Can School-Based Agricultural Extension Programs Improve Technology Diffusion and Rural Education in Liberia?

Researchers evaluated the impact of a school-based agricultural education (SBAE) program on spreading agricultural technologies and improving rural education in Liberia. They also evaluated how the lack of parental and community engagement might affect the program's impact.

Results indicate that SBAE was highly effective in improving both technology diffusion and rural education, but these effects were only achieved when the program was implemented together with parental and community engagement interventions.

Key Findings

- SBAE increased students' and parents' knowledge, knowledge sharing, and adoption of promoted farming practices on parcels outside of school, with greater impacts than extension programs targeting adults.
- SBAE improved student retention rates, school attendance, studying hours, livelihood aspirations, and Parent-Teacher Association (PTA) attendance.
- The positive effects on technology adoption and education were present only with parental and community engagement.
- The program can be cost-effective, with costs breaking even after four years and reaching a 2:1 cost-benefit ratio after six years.

Research and Policy Implications

- Future research should focus on ways to **enhance SBAE's impact on education.** This can involve:
  - introducing more intensive training to help science teachers to internalize the concept of hands-on learning.
  - establishing scholarships to motivate students to focus on academic performance along with agricultural work.
- As programs currently involve just 25-30 members per year, **more efforts are needed to maximize school-level impact.** Examples include:
  - using produce from school farms for school feeding to increase attendance,
  - making the SBAE program part of the compulsory curriculum.

Introduction

Agricultural extension—the process of sharing new information, techniques, and best practices with farmers—is important for improving the livelihoods of rural households in low- and middle-income countries. However, a shortage of qualified extension officers results in few households receiving services, which limits opportunities for agricultural innovation.

This challenge is particularly evident in Liberia, where yields for staple crops rice and cassava are half the Sub-Saharan Africa average, and just three percent of rural households have access to government extension services. Moreover, children often miss school, with dropout rates over 20 percent at upper elementary and junior high school levels and 90 percent of students being overage due to working on the family farm.

SBAE integrates agricultural extension and youth education through classroom extension, school demonstration farms, and student home projects. Evidence suggests that these programs can effectively spread knowledge of improved agricultural technologies and practices within farming communities.

In Liberia's SBAE program, teachers are trained in hands-on teaching methods that integrate farming into science lessons, using school farms as science labs. Students are encouraged to develop home gardens, enabling them to spread new agricultural technologies to others.

Unlike typical school gardens in Sub-Saharan Africa, this program emphasizes voluntary participation and incorporates improved technologies and an agribusiness focus, allowing students to potentially profit from their efforts.

Despite the potential for SBAE, however, limited evidence exists about their broader impact. In addition, there are concerns that using schools for agricultural extension can negatively affect educational outcomes.

The Evaluation

Researchers evaluated the impact of an SBAE program on agricultural technology adoption and rural education in Liberia. A total of 197 schools participated in the study, with 100 randomly selected to receive the SBAE program and 97 serving as a comparison group.

Since parents lived far away from schools (1 hour on average), and rarely visited school farms (only 44 percent visited in three years), researchers implemented parental and community interventions that were randomized across SBAE schools. These interventions aimed to increase parents' exposure to new technologies and students' diffusion efforts within households.

The first intervention involved promotional video sessions about the program for parents, implemented in 50 randomly selected SBAE schools in the first year of the program. The sessions aimed to inform parents about the SBAE program (in particular, about the differences between SBAE and typical school gardening programs) and to convince parents about SBAE's positive impact on students.

The second intervention was an annual farmer field day (FFD) that invited 25 leaders per school of collective farming groups in nearby communities. This annual farmer field day informed the leaders directly, and in turn other members of the community via word of mouth, about the promoted technologies.

Results

Researchers evaluated the program's impact on agricultural technology adoption, students' livelihoods, and students' education. There are two main results.

First, when parental and community engagement were included, the SBAE program was more effective in diffusing agricultural technologies than alternatives targeting adults, and improved students' education and livelihoods. Second, parental and community engagement were pivotal for SBAE's positive impact on both technology diffusion and rural education.

Increased household adoption of promoted farming practices: By the third rainy season, adoption of promoted farming practices on both students' parcels (outside schools) and parents' parcels increased. Students' adoption of bed preparation methods (the main agricultural technology promoted) increased by 18 percentage points (from 29 percent) and parents' adoption increased by 11 percentage points (from 74 percent).

SBAE's impact on parents was two to three times greater than the impact of other intensive extension programs in the Sub-Saharan African context (such as in Udry et al., 2019; BenYishay and Mobarak, 2019). This means that SBAE is more effective in increasing rural households' technology adoption even though it does not directly train adults. It also validates the claim that a school-based approach can improve upon existing extension systems in Africa.

Positive education and livelihood impacts: Contrary to concerns about potential negative effects of SBAE on students' education and livelihoods, SBAE improved these outcomes when parental and community engagement were included. School dropouts fell by 4-5 percentage points (from around 20 percent), and school attendance improved by 24 percent. In addition, as a result of students' increased entrepreneurial activities on farms, students' annual savings increased by 92 percent.

SBAE also improved students' aspirations, as the fraction of students who save for attending university increased by 6 percentage points (from 17 percent). There was a particularly strong effect on students' aspirations to pursue an agricultural career, as indicated by an increase in the fraction of students who studied agriculture as an elective by 19 percentage points.

Engagement improved SBAE impact on technology diffusion: SBAE increased students' and parents' technology adoption only in schools that were randomly assigned to the engagement interventions, and had a close to zero effect otherwise. Further inspection suggests that these interventions altered SBAE's impact via two main channels.

First, these interventions improved parents' exposure to new agricultural technologies via their visits to school farms (from 44 percent to 65 percent). As a result, the number of farming practices that parents reported learning from schools increased by 4.8 times. Parents' beliefs about the number of cassava tubers per plant that students can harvest also increased by 11 percent.

These interventions also substantially boosted students' efforts to spread technologies within households. In the absence of engagement, SBAE had a negligible effect on students who looked after farms, whereas with engagement, SBAE increased this measure by 14 percentage points.

There was also evidence that students became much more likely to teach and demonstrate promoted technologies. As a result, parents' knowledge about the promoted technologies increased by 4.3 percent.

Engagement improved SBAE impact on education:

Engagement interventions reversed the negative impact on education. While the SBAE program reduced student attendance by 31 percent, it increased attendance by 24 percent when engagement interventions were included. Similar positive effects were also observed on students' school enrollment, studying hours, and PTA attendance.

These results indicate that while concerns about a school-based extension program diverting students' efforts from studying are valid, they can be addressed through parental and community engagement, which encourages rural households to view agriculture and education as complementary.

Cost-effectiveness

While crop yield estimates will only be available after the 2025 post-harvest survey, an initial cost-effectiveness calculation suggests that SBAE can be cost-effective despite requiring more investment upfront than alternatives.

The program costs USD 2,000 per school annually for the first three years, mainly for extension visits and teacher training. After this, the cost drops to USD 400 per school per year after the extension component is dropped. Researchers thus calculated the number of years that were required for SBAE to deliver an increase in production value among parents that justifies the program costs (inclusive of the parental and community engagement).

In this calculation, several conservative assumptions were made. First, researchers used lower-bound estimates from agronomic trials to estimate the gain in yields (30 percent for cassava and 50 percent for sweet potatoes, which they used as representative crops). Second, researchers considered only the adoption of bed preparation methods and omitted complementary practices like row planting, regular spacing, and composting. Third, researchers considered only benefits from technology adoption for the initial cohort of parents, omitting benefits for subsequent cohorts of parents and spillovers to non-parent farmers, as well as benefits for students' education and livelihoods.

This interim cost-effectiveness exercise indicates that the SBAE program can break even in four years, which is a reasonably short amount of time. By the sixth year, the benefit-cost ratio reaches 2:1. Researchers will update these estimates as they collect actual data on yield gains and the fraction of household cultivated area that uses promoted technologies (currently assumed to be one-eighth).

Policy Implications

This study provides evidence that contrary to common concerns about pitfalls, SBAE can improve both agricultural extension and rural education. The evidence suggests that SBAE can be highly effective relative to existing alternatives in agricultural extension, with program costs being justified in a reasonably short amount of time.

In view of significant implementation challenges due to high rates of teacher turnover, limited compliance among schools, and the COVID-19 pandemic (only 70 percent of SBAE schools started their farms in the first season), this study should be taken as proof-of-concept for SBAE. Besides the parental and community engagement interventions that are already proven to be pivotal, future research should study ways to tackle current implementation shortfalls.

First, more efforts are needed to improve SBAE's impact on education. Examples include introducing more intensive training to help science teachers internalize the concept of experiential learning, or scholarships to motivate students to focus on academic performance along with agricultural work.

Second, since the program is currently limited to 25-30 members per year, more efforts are needed to maximize school-level impact. Examples include using produce from school farms for school feeding to increase attendance and making the SBAE program part of the compulsory curriculum.

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