

InfoNote

Spatial analysis shows moderate yet significantly more vigorous crops in AICCRA communities compared to control communities

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Highlights

- In southern Ghana, communities with multiple stakeholder CSA field demonstrations (CSA hubs) show significantly more vigorous crops based on satellite imagery from 2021 to 2025, compared to control communities.
- Integrating satellite imagery with household survey data, disaggregated by crop type, will be needed to further test AICCRA's impact on CSA adoption and the impact pathway.
- In the absence of long-run panel household data with objective crop yield data, satellite images together with careful identification of counterfactual communities, can provide a consistent approximation of crop health outcomes in treated vs. control communities.

Since 2021, AICCRA Ghana has been promoting CSA practices and disseminating CIS through multiple channels: CSA hubs (which include multi-stakeholder collaboration and field demonstrations on CSA knowledge¹), radio broadcasts, farmers hotline, etc., in collaboration with technical and scaling partners, including the Crops Research Institute of Council for Scientific and Industrial Research (CRI-CSIR) and the Department of Agriculture. The dissemination effort has reached over 490,000 smallholder farmers, 39.3% of them women.² In AICCRA's second phase, CSA demonstrations were implemented in 40 new communities ("treated communities") across the country.

But does the CSA demonstration improve crop health in these hubs under changing climates?

Challenges in evaluating crop health in CSA hubs and solutions

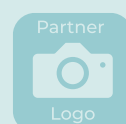
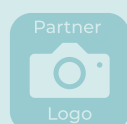
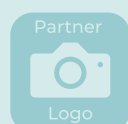
Understanding the effect of AICCRA on crop production involves three major challenges. The first challenge is spillover effects: Knowledge of CSA in a hub may influence neighboring cropland through learning, information sharing, or resource exchange. To address this, our unit of analysis is defined as a 5-km buffer zone of cropland around each community centroid.

AICCRA effort in Ghana

Climate risks increasingly threaten crop production in Ghana. Climate-Smart Agriculture (CSA) practices, such as the use of improved varieties, climate-smart pest and disease management, bundled with Climate Information Services (CIS), offer a pathway to safeguard Ghana's crop production.

¹ <https://cgspace.cgiar.org/items/03806bcf-23c2-499f-8d1f-2c84447c9d73>

² <https://cgspace.cgiar.org/items/11ab5ad2-d207-48b9-8946-538eff0beb35>



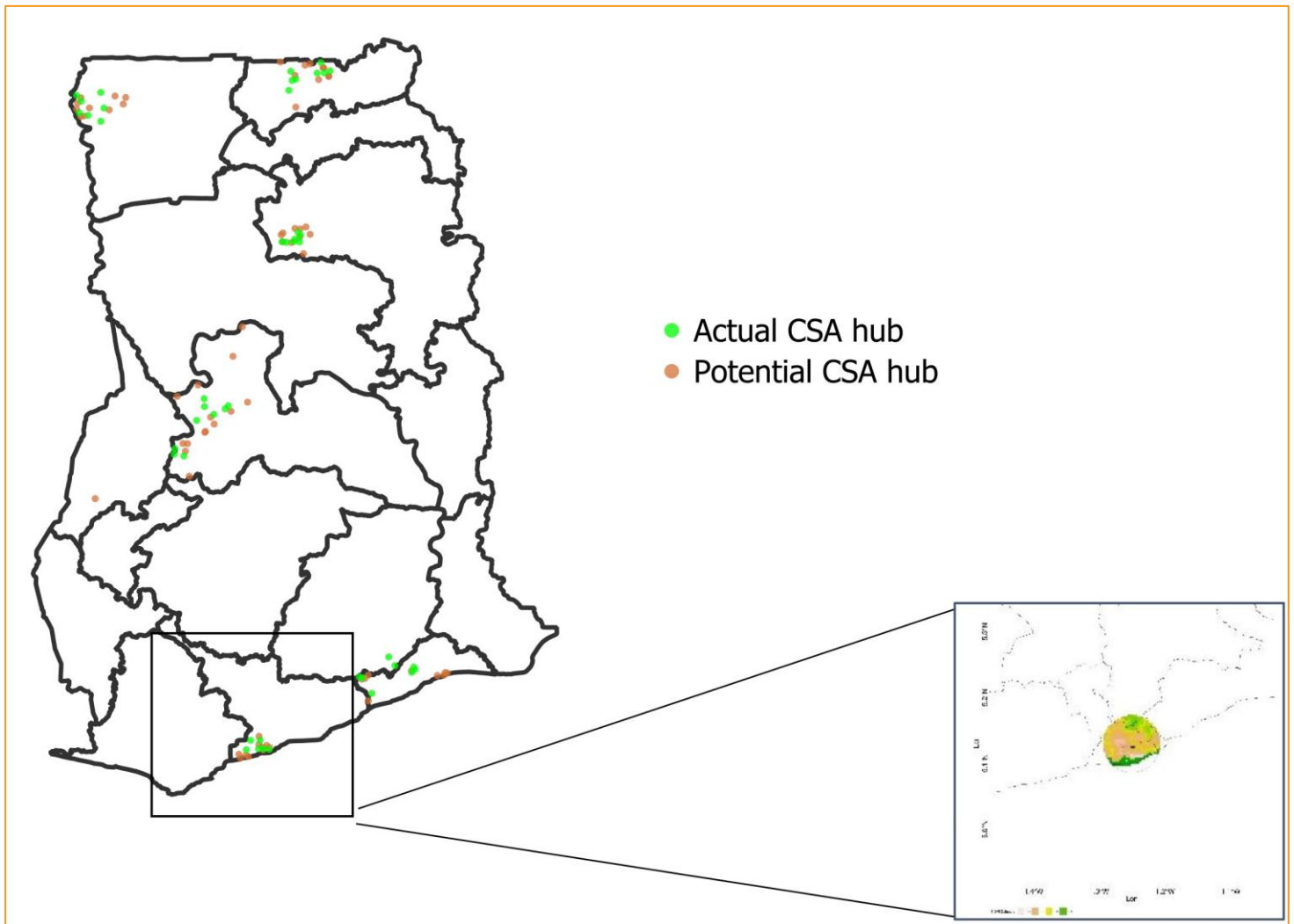


Figure 1. Illustration of treated and control communities for AICCRA II

The second challenge is the identification of appropriate control communities. Since the CSA hubs are not randomly selected, finding valid counterfactual communities is critical. We thus consulted with local agricultural officers, who selected actual CSA hubs before the program started, should resources become available. This to the agricultural officers the purpose of the study, and then asking, "If resources allowed you to select potential locations for future CSA hubs, where would you choose?"

The third is lack of objective production/yield data (for example, from crop cutting data) over time. To tackle this, we analyze the panel Earth Observation (EO). EO offers a solution by providing consistent, high-frequency, and objective measurements across years. We use Normalized Difference Vegetation Index (NDVI) to indicate crop phenological stage and health by comparing the difference between near-infrared light (strongly reflected by healthy plants) and red light (absorbed by chlorophyll). The NDVI values range from -1 to +1. Higher positive values indicate denser, healthier vegetation. NDVI is measured every 10

days at 300 m resolution from 2021–2025, between treated and control communities.

For the 40 communities where AICCRA demonstration is implemented, we merge their georeferenced 5 km buffer with the NDVI data to find the average NDVI score for each period. We only consider the land within the 5 km buffer that is cropland. Figure 1 shows the location of the communities and an example of NDVI map.

Southern Ghana shows significantly healthier crops in CSA hubs

Figure 2 shows the national-level NDVI trends for treated and control communities in Ghana from 2021 to 2025. Both groups follow similar seasonal cycles with peaks = 0.6–0.65 and troughs = 0.4–0.45. There is no significant difference across the groups.

Analyzing Northern and Southern Ghana separately showed clear differences in crop health between treated and control communities (Figure 3). In Northern Ghana, both groups follow a strong seasonal pattern with similar peaks (around 0.6)

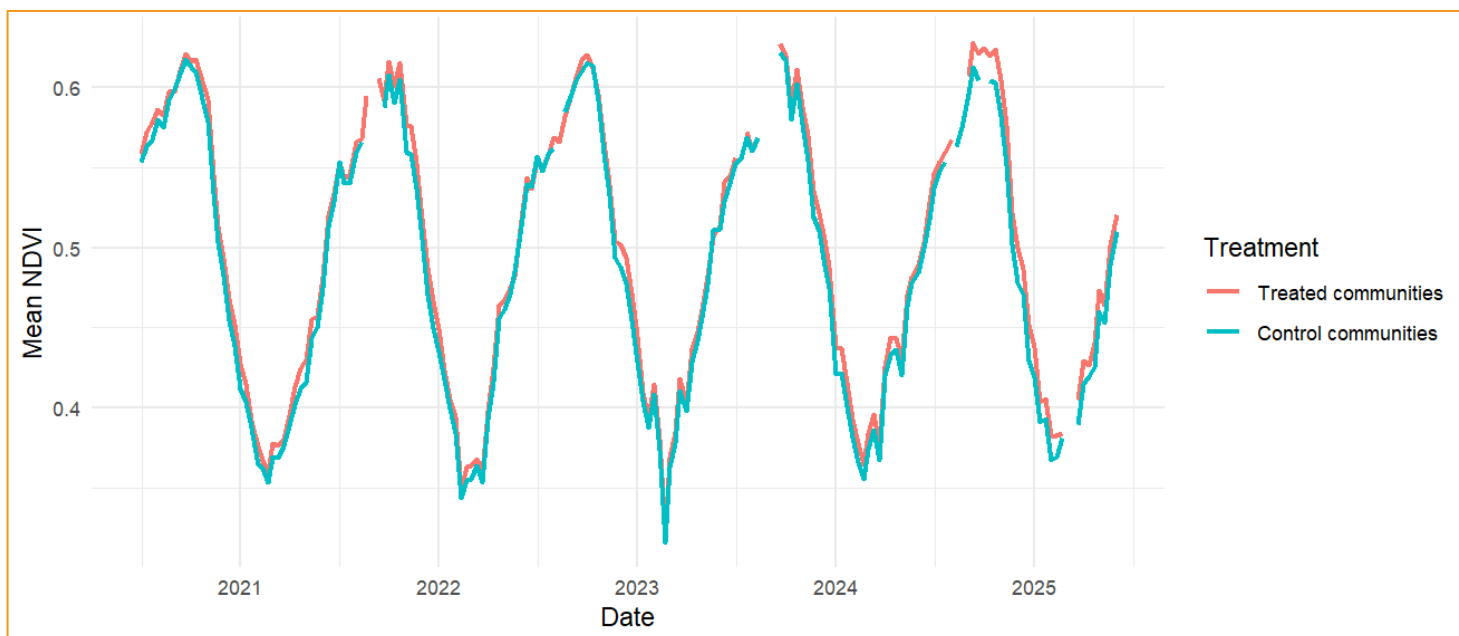


Figure 2. NDVI in Ghana for treated and control communities: 2021-2025.

and troughs (around 0.25–0.3), with no statistically significant differences. In Southern Ghana, NDVI are generally higher (0.5–0.7), with significant higher NDVI in CSA hubs (0.03 higher than control community, p value = 0.001). Southern community also shows two growing seasons as expected.

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Key messages

Our results suggest improved crop health in treated communities compared to control areas, indicating potentially better crop conditions over the year in treated communities. This could be due to higher adoption of CSA practices and more knowledge on how to prevent potential crop loss during dry spells. Causal channels need to be further tested by integrating household survey data.

Methodologically, this exercise shows that in settings without long-term household panel data, satellite-based remote sensing provides a robust alternative for evaluating crop outcomes. By combining high-frequency Earth Observation data with a carefully defined set of counterfactual (control) communities, we can consistently approximate changes in crop health over time in both treated and non-treated areas. This approach reduces reliance on self-reported data—which often suffer from

recall bias and measurement error—and instead relies on objective, spatially comparable indicators of vegetation vigor (e.g., NDVI). When paired with rigorous identification of control communities that closely match treated ones, this method strengthens causal inference, offering credible insights into whether CSA demonstrations are improving crop performance in AICCRA hubs compared to similar, non-participating communities.

Next, with the collected household survey data, we will disaggregate NDVI trends by major crop types (maize, cowpea, etc.) and align them with planting and harvesting calendars, which will help clarify whether observed vegetation improvements are linked to specific CSA practices or seasonal shifts in cropping patterns. More spatial analysis on crop loss after drought episodes will also be conducted.

Further investigation is also recommended for Northern Ghana, where observed effects on improving crop health appear smaller. Understanding the drivers of this lower impact could help refine strategies and enhance the effectiveness of the AICCRA program across the country.

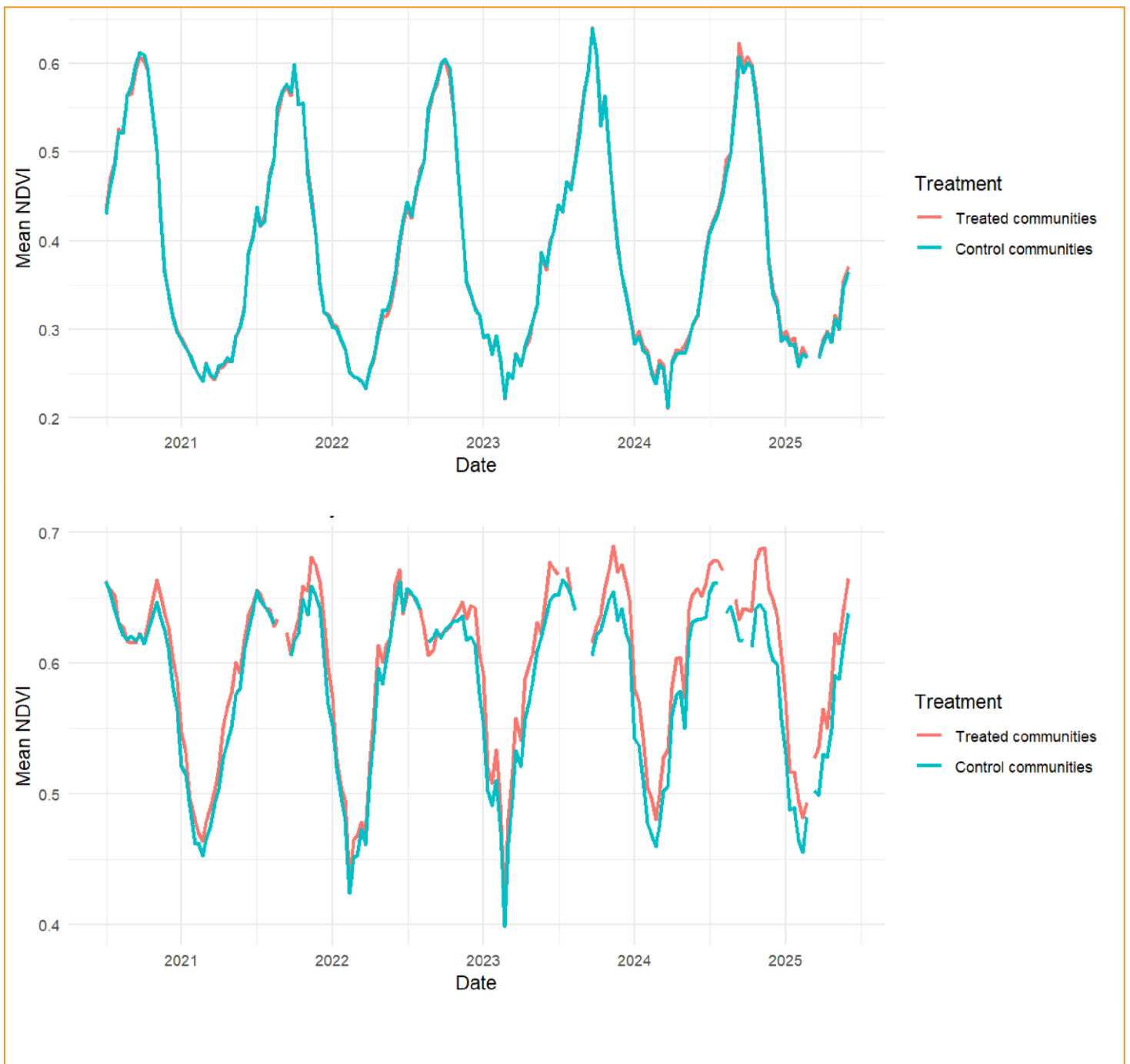


Figure 3. NDVI in northern (top) and (bottom)Ghana, treated vs. control communities: 2021-2025.

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