Mitigating climate change

Insights from the IAP Challenge Fund

Rising global greenhouse gas (GHG) emissions jeopardise the liveability of our planet. Major changes are needed to meet the Paris Agreement target, to limit global warming to well below 2°C, preferably 1.5°C. In response, most countries have set out national climate strategies including nationally determined contributions that set out countries' climate adaptation planning and mitigation across different sectors, including energy, waste and agriculture, among others. The agriculture sector accounts for more than one-quarter of the world's emissions, including forestry and land-use change.[1] To do this we must change how we farm, what we eat, and how much we lose or waste food. A nearly two-thirds contribution to climate mitigation targets is needed from these combined changes by 2050.[2]

A major challenge for the agriculture sector is the required pace and scale of change. Reducing emissions requires action by the more than two billion people employed in agriculture. Most of these people are employed on small farms of less than two hectares, representing about 75% of all farms.[3] Including small farms in climate change strategies is key to bringing agriculture in line with the 1.5°C pathway. Businesses have a critical role for mitigating climate change. Until recently, the focus for most companies has been measuring emissions from electricity consumption and one's own operations. Increasingly, companies understand the need to also account for GHG emissions along their value chains.[4] This includes the purchase of goods and services as well as the use of sold products and their disposal. Agri-businesses that reduce emissions or increase climate resilience by purchasing from or selling products to smallholders are ahead of the curve.

[1] J. Ahmed, E. Almeida, D. Aminetzah, N. Denis, K. Henderson, J. Katz, H. Kitchel and P. Mannion, Agriculture and climate change. Reducing emissions through improved farming practices. McKinsey & Company, 2020, p. 5
[2] J. Ahmed, et al., Agriculture and climate change. 2020, p. 10.

[3] J. Ahmed, et al., 2020, p. 7.
[4] World Resources Institute & World Business Council for Sustainable Development, Technical Guidance for Calculating Scope 3 Emissions, 2013.

These green and inclusive business models are perceived to have investment risks in their early stages, creating a structural barrier of capital constraints. Breaking this barrier is a challenge. The Innovations Against Poverty (IAP) project aims to challenge these perceptions by supporting the growth of such businesses towards commercial viability.

Changes in how we farm

Biochar[5] has significant mitigation potential through CO2 removal and emissions reduction. In the production of biochar, CO2 is first removed from the atmosphere during plant growth. Organic feedstocks are then converted into biochar by heating biomass in the total or partial absence of oxygen (a process called 'pyrolysis'). Finally, this biochar is sequestered for decades and potentially up to thousands of years when applied to soils. Globally, biochar's mitigation potential is estimated at 2.6 Gt CO2e annually.[6] That is an astonishing 13% of all current emissions from agriculture, forestry and land use. Potential co-benefits of biochar application to degraded soils include enhanced productivity, increased water-holding capacity and nitrogen use efficiency, among others.[7] This not only sees biochar application sequestering CO2, but also increasing farm's resilience to climate change.

Rice husk waste

Typically, the risk of failed or lower yields from climatic shocks makes sustaining their livelihoods untenable for smallholder farmers. This means there are clear benefits to serving low-income farming communities with affordable biochar soil amendments. Until today, insufficient investment remains a key barrier to upscaling biochar production. High production costs at small-scale is a contributing factor.[8]

IAP has de-risked the transition from small- to large-scale production facilities for inclusive businesses. By partnering with HUSK in 2020, the first company that commercialised biochar- or carbon-based fertilisers in South-East Asia. HUSK has reached farmers in Cambodia with their biochar, carbon-based fertiliser, and rice husk vinegar. The latter a by-product of the pyrolysis of rice husk and a proven, effective organic pesticide. Biochar produced by HUSK is sinking CO2 at a rate of 1.34 tonne CO2e per tonne, when applied to soil.[9] HUSK also brought a granulated carbon-based fertiliser onto the market, called ONIX P9. This product competes at US$ 500 per tonne with chemical as well as other organic granulated fertilisers. ONIX P9 increases a farmer's return on investment by its simultaneous effects on soil enhancement, moisture retention as well as nutrient uptake. HUSK has run over 220 trials with several varieties of crop across 12 provinces in Cambodia.[10] They have seen an average 26% yield increase after the first application of biochar, 16% for carbon-based fertiliser and 21% for vinegar.

The greatest uncertainty for a biochar-business like HUSK is the availability of sustainably-sourced biomass for biochar production. HUSK managed to turn this uncertainty into a key factor of success, by successfully aligning the interest of different stakeholders in the rice value chain of Cambodia. Cambodia is estimated by FAO to have an aggregate rice production of 11 million tonnes in 2020.[11] Rice husks account for approximately 20% of paddy production on a weight basis. Hence, storage and disposal of rice husks easily becomes a challenge for rice mills. HUSK takes away these pains by offering long-term purchase agreements and collects rice husk at the factory gate. To sustain this relationship in the long-term, HUSK aims to build joint ventures, where rice mills partially own the biochar business.

[5] Biochar is a material made of carbon and ashes, produced by heating organic matter in an oxygen-limited environment.
[6] IPCC, Sixth Assessment Report (AR6), Working Group III (WGIII). Chapter 7: Agriculture, Forestry and Other Land Uses (AFOLU). p. 7-63-7-64.
[7] W. Gwenzi, N. Chaukura, F.N.D. Mukome, S. Machado and B. Nyamasoka. Biochar production and applications in sub-Saharan Africa: Opportunities, constraints, risks and uncertainties, J. Environ. Manage. 2015
[8] W. Gwenzi, et al., Biochar production and applications in sub-Saharan Africa. 2015.
[9] Based on carbon sink certificate from 2022 issued by the European Biochar Certificate (EBC).
[10] 157 farms on biochar, 17 farms on carbon-based fertiliser, and 16 farms on rice husk vinegar as natural insect repellent.
[11] FAOSTAT. Domain: Crops and livestock products. Area: Cambodia. Element: Production. Item: Rice. Year: 2020, https://www.fao.org/faostat/en/#data/QCL (accessed 23-11- 2022).

In addition, the supplying farmers of the rice mill are targeted for sales of the carbon-based fertilisers. Farmers benefit from increased yields and improved resilience to climatic shocks. These increased yields lead to increased paddy supply to the rice mill. Moreover, HUSK generates carbon removal certificates, allowing them to offer such certificates to international rice brands for offsetting part of their footprint. The carbon revenues help to set more competitive pricing strategies, increasing affordability of the organic fertilisers for farmers. HUSK sells carbon removal units to buyers in the voluntary carbon market.

The successful model of HUSK was shaped by coping with the uncertainty of available rice husks for biochar production. They were enduring declining production rates by the previous supply chain partner. IAP provided grant financing to de-risk the transition to a new and larger production facility in Kampong Thom province in Cambodia. This new facility is strategically located next to Cambodia's largest rice miller: AmruRice, who partnered with IAP in 2016. New machinery obtained through IAP funding enabled HUSK to double its production capacity, from 300 to 600 tonnes of biochar per month. At full capacity, HUSK will contribute 1.2% to Cambodia's Nationally Determined Contribution for the agriculture sector by 2030.[12]

Change in what we eat

Changes in diet are one of the most impactful measures to reduce emissions. The mitigation potential of shifting diets to dairy alternatives is huge. Globally, emissions from milk production represent about one-third of the livestock sector emissions.[13] The global average emission intensity of dairy milk was estimated at 2.5 kg CO2e per kg milk in 2015, according to FAO. There are however large differences in emission intensity between regions, with the highest in Sub-Saharan Africa at 6.67 kg CO2e per kg milk. Within each region, there is again a wide variation in emission intensity due to the diversity in on-farm efficiency.[14]

On the market side, the demand for dairy alternatives is strongly on the rise. Its market is valued at an estimated US$ 27.3 billion globally in 2022 and projected to reach US$ 44.8 billion by 2027.[15] That is an annual growth rate of 10%. Key consumer drivers are the veganism trend gaining popularity. Besides, more and more consumers without any dietary requirements are opting for plant-based alternatives for health and nutrition reasons. This presents an opportunity to innovate and create tasty products that appeal to all consumers who have an interest in plant-based alternatives.

Affordable and nutritious soya milk

As source of dietary protein, soya milk presents a nutritious dairy alternative. Legumes, especially soya beans, have the highest protein content and amino acid composition among plants.[16] Soya milk's mitigation potential is estimated at 5.69 kg CO2e per kg of dairy milk substituted in the Sub-Saharan African market.[17] However, affordable, and locally produced soya milk in low and lower-middle income countries is scarce.

[12] 600 tonnes/month of biochar (2023–2030) = 57.6 ktonne, potentially sequestering 77.2 ktonne CO_2e—1.2% of Cambodia's 2030 NDC target. UNFCCC NDC Registry, https://unfccc.int/NDCREG. Accessed 23 Nov. 2022.
[13] Opio, C., et al. GHG Emissions from Ruminant Supply Chains. FAO, 2013.
[14] FAO and GDP. Climate Change and the Global Dairy Sector. FAO, 2018, p. 25.
[15] MarketsandMarkets. Dairy Alternatives Market – Forecast to 2027, http://newfoodmagazine.com/article/150352/the-rise-of-the-non-dairy-consumer. Accessed 23 Sept. 2022.
[16] Weindl, I., et al. "Sustainable Food Protein Supply: A Leibniz Position." Global Food Security, vol. 25, 2020.
[17] Dairy milk emits 6.67 kg CO_2e/kg vs. 0.98 kg CO_2e/kg for soya milk. Poore, J., and T. Nemecek. "Reducing Food's Environmental Impacts." Science, vol. 360, no. 6392, 2018, pp. 987–92.

For example, no locally produced soya milk used to exist in Zambia. As an alternative to dairy, in 2021, 260Brands partnered with IAP to bring an affordable nutritious soya-based drink to the Zambian market, combatting the national malnutrition crisis in the country, contributing to improved income for smallholder soya bean producers, and reducing emissions. 260Brands produces long life sweetened and unsweetened as well as flavoured soya milk, free from cholesterol and low in saturated fats. It is processed at ultra-high temperature and packaged aseptically in brick and pouch packaging, allowing for a 6-to-12-month shelf life. Long life milk caters to the large low-income consumer group, who have little to no refrigeration access. The longer shelf life allows them to store the milk and consume it at their convenience.

260Brands leveraged the IAP partnership by raising additional financing to build and operate the first soya milk processing facility in Zambia. It is projected to produce three million litres of soya milk annually for the coming 20 years. Such production capacity could result into a potential avoidance of 17.5 thousand tonnes of CO2e emissions annually.[18] At full capacity, this equals 0.7% of Zambia's Nationally Determined Contribution by 2030.[19] To successfully implement the soya bean sourcing model from smallholders, 260Brands is diversifying its sourcing locations. This helps to mitigate the risk of external shocks in one area, where other areas are not affected to fluctuating soya bean prices. Secondly, the company is anticipating limited willingness or ability to pay for quality seeds on credit among farmers. Causal factors could be delayed rains, free agri-input schemes or delayed payments from governmental programmes. Thirdly, 260Brands aims for the timely collection of soya beans to mitigate the risk of side-selling by smallholders. Lastly, defaulting on agreements is mitigated by offering a premium price for organically grown beans.

Changes in how much food we waste

Around one-third of food produced globally is lost or wasted.[20] Food loss and waste is a major concern from an environmental, social, and economic point of view. About 8 to 10% of global greenhouse gas emissions are associated with it.[21] In the sub-Saharan African region, the percentage of food loss is reported to be over 20%.[22] This forms a major concern for smallholder farmers, who rely on their harvest for food and income security. Ethiopia is one of the countries affected by high post-harvest losses of foods. Key reasons are poor handling and market infrastructure, such as limited number of roads to farm gates and a lack of cold chain and proper packaging or storage facilities. Limited private investment is a contributing factor.[23] A comprehensive post-harvest loss study for several cash crops in Ethiopia revealed that storage presents a critical loss point. Hence, a storage solution could offer the biggest potential for food loss reduction. For maize, the crop grown by most smallholders, 11.1% of the food loss occurs at storage from farm to fork.[24]

[18] Assumes all soya milk replaces dairy. Soya milk density: 1,027.1 g/L.
[19] 24 million litres sold (2023–2030) could avoid ~140 ktonne CO_2e—0.7% of Zambia's 2030 NDC target.
[20] FAO. Global Food Losses and Food Waste: Extent, Causes and Prevention. Rome, 2011.
[21] UNEP. Food Waste Index Report 2021. Nairobi, 2021.
[22] FAO. SDG Indicator 12.3.1 – Global Food Loss and Waste. 2020, https://www.fao.org/sustainable-development-goals/indicators/1231/en. Accessed 23 Nov. 2022.
[23] Teferra, T.F. The Cost of Postharvest Losses in Ethiopia: Economic and Food Security Implications. 2022.
[24] FAO. Postharvest Loss Assessment of Maize, Wheat, Sorghum and Haricot Bean. 2017, pp. 28–30.

Reducing post-harvest food loss

Shayashone's hermetic PICS bags[25] offer a solution to the problem of storage loss due to weevils, rodents, and grain mould. The PICS bag is a three-layered storage bag that preserves the freshness, taste, and odour of the grain. It distinguishes itself from ordinary non-airtight storage bags by its dual function of storage and protection and lasts three times longer. The GHG abatement costs of PICS bags are estimated at US$ 36 per tonne of CO2e avoided when storing maize.[26]

IAP partnered with Shayashone Trading Plc to pilot a youth resellers distribution model for the PICS bags. Since then, the company managed to sell more than 5 million bags to farmers. This equals to an estimated 111 thousand tonnes of maize saved from storage loss and 188 thousand tonnes of CO2 avoided. A demand of more than two million bags is collected for this harvest season alone. On average, Shayashone's annual growth of sales has been an astonishing 45% during 2017 to 2021. The key success behind this growth is a strategy heavily relying on demand creation. As a new product in the market, the company recognized the need to demonstrate the product value to farmers. Extensive demonstrations were, and still are, organised through influencers like community leaders, model farmers and extension workers from the government.

Evidence resulting from demonstrations are used as critical sales points with key repeated messaging to rural customers using local FM radio stations. Moreover, sales points are close to farmers, like agro-dealers, small shop vendors at small towns, and youth resellers in rural areas. Each vendor is linked to youth resellers, who are taking the product to the villages where they promote and supply the bags. Shayashone sells through 450 vendors and 400 youth resellers and has reached over 10,000 villages across Ethiopia. The key challenge is to sustain the last-mile distribution. This requires a strong market demand to reach critical volumes, so that vendors and resellers run a profitable business. To achieve this, Shayashone aims to offer product bundles that include water filters and is relying on customers to act as promoters.

[25] Refers to hermetic storage tech: Purdue Improved Crop Storage (PICS) bags.

[26] Based on 100 kg maize per PICS bag, 3-year lifespan, cost data from Shayashone (2017–2021), and 1.7 kg CO_2e/kg maize (see note 11).

In October 2020, IAP funded a customer survey among 262 PICS bag customers using a lean data approach, conducted by 60 Decibels.[27] This survey revealed that an astonishing 86% of all customers are promoters, with only 3% detractors. As promoters are powerful brand ambassadors, Shayashone is able to keep marketing costs within limits to sustain a healthy profit margin. Promoters loved that the PICS bag maintains a high quality of goods (42%), provides chemical-free storage (38%), and is durable and long-lasting (29%). One farmer explained: "It preserves agricultural products for a long period. I kept my products for more than one year without being spoiled." The youth resellers distribution model has served as a catalyst for market development, facilitating access at the last-mile, and product knowledge transfer.

Conclusion

Why are these innovative business models that remove carbon or reduce emissions while serving low-income market segments so relevant to highlight? The science is clear that to stop climate change from jeopardizing the liveability of our planet, we need to drastically reduce emissions. And agriculture has an important contribution to make. Major changes in agriculture will need to come from producing food more efficiently, changing our diets, and reducing food loss and waste. The examples highlighted for each of these changes show that there are clear and proven business opportunities in these categories; business opportunities that deliver positive impacts for farmers, consumers, businesses, and investors.

Both follow-on investments and replication of these green and inclusive business models in other contexts are needed to achieve impact at scale. The highlighted businesses all have strategies in place to expand regionally in the coming years, but they are still confronted by capital constraints. The success factors and key challenges discussed in rolling out these business models are applicable to other geographies. GHG abatement potential and costs for these innovations might vary across geographies. However, such information contributes to an increased understanding how the agriculture sector can reduce its emissions.

HUSK, 260Brands, and Shayashone are all on track in their pathway to scale. Their unique inclusive models address pressing local development challenges[28], while contributing to bringing agriculture in line with the 1.5°C pathway. This makes them critical actors in the transition towards more sustainable food systems. As such, these businesses present highly attractive investment opportunities for triple bottom line investors for further scaling in the region or elsewhere.

[27] K. Harrison, K. Mountain and A. Srivastava, Innovations Against Poverty Social Impact Measurement Insights of the 1st Investment Round of Phase II. 60 Decibels, 2021.

[28] Land degradation, nutrition crisis, and high post-harvest losses, respectively.

SNV is a global development partner deeply rooted in the African and Asian countries where we operate. With 60 years of experience and a team of approximately 1,600 people, we strengthen capacities and catalyse partnerships that transform agri-food, energy and water systems. Working on the core themes of gender equality and social inclusion, climate adaptation and mitigation, and strong institutions and effective governance, we tailor our approaches to different contexts to achieve large-scale impact and create sustainable and more equitable lives for all.

For Further Details
Ignacio Blanco, Multi Country Programme Manager, iblanco@snv.org
www. innovationsagainstpoverty.org
www.snv.org/project/innovations-against-poverty-iap

SNV Impact that matters