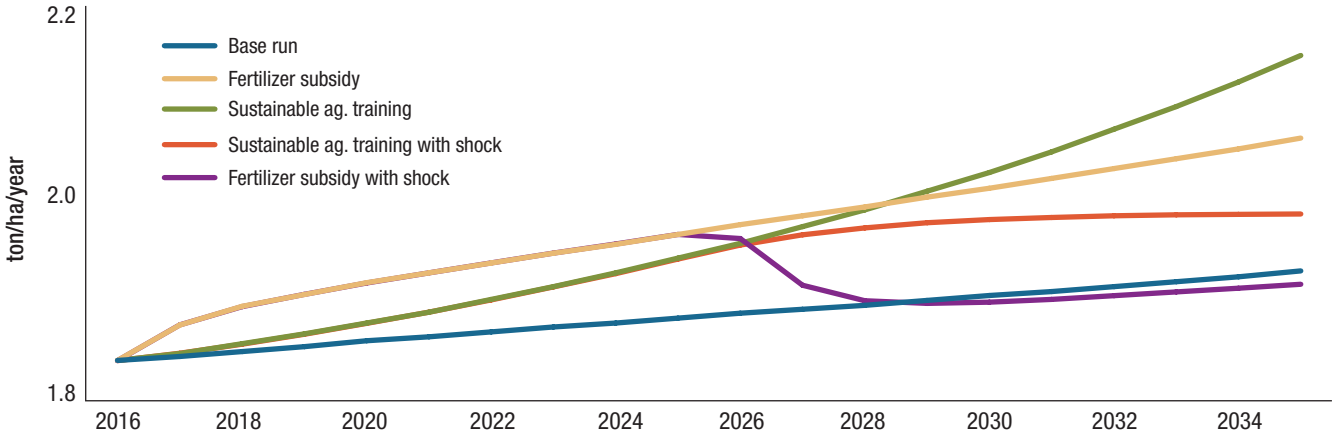
In the simulation, impacts of the farmer training policy are not observed in the first 5 years as time is required to adopt sustainable farming practices and for benefits such

Figure 2: Percentage changes (compared to BAU) of key indicators in 2030 with fertilizer subsidy, sustainable agriculture-training, synergy and the comprehensive scenarios




as improved soil organic matter to manifest. However, positive impacts from this intervention are relatively large and sustainable in the mid- to long-run. The impact of the fertilizer subsidy becomes immediately evident after the intervention. However, under the sustainable agriculture training scenario, average cereal yield gradually increases over time and in 2028 exceeds the average cereal yield of the fertilizer subsidy scenario. Under the synergy policy, average yield is barely higher in 2035 than for the farmer training policy. The benefit of the fertilizer subsidy in the synergy policy scenario (20% of total agricultural budget for subsidy over the first 5 years of the policy, then gradually decreasing to 5.4% at year 2035 – see table 1 for budgets) is to increase yields in the early years after policy

Figure 3: Simulation results of average cereal yield under fertilizer subsidy, and sustainable agriculture training with shock scenarios



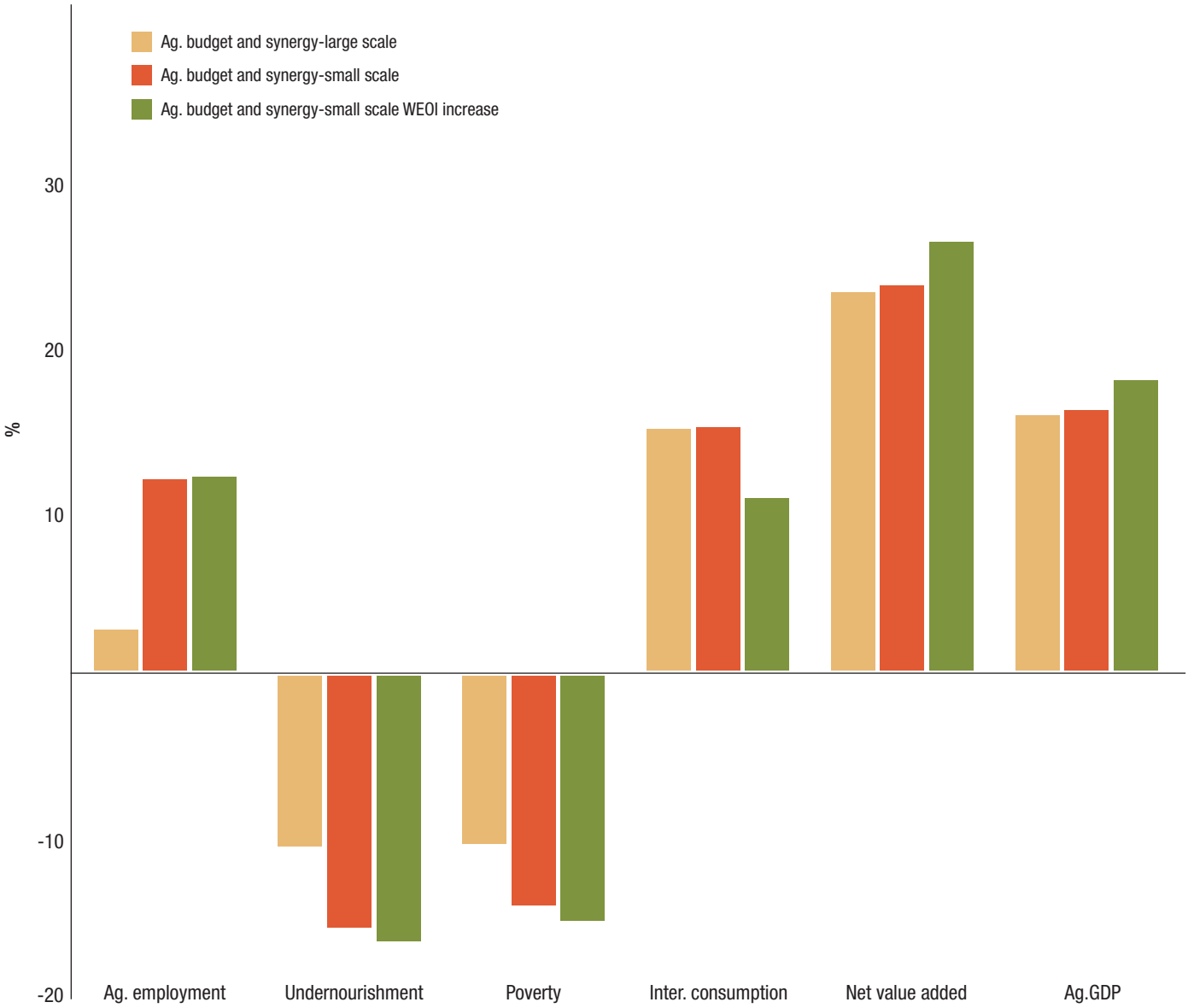
implementation. Figure 1 shows yield under the fertilizer subsidy and synergy policies to be near identical during the first 5 years after policy implementation.

Figure 2 presents the percentage changes of key social, economic and environmental indicators in 2035. Most social and economic indicators (such as poverty, prevalence of undernourishment, yield, crop value-added and agricultural production) show desirable changes by 2035. The maximum desirable change is observed in the agriculture budget and synergy scenario.[2] Chemical fertilizer dispersion to the environment and soil nutrient deterioration (nutrient erosion) increase under the chemical fertilizer subsidy scenario, while soil nutrient status improved under the other scenarios.

The simulation results in Figure 3 show that the fertilizer subsidy shock (abruptly eliminating the fertilizer subsidy) will result in a sudden drop of average cereal yield, dropping below the base run value by 2030. However, a shock to the sustainable agriculture training scenario (eliminating the budget for sustainability training) causes the average yield to increase at a decreasing rate rather than dropping below the base run value. This is because sustainable agriculture practices are assumed to erode only gradually after the sustainability training budget is eliminated, due to their knowledge-based, internal-input nature. Also, it takes time for the loss of soil organic matter if sustainable agriculture practices are abandoned. The simulation results of other socio-economic and environmental indicators also show greater sensitivity to the shock in the fertilizer subsidy scenario than in the training scenario.

Figure 4 shows the support distribution scenarios comparing the percentage changes over the base run of key indicators in the following scenarios: agriculture budget and synergy-large scale, agriculture budget and

Figure 4: Percentage change (compared to BAU) of key indicators in 2035



synergy-small scale, agriculture budget and synergy small scale with gender scenario (women's economic opportunity index - WEOI increase).

The simulations indicate that when women have better economic opportunities (such as better access to credit, better access to subsidies, better access to land etc.) intermediate consumption will decrease and ultimately result in desirable outcomes such as reducing poverty and under-nourishment, and increasing agricultural GDP.

## FINDINGS

The simulations with T21 Kenya lead to four primary findings regarding agricultural policies for small-holder farmers in Kenya:

1. Increasing government expenditure for subsidizing chemical fertilizer for small-scale farmers has almost immediate favorable impacts on yield, production, poverty, and undernourishment. However, increased and continued use of chemical fertilizers also causes adverse impacts of chemical dispersion and soil nutrient degradation that eventually constrains yield.

2. Increasing agricultural expenditure for training small-scale farmers in sustainable agriculture results in higher yields and better overall achievement of economic, social and environmental development indicators than with the fertilizer subsidy policy in the longer term at approximately half the cost of expenditures for subsidizing chemical fertilizer. These results are in agreement with research conducted under the International Assessment for Agricultural Knowledge, Science, and Technology for Development (IAASTD) (McIntyre, Herren, Wakhungu and Watson, 2009). Also, the sustainable agriculture training scenario exhibits greater resilience to shocks than the fertilizer subsidy scenario. However, the sustainable agriculture training scenario requires more time (five years) to take effect than the fertilizer subsidy scenario.

3. The simulations show that a strong synergy is generated when the fertilizer subsidy and sustainability training scenarios are strategically combined.[3] When the fertilizer subsidy and expenditure for both sustainability are increased over the first five years with the fertilizer subsidy gradually phased out thereafter, average yield is increased across the short, medium, and longer time horizons and is greater than either of the first two policies in isolation.

4. If the agricultural budget is increased to 10% of the total government budget as recommended in the Comprehensive Africa Agriculture Development Programme (CAADP) agenda, the favorable impacts on social, economic and environmental indicators will be significant when combined with the synergy scenario. This improvement could even be higher if government policies are put in place to create better economic opportunities for women.

## RECOMMENDATIONS

This simulation results point out to several recommendations with regard to small-holder fertilizer subsidies and alternative policies:

- Increased use of chemical fertilizer will boost production in the immediate terms but may damage soil organic matter and natural soil fertility in the long run thereby undermining agricultural production in the long run as well as damaging water resources and biodiversity.

- Extensive training in ecological agriculture practices should be provided to small holders to turn Kenyan agriculture to sustainable production. This would involve extensive training of trainers, field demonstrations, and communications to accelerate farmer adoption of sustainable practices and to encourage farmer-to-farmer word-of-mouth exchanges on sustainable agriculture (see next section for policy recommendations).

- The Government should consider a moderate fertilizer subsidy to help maintain yields during the early years of the transition to sustainable agriculture, while farmers are mastering techniques of ecological farming and while soil organic matter is being increased. Fertilizer subsidies would be gradually phased out after this initial adjustment period.

- The participation of women in sustainable ecological agriculture should be supported by making training, subsidies, credit, and access to land gender equitable.

- It is recommended that the overall agricultural budget be increased toward the 10% of total government budget level as recommended by the CAADP in order to provide support for the recommendations listed above.

# POLICY MEASURES FOR EXTENSIVE TRAINING IN ECOLOGICAL AGRICULTURE

The CCGA Policy Brief No. 2 "Scaling up Agro-ecology in Kenya" identifies concrete measures, interventions and good practice examples of flagship programs that can foster sustainable training of small-scale farmers in Kenya in agro-ecological principles. A summary of the findings from this report is provided here:

- **Research & Extension:** Increase funding for National Agriculture Research Centres and strengthen locally adapted research and development on agroecology while linking national research to country-wide extension services.
- **Information & Communication:** Increase access to information on agroecology for farmers through the use of technology and new media using targeted communication messages based on community needs.
- **Lessons learned:** Support existing soil management initiatives in Kenya and make use of the experiences made for the development of further sustainable agriculture training interventions.
- **Private Sector Involvement:** Support initiatives that engage corporates such as the as Incentives for Ecosystem Services (IES) and PPP (public-private partnership) models to demonstrate sustainable fertilizer use while lifting environmental standards.
- **Human Resources and Institutional Skills Enhancement:** Increasingly empower and enable extension service providers and academic institutions in developing and disseminating knowledge on sustainable agriculture practices.

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## ENDNOTES

1. T21 Model briefing paper: www.millennium-institute.org/resources/elibrary/papers/T21brief_technical.pdf.
2. Simulations indicate that this change could reach up to 40% (for yield), if the 10% agriculture budget increase is implemented after five years instead of fifteen years (not shown).
3. A full description of these combinations of inputs and practices is outside the boundary of this study.
4. Simulations indicate that this change could reach up to 40% (for yield), if the 10% agriculture budget increase is implemented after five years instead of fifteen years (not shown).
5. The precise nature of this combination requires specialized investigation outside the boundary of this study.