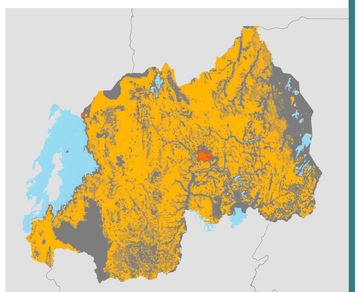
VITAL SIGNS | Balancing agriculture, food security, and the environment in Rwanda

Meghan Cook | Rachel Kenny | Austin Richards

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 services. 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.



Over three quarters of the land in Rwanda is used for agriculture and grazing

Endangered mountain gorilla juvenile in Volcanoes National Park

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 its protocols, and make recommendations to improve future data collection.

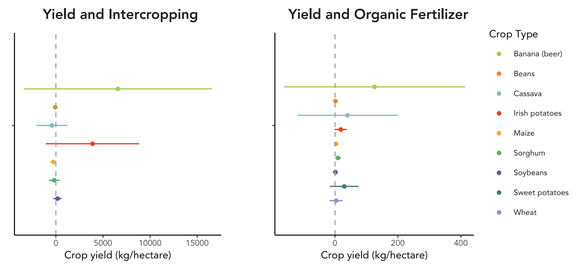
PROJECT OBJECTIVES

- 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

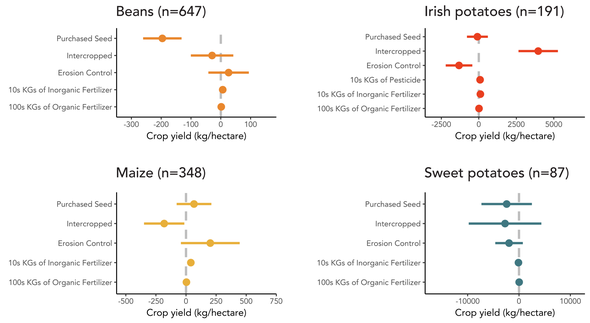
CROP YIELD AND AGRICULTURAL PRACTICE

We explored the association between yield and agricultural practice in a series of crop-specific models. The adjacent figures highlight a selection of our results: the range of likely outcomes of change in yield after employing intercropping as a strategy (left figure) and adding 100 kg of organic fertilizer (right figure). Intercropping is defined as growing two varieties of crops at the same time on the same plot.

We analyzed the use of purchased seeds, intercropping, erosion control, pesticides and inorganic and organic fertilizer.

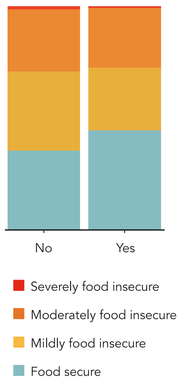


For most crops, except maize, intercropping was not associated with significantly lower yield of a plot's main crop. The benefit of intercropping can be the additional yield of a secondary crop.



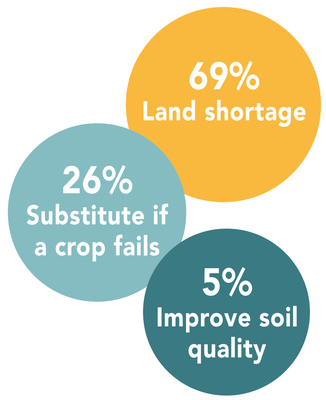
For crops with the greatest sample size, we further explored the yield relationship in a second set of models which analyzed each practice simultaneously, accounting for potential interactions between practices. Our models account for harvest year, season, and agro-ecological zone and our results are crop specific. For example, use of purchased seeds was associated with significantly lower bean yield, and intercropping was found to be associated with significantly greater Irish potato yield.

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 zero 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.



AGRICULTURAL RECOMMENDATIONS

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**
Efficacy of various agricultural practices and inputs varied by crop variety	**Agricultural management should be crop specific**
Intercropping is associated with greater food security and provides a secondary crop harvest	**Intercropping may be promoted as a strategy for sustainable intensification**

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**

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