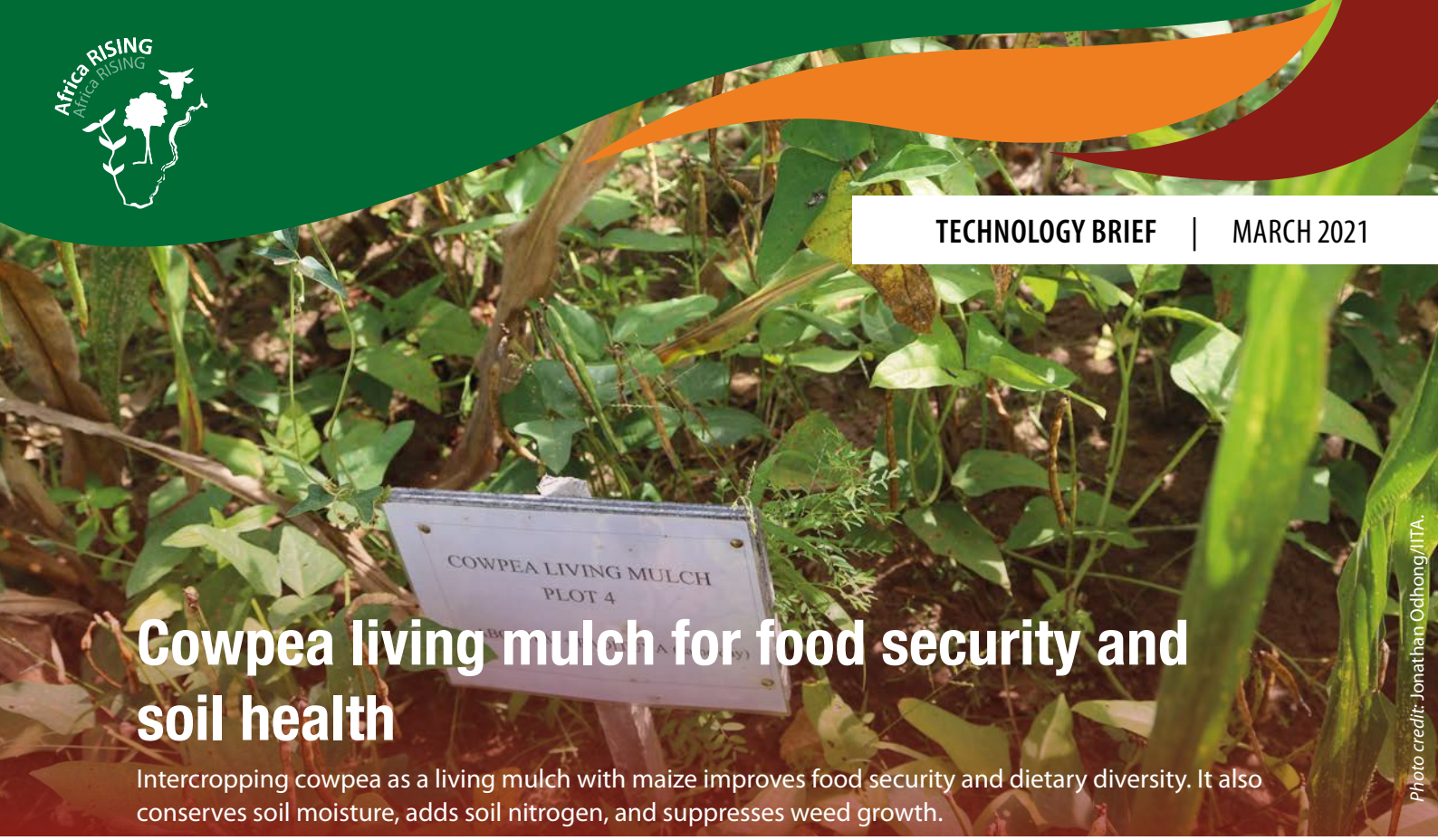

Photo credit: Jonathan Odhong/IITA.

Cowpea living mulch for food security and soil health

Intercropping cowpea as a living mulch with maize improves food security and dietary diversity. It also conserves soil moisture, adds soil nitrogen, and suppresses weed growth.

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Description of the technology

A living mulch is a plant grown specifically to cover the soil surface, add nutrients, increase soil moisture, and reduce weeds. When planted as an intercrop in a maize-based cropping system, cowpea (*Vigna unguiculata*) provides all these services as well as additional protein-rich food for farming families and quality feed for their livestock. Cowpea supplies valuable micronutrients such as iron and folic acid, which are particularly important for maintaining the health of pregnant women.

Cowpea is planted one to two weeks after sowing the maize to give the maize a competitive advantage over the available water, light, and nutrient resources. Spreading, rather than climbing varieties of cowpea are recommended since these provide better soil cover and will not climb the maize plants. Cowpea can be harvested before the maize, providing useful food during the 'hunger gap.'

Cowpea as a living mulch has been found to increase maize grain yield by 34% and protein production by 75% compared with growing maize as a sole crop. It also improves soil moisture storage by 80% in the top soil (0–20 cm) at the tasseling stage of maize growth. Being a legume, cowpea 'fixes' nitrogen from the air in its root nodules, thereby increasing soil nitrogen by 17% in a maize–cowpea intercrop. This reduces the need to apply nitrogen fertilizer to the maize crop. The calculated soil quality index from measured soil properties for cowpea living mulch was 50% higher than that of a sole maize crop.

Key messages

MAIZE GRAIN YIELD **increased** by

34% when intercropped with cowpea

COWPEA–MAIZE INTERCROP produced

75% more protein than a sole crop of maize

SOIL MOISTURE **increased** by **80%**

and SOIL NITROGEN by **17%** in a **MAIZE–COWPEA** intercrop

ONLY 1 WEEDING SESSION is needed per growing season when COWPEA is **intercropped** with MAIZE

Conditions that favor uptake

Agro-ecological conditions: Maize and cowpea grow best in well-drained, fertile soil with a pH of 5.0–7.2. Maize has a total crop water requirement of 500–800 mm per growing period, with cowpea requiring 300–500 mm. This technology is therefore suitable for areas with an annual rainfall of 800 mm and above. Both crops perform well in a temperature range of 18–35°C.

Access to inputs and markets: The technology is most attractive (and will yield the greatest benefits) to farmers when they can access effective agro-input dealer networks to obtain improved seeds (maize and cowpea) and fertilizers. Farmers also need access to markets and market information for cowpea grains and livestock fodder to maximize their incomes from the sale of cowpea products.

Alignment with household resource endowments

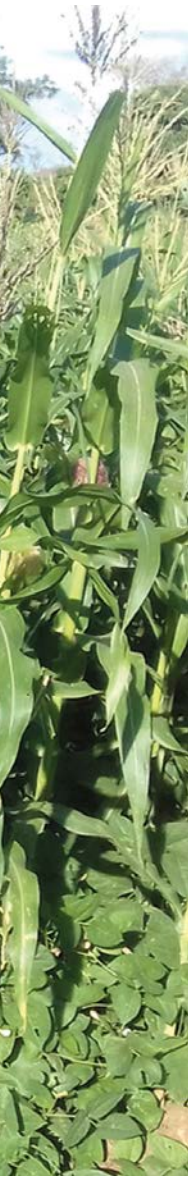
All maize-growing households can implement the technology at any level of resource endowment. By reducing weeding time, cowpea living mulch can release farmers to perform other activities during the peak period for labor demand. Farmers who cannot access inorganic fertilizer (lack of cash or availability) benefit from the cowpea's ability to fix nitrogen. Cowpea residues are providing useful animal feed during the dry season in mixed crop-livestock sytems. While farmers need to expend extra labor on harvesting and transporting the fodder to the livestock compound or area, there are significant benefits to feeding livestock in a confined space. The manure can be collected more efficiently and used to improve soil structure and fertility for subsequent crops.

Necessary ingredients for implementation

Appropriate varieties: The technology will provide the greatest benefits to farmers when they plant improved varieties that meet their needs. These include short-duration maize varieties (maturing in 80–90 days) that are high yielding and drought resistant. The cowpea variety selected should be a spreading type since the semi-erect and erect types will climb up the maize plants.

Planting: The maize seeds should be sown at an inter-row spacing of 75 cm and intra-row spacing of 40 cm. The cowpea seeds should also be planted at a 75-cm inter-row spacing, starting from the mid-point of the first two maize rows, and intra-row spacing of 20 cm. Weeding will be required at 14–21 days after planting maize, depending on the degree of weed growth in the field.

Crop management: Farmers should apply nitrogen, phosphorus, and potassium (NPK) fertilizer to the maize plants at a rate of 40:40:40 kg per hectare at 10 days after planting. They should also top dress with ammonium sulfate at 20 kg per hectare at 21 days after the first application of fertilizer. The NPK fertilizer application sometimes coincides with the sowing of cowpea one or two week(s) after the maize depending on the soil moisture conditions of the field. Cowpea will produce root nodules with the native rhizobia in the soil and therefore may not require an inoculant. The cowpea benefits from the NPK fertilizer applied to maize during the early stages of growth, but phosphorus fertilizers (triple or single superphosphate) may be applied at 30 kg per ha to the cowpea to boost nodule formation for fixing biological nitrogen into the soil. Cowpea pests, such as thrips and aphids, should be controlled with Cymetox super (30 g cypermethrin and 25 g dimethoate as active ingredients at 1 liter per hectare) at the flowering stage of the cowpea, and Lambda cyhalothrin (25 g cyhalothrin as an active ingredient at 250 ml per hectare) should be used to control pod-sucking bugs and pod borer (*Maruca Vitrata*) at the podding stage.



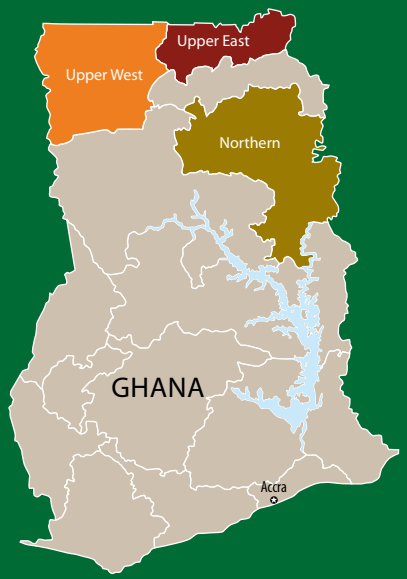
Cowpea living mulch in a farmer's field in northern Ghana.
Photo credit: Nurudeen Abdul Rahman/IITA.

Adaptation possibilities

Other grain legumes such as groundnut (*Arachis hypogaea*), preferably the spreading type, and soybean (*Glycine max*) could be grown as a living mulch as an alternative to cowpea, especially in areas where the agro-ecology favors these crops over cowpea, or where farmers prefer groundnut or soybean for dietary or market reasons. Farmers should consider the maturity period of the groundnut and soybean varieties selected as alternatives to cowpea to ensure that planting them at one to two weeks after the main crop will allow them to mature within the season. Similarly, farmers living in agro-ecologies that favor cereal crops like sorghum and millet (due to climate, dietary, or market reasons) may also grow these cereals with cowpea as a living mulch.

Where was the technology validated?

The cowpea living mulch technology was validated through on-farm trials conducted in six districts and 12 communities across the three northern regions of Ghana during the 2017, 2018, and 2019 cropping seasons. Twelve fields of 350 square meters were used for researcher-led trials and 129 fields of 4000 square meters for farmer-led trials. Ghana's three northern regions have a mono-modal rainfall pattern with a mean annual rainfall of 700–1200 mm and mean monthly minimum and maximum temperatures of 25 and 38°C.



Potential benefits to users

Food security and dietary diversity: By increasing maize grain yield and providing an additional food source in the cowpea grain, this technology increases the calorific food available to the household. Cowpea grains offer a valuable source of protein and micronutrients for dietary diversity.

Soil fertility: Cowpea as a mulch improves soil moisture and water storage in the topsoil. Cowpea fixes biological nitrogen through its roots, and the crop residue also contributes to soil nutrients and carbon.

Weed control: The canopy of the cowpea mulch shades the soil and reduces weed growth. This means farmers only need to weed the field once rather than twice (depending on how fast the cowpea canopy covers the soil surface).

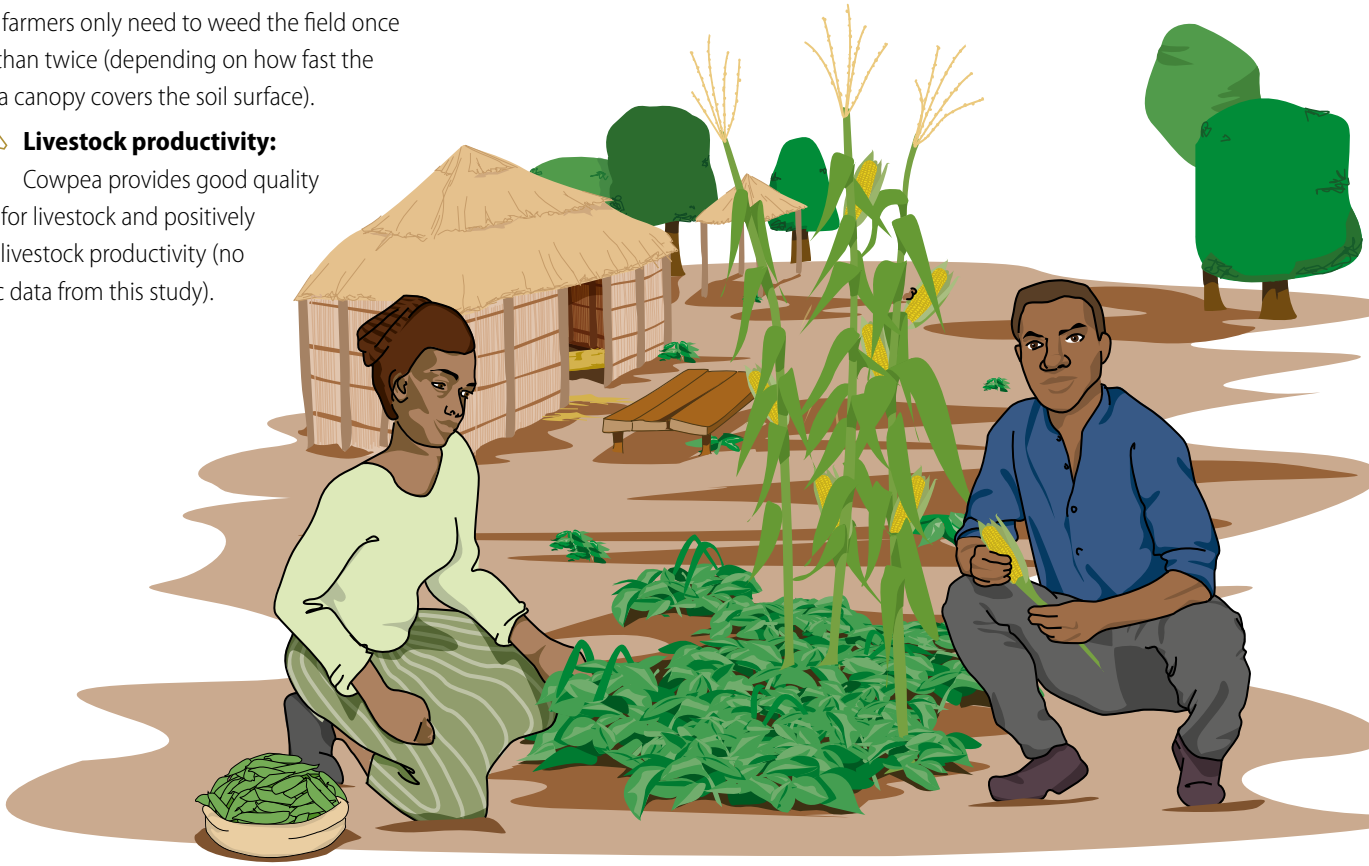
Livestock productivity: Cowpea provides good quality fodder for livestock and positively affects livestock productivity (no specific data from this study).

Things to worry about

Labor: Compared with a sole maize crop, there is an increased labor requirement for planting (65%), harvesting (221%), and processing activities that are performed mostly by women and children. Although weeding can be reduced from twice to once, early weeding is slightly more time-consuming (by 35%) since farmers need to be careful when weeding around the cowpea seedlings. Harvesting the intercropped cowpea needs to be done carefully to avoid damaging the maize plants.

Access to inputs: Some farmers may be unable to access inputs, including improved seeds and fertilizers, due to their remote location or lack of cash or credit.

Fluctuating market prices: Maize and cowpea market prices are subject to fluctuation, depending on the prevailing socio-economic conditions.



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Africa RISING

The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative. Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base. The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation, and impact assessment.

Africa RISING website: **https://africa-rising.net**