

## AGRICULTURAL MANAGEMENT RECOMMENDATIONS

Efficacy of various agricultural practices and inputs varied by crop type

Agricultural management should be crop specific

The results of our analysis showed few strong associations between use of inputs and yield

Programs should focus on training for best practices of pesticide and fertilizer application, as opposed to only increasing access

Intercropping is associated with greater food security and provides a secondary crop harvest

Intercropping may be promoted as a strategy for sustainable intensification



A field that has been intercropped



## DATA RECOMMENDATIONS

Insufficient sample size for some questions

Adjust sampling strategy based on indicators most relevant to the use case

Survey questions can be inconsistent with desired analyses

Select survey questions based on planned analyses. Remove extraneous questions

Data quality and management concerns

Incorporate verification criteria to protect against inaccuracies and include questions on length of time a practice has been employed



Wildlife Conservation Society data collectors in the field

## ACKNOWLEDGEMENTS

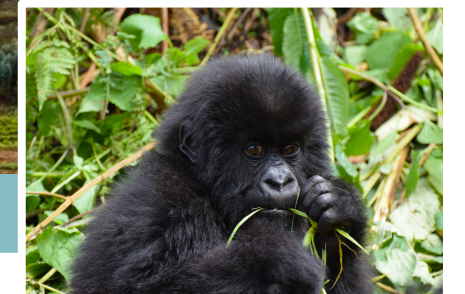
We would like to thank our faculty advisor, Mark Buntaine, our PhD advisor, Patrick Hunnicutt, and our external advisors David Tilman and Jacqueline McGlade. We would also like to thank the Bren School at UCSB, our client Conservation International, the Wildlife Conservation Society Kigali field office, and the University of Rwanda GIS department. Photos: CI Photo Vault



# VITAL SIGNS

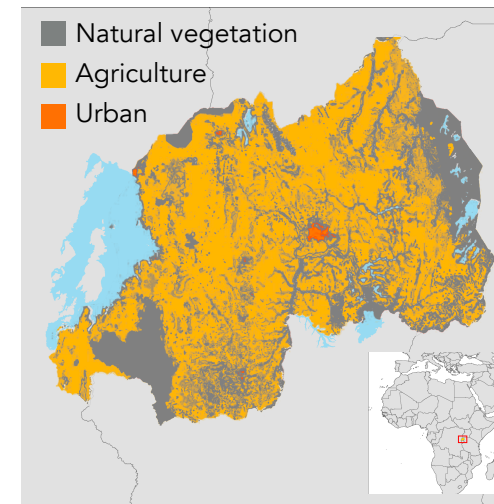
Balancing Agriculture, Food Security and the Environment in Rwanda

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## INTENSIFICATION OVER EXPANSION

Global population is projected to rise to 9.8 billion people by 2050, resulting in an unprecedented increase in food demand. Feeding this growing population will require increased agricultural production, which can threaten ecosystem health. This is particularly relevant in countries with high projected population growth and high levels of biodiversity. Rwanda is a small East African nation in which most people rely on subsistence agriculture. Save for three national parks, most of the land in Rwanda is already farmed. To avoid clearing additional land for agriculture, it's necessary to intensify yield: produce a greater harvest on the same amount of land.



Key stakeholders who manage agricultural development seek ways to maximize crop production while minimizing ecological impacts. These decisions require information that is often lacking. Conservation International seeks to address this need through Vital Signs, a data collection and monitoring program that examines agriculture, human wellbeing, and ecosystem health in sub-Saharan Africa. Our project is one of the first in-depth analyses of the Vital Signs Rwanda data to identify relationships between farming practices, agricultural production, and household food security. We also explore the limitations of the dataset, and make recommendations to improve future data collection.

## PROJECT OBJECTIVES



Analyze the relationship between agricultural practices and overall crop yield



Determine associations between agricultural practices and household food security



Identify data limitations and offer suggestions for improvement of data collection



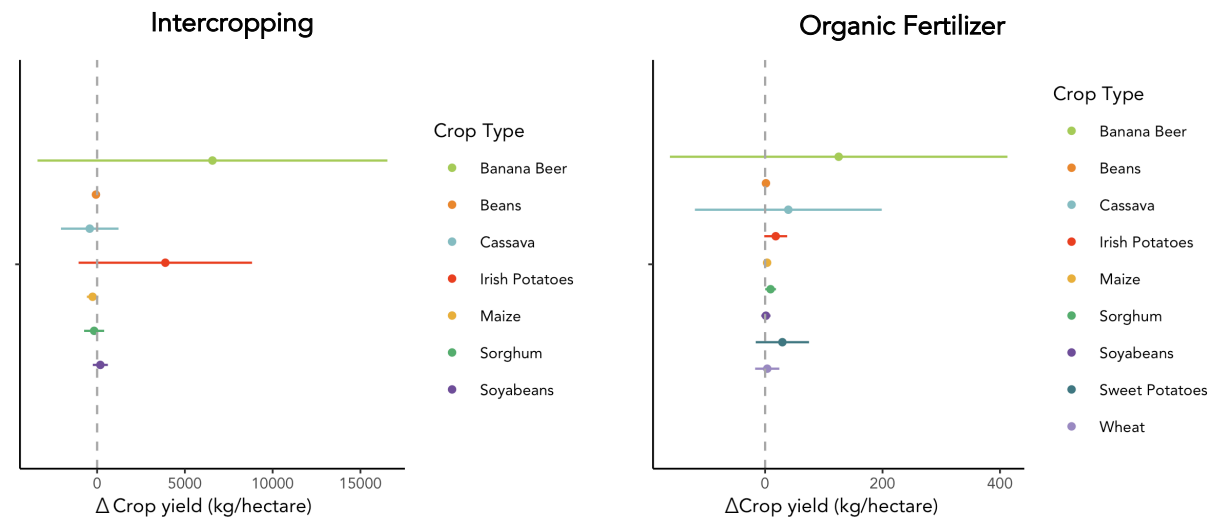


## CROP YIELD AND AGRICULTURAL PRACTICE

We explored the association between yield and agricultural practice in a series of crop-specific models. For each crop, our results provide insight into the range of likely yield outcomes associated with various farming strategies. Analyzed practices included the use of purchased seeds, intercropping, erosion control techniques, pesticides, and inorganic and organic fertilizer. Intercropping is defined as growing two varieties of crops on the same plot at the same time. First,

our analyses looked at the efficacy of each of these practices alone. In a second set of models, each practice was analyzed simultaneously, thus accounting for potential interactions between practices. Our models also accounted for potential effects of harvest year, harvest season, and the agro-ecological zone where the plot was located. The figures below show the change in crop yield when an agricultural practice or input is employed.

### Sample of Results: Single Practice Models

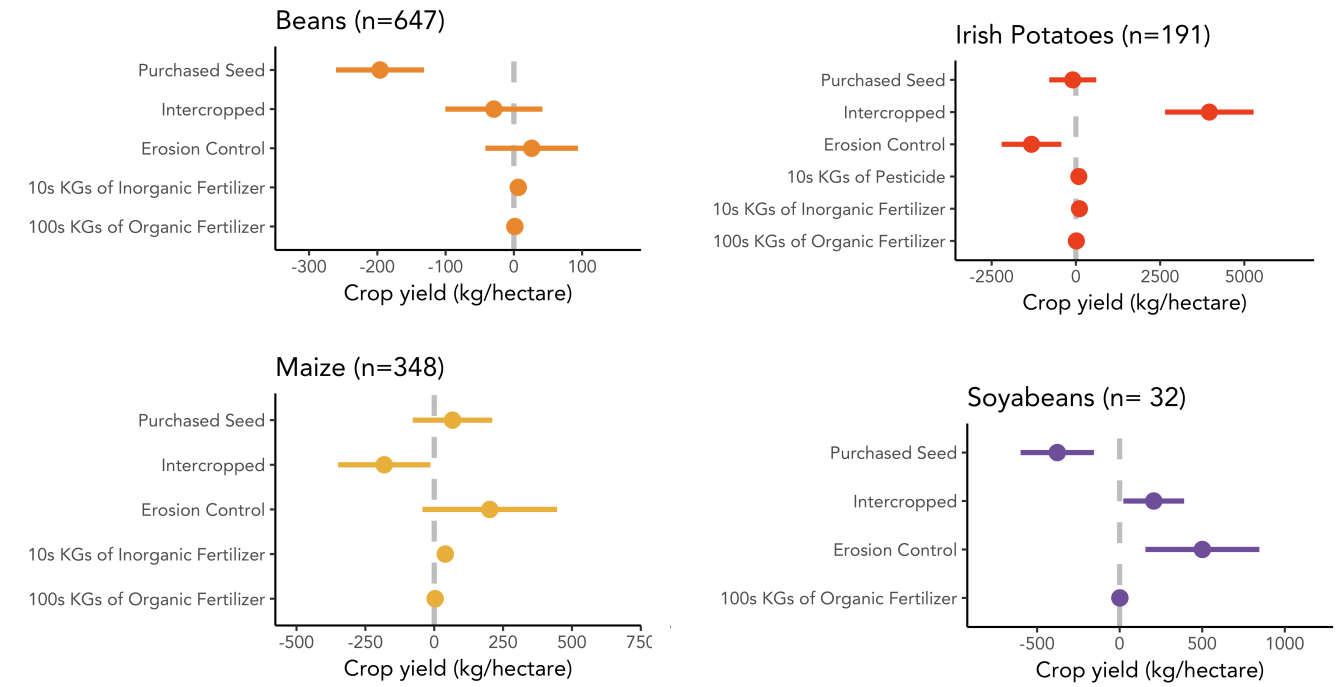


For most crops, except maize, intercropping was not associated with significantly lower yield of a plot's main crop. The benefit of intercropping can be the additional yield of a secondary crop.

Results varied by crop type. For example, in the multi-practice models (upper right), intercropping was associated with significantly greater yield for Irish potatoes, but was also associated with significantly lower yield for maize. Erosion control techniques, such as the construction of terraces and bunds, and the deployment of sandbags for water retention, were associated with significantly greater soybean yield, and with significantly lower Irish potato yield. In many cases, we did not find a significant association between a given practice and yield. In each figure the horizontal lines represent the range of likely outcomes. If this line crosses the plane of zero, we are unable to confirm a statistically significant association between that practice and yield for that crop variety.



### Sample of Results: Multi-Practice Models



Associations between agricultural practices and yield varied widely by crop type



## FOOD SECURITY AND AGRICULTURAL PRACTICE

Food security is defined as having physical, social and economic access to sufficient, safe, and nutritious food. Using Vital Signs household survey responses, we derived a household food security index score based on the standardized House Food Insecurity Access Scale (HFIAS) index created by USAID. We found that households which sometimes intercrop are characteristically more food secure than households which only grow crops in a monoculture. Intercropping has little to no economic barriers to implementation, and previous research suggests this practice can also improve soil quality and decrease annual variability in yield.

All else equal, households which intercrop are more food secure.

