

CLEAN
COOKING
ALLIANCE



2023 STATUS REPORT

Clean Cooking as a Catalyst for Sustainable Food Systems



Mozambique—Women using bioethanol cookstove.
Mauro Vombe / Clean Cooking Alliance

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Cover Image: Kenya—Woman with biodigester.
Sistema.bio

ACCELERATING PROGRESS ON CLEAN COOKING IS KEY TO FOOD SYSTEM TRANSFORMATION.

Clean cooking has largely been overlooked in food policy dialogues and interventions, yet proactively addressing the interconnected challenges of clean cooking access and food security is key to building sustainable and resilient food systems.

Cooking is an essential component of daily life, bringing people together and connecting us to the food that sustains us. It should be impossible to think about food without also thinking about cooking, yet as governments, donors, and organizations struggle to respond to a global food crisis of unprecedented proportions, changing the way food is cooked is rarely acknowledged as the vital solution it is. Worldwide, around 735 million people are facing hunger¹ and a staggering 2.3 billion people, roughly one-third of the global population, lack access to clean energy for cooking, relying instead on polluting fuels and stoves to prepare their meals.²

The confluence of these crises is exacerbated by the compounding impacts of climate change, the COVID-19 pandemic, and global conflicts, which have doubled the number of people facing acute food insecurity in the past three years³ and led nearly 100 million people to revert to traditional uses of biomass for cooking.⁴ The outlook is concerning: Without substantial reforms in our global food system, up to 80 million more individuals could experience hunger by 2050,⁵ and without a dramatic increase in investment and action, 1.9 billion people will still lack access to clean cooking in 2030.⁶

These statistics underscore the urgent need for a collective response to address the twin challenges of food system transformation and clean cooking transition. Access to nutritious food and the means to prepare it with clean, affordable, reliable, sustainable, and modern energy is not just a matter of convenience; it is a fundamental human right and a prerequisite for resilient food systems.



Woman with biogas stove.
HomeBiogas

Accelerating access to clean cooking solutions, such as biogas, ethanol, liquefied petroleum gas (LPG), electricity, and high-efficiency biomass stoves safeguards climate and nature, improves nutrition, and supports the health and livelihoods of the millions of smallholder farmers who produce one-third of the world's food. By decreasing the demand for charcoal and fuelwood, clean cooking technologies reduce climate-harming emissions and forest degradation, protecting ecosystems crucial for sustainable

food production. Clean cooking solutions can support land restoration and climate-smart agriculture activities, building resilience for farmers and households. Shifting to cleaner cookstoves and fuels can also save time and money, especially for women, enabling access to a greater diversity of foods and enhancing their livelihoods and food security.

While the health and climate benefits of clean cooking are well documented, less attention has been given to the benefits

to the food system, particularly concerning food security and nutrition. This report seeks to strengthen the linkages, providing an evidence-based foundation for the value of clean cooking in food system transformation. It highlights the impacts and benefits of clean cooking on climate, nature, and communities within the food system and illustrates where clean cooking interventions are improving agriculture, livelihoods, and nutrition.

The report also serves as a call to action for food system stakeholders, to acknowledge and mainstream clean cooking into global and national food system agendas. It offers a set of strategic recommendations for governments, donors, investors, and the private sector to accelerate clean cooking a catalyst for sustainable and resilient food systems.

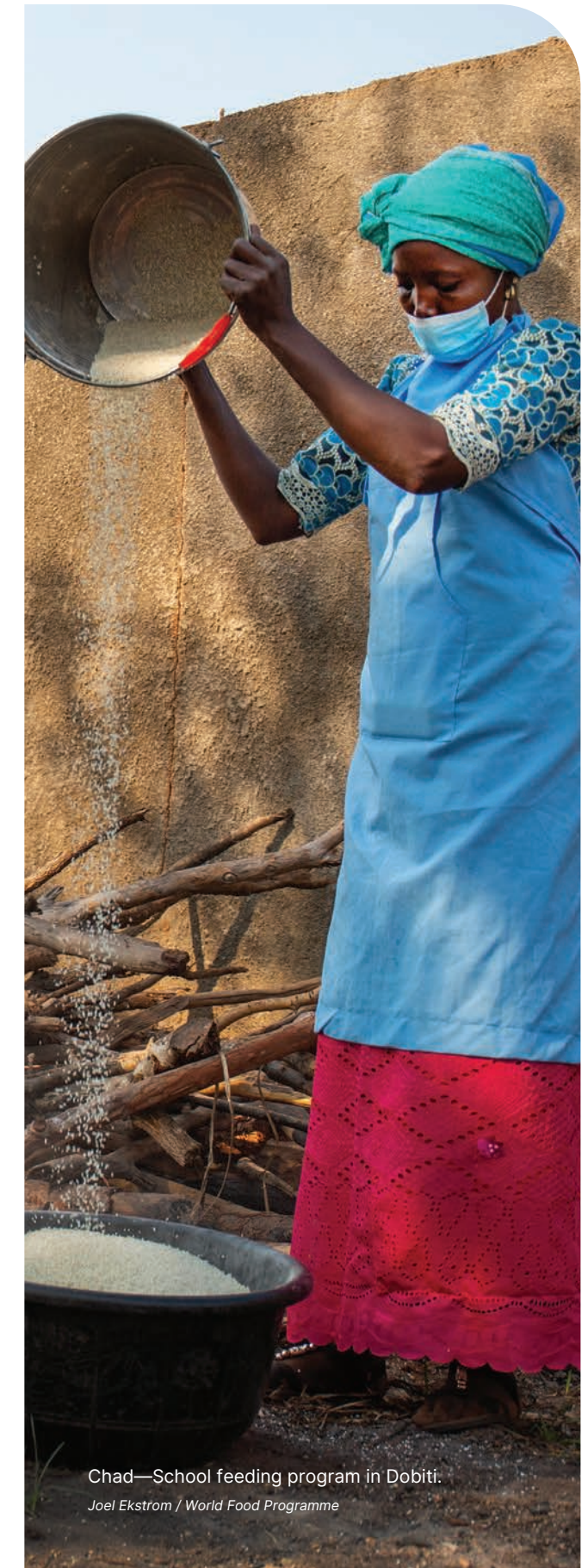
- **Governments** in low- and middle-income countries should prioritize a nationwide transition to clean cooking as a key policy measure to enhance climate resilience and food security. This involves integrating clean cooking into national food system transformation pathways and nutrition strategies, accounting for domestic cooking emissions and forest degradation in greenhouse gas calculations, establishing a Clean Cooking Delivery Unit. Developed countries should acknowledge and endorse the interconnectedness of clean cooking and food security, providing financial support to de-risk and promote integrated initiatives, including large-scale clean cooking programs in key agricultural regions, innovative finance mechanisms, and a focus on supporting women farmers and incorporating clean cooking into school feeding programs.
- **Multilaterals and concessional capital providers** should recognize the role of clean cooking in sustainable food systems, actively engaging in cross-sector efforts by enhancing coordination between SDG 2 and SDG 7 agendas through platforms like UNFSSS, COP, and other major forums. To further support clean cooking

initiatives, these entities should expand financial instruments, pairing investments with technical assistance funds to promote the use of advanced digital monitoring solutions, ensuring gender-disaggregated data collection to inform innovative policies addressing both clean cooking and food security.

- **Donors and investors** should explore new opportunities in the intersection of clean cooking, food security, climate, and nature, collaborating with investees and clean cooking projects to attract innovative finance. This involves promoting results-based finance that recognizes the co-benefits of clean cooking, evaluating its cost-effectiveness as a risk mitigation tool in food system investments, and working with stakeholders to establish clear metrics for documenting the benefits of clean cooking to the broader food system.
- **Agri-food corporations** should incorporate clean cooking into their broader strategies for smallholder farmers, nature-based investments, and distribution channels. This involves implementing screening processes in sustainable agriculture supply chain programs to identify and address unsustainable fuelwood collection, promoting investments in clean cooking to protect nature-based carbon removals and climate-smart agriculture, considering high-quality clean cooking carbon projects for net-zero emissions strategies, and exploring the use of distribution channels to improve the accessibility of clean cooking solutions in their markets.

- **Clean cooking companies** should collaborate with agri-food and nutritional organizations to enhance the impact of clean cooking value chains on environmental, health, and livelihood outcomes crucial for food security. This involves integrating clean cooking into agricultural capacity building strategies for rural farmers, implementing multimodal interventions with nutrition organizations, and educating customers on the immediate benefits of clean cooking for food security.

The urgency for action, financing, and collaboration cannot be understated. Current food systems were set up to feed a global population of 3 billion people, yet as we grow toward 10 billion people by 2050, these systems struggle to keep up, despite innovations and increases in productivity. Transforming food systems must begin with mitigating climate change, protecting nature, and empowering smallholder farmers, especially women, and this requires a rapid transition to universal clean cooking access.



Chad—School feeding program in Dobi.
Joel Ekstrom / World Food Programme

Foreword



**DYMPHNA
VAN DER LANS**
CEO, Clean Cooking Alliance

Access to an adequate and nutritious food supply is a fundamental human right, and the means to prepare that food with clean, affordable energy is equally indispensable.

In recent years, we have borne witness to a series of seismic shocks, from the far-reaching implications of the COVID-19 pandemic to the challenges posed by rising inflation, regional conflicts, and the inexorable force of climate change. These shocks have placed immense strain on our global food and energy systems and the lives of millions of smallholder farmers and vulnerable communities, disrupting the path toward our shared climate and development objectives.

Clean cooking is more than just a means to prepare meals; it is a catalyst for change. Reliance on polluting and inefficient cooking stoves has detrimental impacts on climate, nature, and livelihoods, especially for the 600 million smallholder farmers around the world who are growing 30% of the world's food supply. Moreover, the lack of affordable, clean energy for cooking directly influences the nutritional well-being of households.

The consequences of inaction loom large; by 2030, 1.9 billion people could still be without access to clean cooking, while nearly 600 million individuals will continue to grapple with chronic undernourishment. Fortunately, we have the knowledge and technologies to provide affordable clean cooking to every person in the world—but only if governments, investors, and the private sector make it a priority. Clean cooking is a powerful cross-cutting solution with benefits for the food system through positive outcomes for climate, nature, women, health, and livelihoods.

Integrating clean cooking into food policy and programs and increasing finance and collaboration across the food and energy access sectors will have multiplying effects for all other Sustainable Development Goals. As leaders gather for 28th Conference of the Parties (COP 28), this report serves as a call to action and collaboration for key stakeholders in the food system arena. It beckons them to recognize and integrate clean cooking into holistic food systems' agendas and interventions, thereby fortifying the foundation of a sustainable food system transformation.



GERNOT LAGANDA
Director, Climate and Disaster Risk Reduction,
United Nations World Food Programme

Energy solutions for clean cooking hold significance beyond mere food consumption—they can be a real lifeline for the world's most vulnerable people. For the World Food Programme (WFP), clean and diversified energy sources do not only complement food assistance but also strengthen resilience and empower communities to tackle both energy poverty as well as food insecurity. When families have access to affordable energy and efficient cooking solutions, they can allocate more resources to nutritious food, education, and income-generating activities. This is why, as advocates for and enablers of zero hunger, we also champion access to energy for clean cooking—especially amidst the increasing adversities and shocks communities are facing on the frontlines of the global climate crisis.

Millions of children worldwide—particularly girls—cannot go to school because their families rely on them in the field or to perform domestic duties such as wood fuel collection. This robs them of time that could be spent on education and personal growth. For more than six decades, WFP has supported school meals initiatives, collaborating with governments in more than 100 countries to set up sustainable, national, school meal programs. Globally, 418 million children are receiving school meals, many of which are prepared with wood fuel over inefficient open fires. This contributes to forest degradation, indoor air pollution, and carbon emissions. In a time of unprecedented technological advances, it is time for these practices to change. Virtually every child on Earth is already affected by climate change, environmental degradation, and biodiversity loss. The best investments we can make now are to ensure that the services children need to survive, grow, and thrive are resilient to climate and environmental shocks and do not undermine the environment in which children live. The School Meals Coalition advocates for every meal prepared in schools to be planet friendly. Clean cooking is an absolutely essential building block for realizing this vision.

This report highlights the important role of cooking energy in achieving zero hunger, improving nutrition, and building resilience. Jointly addressing Sustainable Development Goals 2 and 7 through innovative solutions such as clean cooking is crucial to securing a sustainable, healthy, food system that uplifts communities, protects the environment, and achieves food security. WFP is looking forward to continuing this journey with the Clean Cooking Alliance.



ALEX EATON
CEO & Co-Founder,
Sistema.bio

Poverty, food security, and climate change are deeply intertwined, affecting the lives of millions of smallholder farmers worldwide. Empowering farmers is at the heart of what we do at Sistema.bio.

In communities across the world, smallholder farmers produce tonnes of agricultural and livestock waste every day. This emits harmful greenhouse gas emissions, contributing to climate change. By converting organic waste, such as crop residues and animal manure, into valuable biogas and nutrient-rich biofertilizers, biodigesters offer farmers a sustainable source of clean energy, a reduced reliance on chemical fertilizers, and a sustainable solution for enhancing soil fertility. This not only improves crop yields but also reduces the drudgery of manual labor and saves money, empowering farmers to escape the cycle of poverty. The potential of biogas from farm waste is over 100 million farms (500 million people), in the Africa, Asia and LATAM.

Clean cooking solutions such as biogas play a crucial role in cultivating a sustainable food system and circular economy. In fact, biogas reduces greenhouse gas emissions while providing a reliable energy supply for farmers, households, and even schools. In Kenya, Sistema.bio digesters provide cooking gas for a school feeding program for over 1,400 students; saving the school money on fuel and allowing them to spend more money on providing nutritious food for students.

The organic fertilizer produced as a by-product not only saves farmers time and money but supports a regenerative farming system that focuses on the long-term health of the soil. A shift of 10-20% of agricultural production towards regenerative practices could effectively reverse climate change. Equally significant, this transition would also play a crucial role in ensuring sustainable food production and nutritious crops on the food systems agenda.



**KATHLEEN
ROBERTON**
Interim Executive Director,
Sustainable Harvest International

Clean cooking is a fundamental building block for sustainable and climate-resilient farming practices. As we face the ever-growing challenges of climate change, it's imperative that we equip farmers with the tools and knowledge they need to adapt and thrive. Clean cooking technologies play a pivotal role in achieving this goal.

Approximately 30–40% of deforestation is attributed to the unsustainable practices of small-scale farmers. Every day, subsistence farmers struggle to secure basic sustenance and income to support their families. It's clear that environmental degradation and poverty are inherently linked, which calls for a holistic approach.

Sustainable Harvest International (SHI) supports 3,065 farmers with the tools and knowledge they need to implement alternatives to slash-and-burn agriculture, sustain the land for future generations of farmers, and halt deforestation. Empowering farmers to implement regenerative agricultural practices is at the heart of what we do. Farmers in SHI programs have planted over 4 million trees as part of an ecology-based approach to farming, and they've adopted green technologies that help them preserve those trees and the nearby forests.

Implementing sustainable strategies such as agroecology, agroforestry, reforestation, and clean cooking solutions that improve well-being and protect local ecosystems is critical to improving rural livelihoods and reducing the drivers of deforestation. Clean cooking also directly benefits the health and well-being of 33 farming communities in Central America. Replacing inefficient and health hazardous cookstoves with cleaner, more modern stoves and fuels lessens the burden of respiratory diseases associated with household air pollution, especially important for women and children.

This report examines the crucial linkages of clean cooking, climate-smart agriculture, livelihoods, and food security. Acknowledging the value of clean cooking to build resilient communities around the world is crucial to creating a just and sustainable world that nourishes communities and the earth.



Kenya—Woman cooking with biomass stove.
Peter Irungu / Clean Cooking Alliance

PART ONE

The Food and Energy Nexus

▶ As governments, donors, and organizations struggle to respond to a global hunger crisis of unprecedented proportions, changing the way people cook is rarely acknowledged as the vital solution it is. Cooking is an integral part of the food system. Beyond its most obvious impact on consumption and nutrition, as a driver of climate change and land degradation, cooking has a significant impact on food production. Efforts to reform food systems must recognize the role clean cooking can play in ensuring resilience and sustainability.

FOOD SYSTEM TRANSFORMATION CAN BE AN ACCELERATOR OF SUSTAINABLE DEVELOPMENT, BUT EFFORTS MAY BE OVERLOOKING A CRITICAL FACTOR: THE WAY PEOPLE COOK.

Food systems are at the heart of the 2030 Agenda for Sustainable Development, as embodied in the Sustainable Development Goals (SDGs), including eliminating poverty, hunger, and malnutrition, and achieving good health and well-being, while promoting climate and environmental sustainability. With the world not on track to achieve any of the SDGs by 2030, the food system has taken center stage.⁷ The convergence of multiple, interlinked global shocks—the COVID-19 pandemic, rising inflation and economic downturns, climate change and natural disasters, and regional conflicts—is severely straining food systems around the world. Weakened food systems in turn can trigger vicious cycles of aggravated, protracted social, political, economic, and environmental crises. The food crisis is now firmly on international

and national agendas, focusing on radical transformation of the global food system as a critical SDG accelerator.⁸ To achieve this vital transformation, efforts to address the drivers and impacts of the food crisis must be holistic and include transitions to clean cooking to ensure resilience and sustainability.

In the past two years, the impacts of climate change, COVID-19, and regional conflicts have more than doubled the number of people facing acute food insecurity to 345 million in 82 countries.⁹ Recent reports on the world's unfolding food crisis have centered around the war in Ukraine and the blockade of grain exports, but the conflict is only the latest shock for a global food system already in crisis. Food insecurity and hunger have been on the rise since 2014.¹⁰

Even before Russia's invasion of Ukraine, the increasing severity and frequency of regional conflicts, global economic shocks, and climate-related weather extremes were disrupting food production and distribution, driving up prices and affecting the health and livelihoods of billions around the world.

While conflict and economic shocks remain persistent drivers of hunger and food insecurity around the world, climate change is an increasingly interrelated and mutually reinforcing driver of the food system crisis.¹¹

Rising temperatures, altered precipitation patterns, and extreme weather events have wreaked havoc on agriculture. In 2022, weather extremes were the primary driver of acute food insecurity for 56.8 million people, more than double the number (23.5 million) in 2021.¹² Prolonged droughts, devastating floods, and wildfires have decimated crops, reduced yields, and made farming increasingly unpredictable.¹³ Smallholder farmers, often in vulnerable regions, are disproportionately affected, with their livelihoods hanging in the balance. Moreover, climate change has disrupted

ecosystems and threatened biodiversity, which have a vital role in food production and security. The loss of pollinators, such as bees, and the degradation of land and soil quality exacerbate the challenges faced by farmers worldwide.

The global food crisis is a complex and multifaceted challenge, driven by a convergence of factors.¹⁴

Without a coordinated approach to food system reforms, as many as 80 million more people could face hunger by 2050, especially in Africa, South Asia, and Central America.¹⁵ To address this crisis, it is imperative to adopt a holistic approach that encompasses climate resilience, sustainable agriculture, social equity, and robust local food systems. Collaboration among governments, international organizations, and local communities is essential to build a more resilient and equitable food system that can withstand future shocks while ensuring that no one goes hungry in a world of plenty.

But the food system does not exist or operate in isolation,

and the unfolding food crisis highlights the interconnected nature of energy and food security. The concept of the water-energy-food nexus is well documented¹⁶ with significant emphasis on the energy intensity of agri-food systems, which account for 30% of global energy consumption and one-third of global emissions.¹⁷ Direct energy consumption includes energy for irrigation and farm machinery, but 70% of the energy used by agri-food systems occurs after food leaves farms, in transportation, processing, packaging, shipping, storage, and other procedures. Beyond energy consumption and emissions intensity, the connection between food and energy goes far deeper.

Not merely commodities, food and energy are basic human needs and essential to daily life. While 735 million people face hunger around the world, 675 million people lack access to electricity and a staggering 2.3 billion people live without access to clean energy for cooking.¹⁸ Ensuring access to affordable, reliable, sustainable, and modern energy is essential for sustainable development and is a fundamental

PART ONE

enabler of achieving food security and zero hunger. Global campaigns such as Power for All’s “Powering Agriculture” call for an end to energy poverty by promoting the widespread adoption of distributed renewable energy throughout the food system. While food system dialogues have increasingly recognized the link between access to energy and agricultural production and value chains,¹⁹ the impact of energy access, specifically access to clean cooking solutions, on food security at the household level has not been explored in detail and consequently the two sectoral priorities are often disconnected.²⁰

Cooking is an integral part of the food system—most obviously affecting consumption and nutrition—but as a driver of climate change and land degradation, it also has a significant impact on food production. The food system encompasses a range of activities from the production and processing of food to its distribution, preparation, and consumption.²¹ These activities have a substantial adverse impact on the environment as they are responsible for

roughly one-third of global greenhouse gas (GHG) emissions, use 70% of the world’s freshwater, and contribute as much as 80% of biodiversity loss.²² While the environmental footprint of the

food system is most often considered in terms of land use, the harvesting and burning of polluting fuels for cooking also have a significant negative environmental impact that is often overlooked.

SHARE OF THE POPULATION WITHOUT ACCESS TO CLEAN FUELS FOR COOKING, COMPARED TO SEVERE FOOD INSECURITY

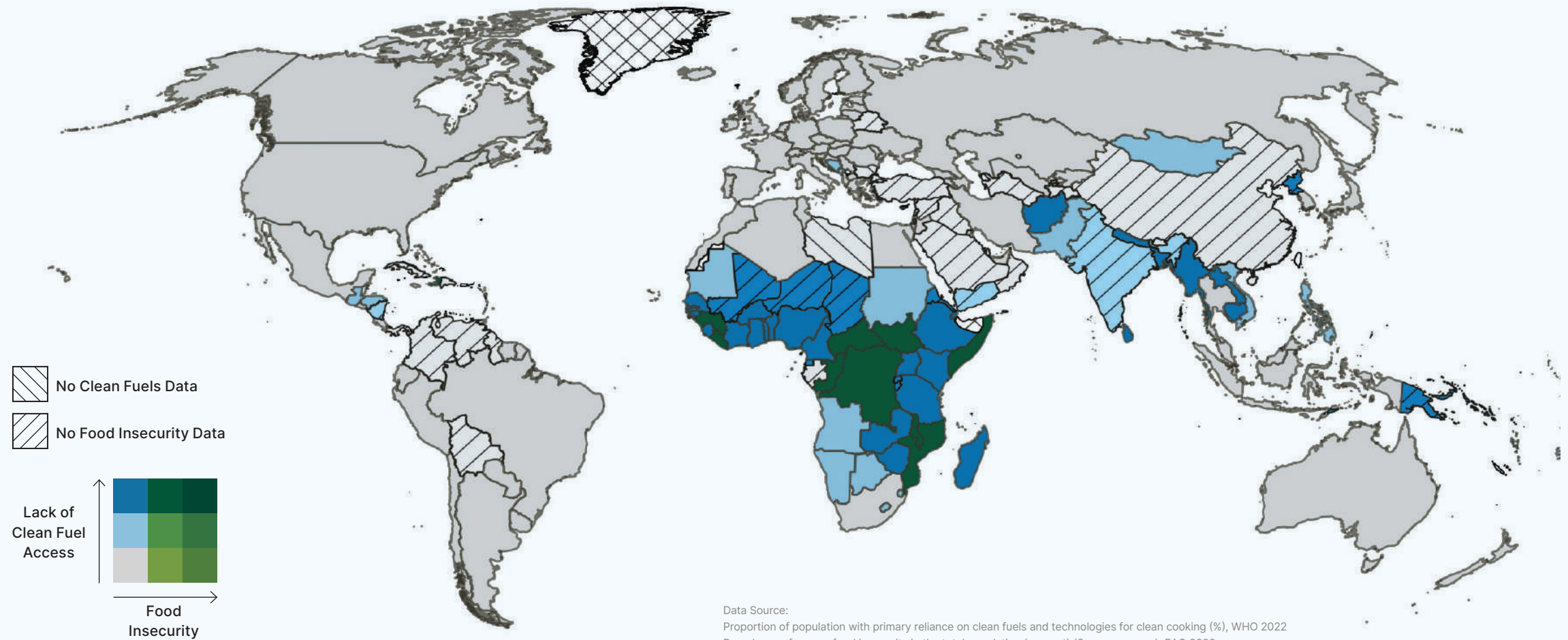


Figure 1: Global Food Insecurity and Cooking Energy Poverty.

Sub-Saharan Africa and South Asia have some of the highest rates of hunger, food insecurity, and malnourishment, while having the lowest rates of access to clean energy.

PART ONE

DRIVERS & OUTCOMES

CLEAN COOKING PLAYS AN IMPORTANT ROLE IN EMISSIONS AVOIDANCE AND REMOVALS FROM LAND RESTORATION, CONSERVATION, AND IMPROVED MANAGEMENT OF NATURAL ECOSYSTEMS; IMPROVES FOOD SECURITY AND NUTRITION; PROMOTES CIRCULAR WASTE-TO-ENERGY SOLUTIONS; AND CONTRIBUTES TO RESILIENT AGRICULTURAL LIVELIHOODS.

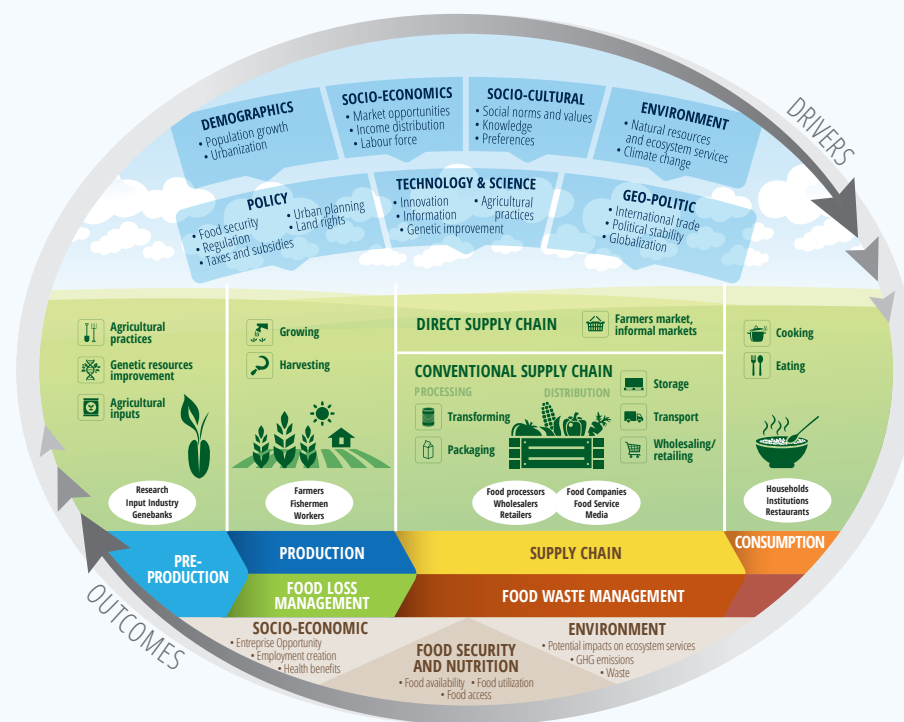


Figure 2: Cooking is an integral part of the food system.
Source: International Center for Tropical Agriculture (2017). The Food System.

Cooking with polluting fuels and stoves costs the world more than US\$ 2.4 trillion in damage²³ to the climate and local economies and contributes to 3.2 million premature deaths each year.²⁴ Up to 34% of woodfuel harvested is unsustainable (where harvest exceeds incremental growth), degrading land and soils, contributing to biodiversity loss, and threatening the livelihoods of nature-dependent and agricultural communities.²⁵ Unsustainable harvesting and incomplete biomass combustion from cooking account for roughly 2% of global carbon dioxide equivalent (CO₂e) emissions, on par with the aviation sector, contributing to the climate

crisis and threatening food production.²⁶ Urgently reducing cooking demand for unsustainable fuelwood and charcoal is a crucial step toward safeguarding nature, ensuring climate adaptation, and building resilience for the 600 million smallholder farmers who produce one-third of the world's food.²⁷ Clean cooking is also an essential pillar of food security, affecting the availability, access, and use of safe and nutritious food.²⁸ Without access to affordable, reliable, clean cooking solutions, food safety can be compromised, food losses due to inefficient cooking practices increase, and overall nutrition outcomes are minimized.

Yet, despite these benefits, clean cooking remains one of the most undervalued and underfunded environmental and health solutions on the planet. Investment in the sector hovers around US\$ 215 million each year—a fraction of the US\$ 8 billion required annually to achieve universal access to clean cooking by 2030.²⁹ This stark underinvestment reflects a critical misalignment in global priorities, as clean cooking is intrinsically linked to broader goals of environmental sustainability, health improvement, gender equality, and food security. Without urgent action, 1.9 billion people will lack access to clean cooking in 2030,³⁰ and nearly 600 million people will be chronically undernourished.³¹ Proactively addressing these interconnected challenges is paramount for achieving a more sustainable and resilient food system, ensuring that individuals have access to clean cooking technologies and nutritious food while simultaneously mitigating the environmental and health impacts associated with traditional cooking practices.

Clean cooking has largely been overlooked in food policy dialogues and interventions. Amid a growing global interest and concern over the impacts of the food system on climate

and development challenges, the way families cook is hardly considered. Global convenings, such as the UN Food Systems Summit, the Conference of Parties (COP 26 and COP 27), and the UN General Assembly have pushed for a transformation of global food production and consumption all within the framework of the 2030 Agenda for Sustainable Development. The 2021 UN Foods System Summit prompted several countries to initiate food security and nutrition strategies for the first time, with more than

1,600 Food Systems Summit Dialogues being held around the world and 126 countries adopting national pathways.³² At the 2023 UN Food Systems Summit +2 Stocktaking Moment, over 100 countries submitted voluntary country progress reports. Two-thirds (67%) of these countries reported integration of the pathway into national strategies or sector plans.³³ While renewable energy and energy efficiency feature in many of these pathways, clean cooking is still largely missing.

NOW IS THE TIME TO LEVERAGE INTENSIFIED INTEREST IN FOOD SYSTEMS TRANSFORMATION TO ALIGN POLICY, PROGRAMS, AND FINANCE FOR NATURE AND FOOD SECURITY WITH A RAPID ACCELERATION IN ACCESS TO CLEAN COOKING TO TRANSFORM LANDSCAPES, ENHANCE AGRICULTURAL LIVELIHOODS, AND IMPROVE NUTRITIONAL OUTCOMES.



PART TWO

Clean Cooking as a Catalyst for Sustainable Food Systems & Resilience

- ▶ Food systems are highly vulnerable to climate shocks and environmental degradation. Accelerating progress on clean cooking can alleviate some of these pressures, increase resilience against shocks, and support the ability of food systems to provide healthy, accessible, and affordable diets for all.

Bangladesh—The UN's World Food Programme and Central Emergency Response Fund are using forecasts to help people prepare for the next climate shock.

Sayed Asif Mahmud / World Food Programme

PART TWO

CLEAN COOKING IS A TRANSFORMATIVE SOLUTION WITH PROFOUND IMPLICATIONS FOR CLIMATE, NATURE, AND COMMUNITIES, AND IT IS A PREREQUISITE FOR RESILIENT FOOD SYSTEMS.

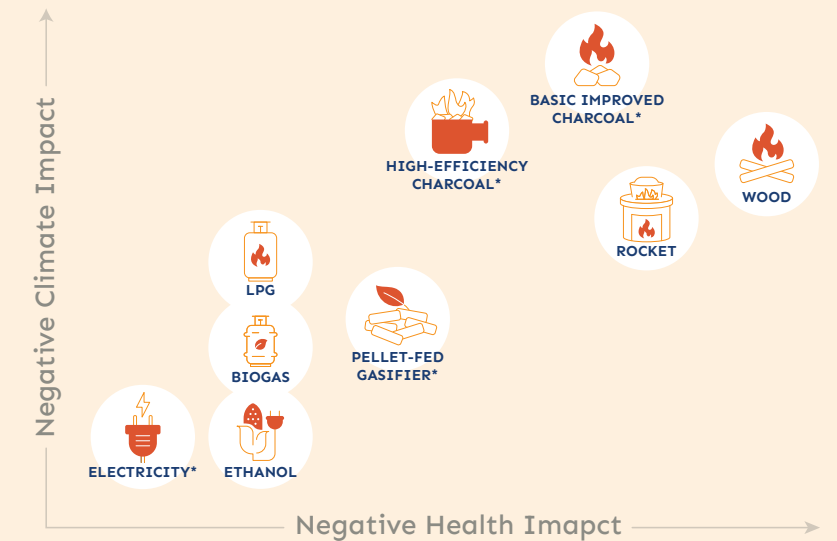
Climate change poses a growing threat to the global food system, with rising temperatures, shifting weather patterns, and environmental degradation making food production increasingly uncertain and challenging. These consequences are not uniform; vulnerable populations in climate-sensitive regions bear the brunt of climate shocks and food insecurity. Reliance on unsustainable, polluting cooking fuels exacerbates these challenges by generating large quantities of climate pollutants, driving forest degradation, and placing a continuous burden on the health and livelihoods of women. Moreover, lack of access to clean cooking solutions negatively affects the quantity, quality, and nutritional content of meals, contributing to increased hunger.

Addressing the interconnected challenges of climate change, food security, and energy access require a holistic and cross-cutting approach that addresses the drivers of degradation and unsustainable biomass use and supports the health and resilience of the world's agricultural producers. Accelerating local clean cooking transitions as part of broader restoration, climate-smart agriculture, and nutritional programs is one of the most immediate and cost-effective ways to support food system transformation.

WHAT IS CLEAN COOKING?

“Clean cooking solutions” refers to a suite of fuel-stove combinations with emissions performance that meets the World Health Organisation’s guidelines for indoor air quality. This category includes high-efficient charcoal and biomass pellet stoves, liquefied petroleum gas (LPG), biogas, ethanol, electric stoves, and pressure cookers. Solutions are context-specific and must meet consumer needs and willingness to pay. As cooking in developing countries evolves along the energy ladder with increased income, it rarely switches completely from one fuel to another. Rather, households experience cookstove and fuel “stacking,” a phenomenon of using multiple stove and fuel cooking combinations within the same household. The dynamics of user adoption and preferences are at the heart of efforts to increase access to modern cooking services and mitigate the impacts of pollution from traditional cooking.

Figure 3: Clean cooking solutions for climate and health impact.



*Climate impact depends on many factors including level of displacement and renewability of fuel.



1. Reducing Climate Change and Forest Degradation

Climate change has a direct and significant impact on food insecurity. As global temperatures rise, food production becomes more difficult and uncertain due to changes in weather patterns, extreme weather events, and other environmental disruptions.³⁴ According to the Intergovernmental Panel on Climate Change, food security will be increasingly affected by projected future climate change,

with impacts varying regionally.³⁵ Vulnerable populations, which often live in regions susceptible to climate change impacts, are disproportionately affected by extreme weather events, food insecurity, and displacement. Food systems must consider climate change at the local level, addressing the contributing drivers and prioritizing immediate mitigation and adaptation solutions, including clean cooking.

Clean cooking is vital to combating global climate change and reducing environmental degradation. The use of polluting cooking fuels emits harmful climate-warming emissions such as black carbon (BC) and GHGs, including carbon dioxide (CO₂) and methane (CH₄). Research has shown that incomplete biomass combustion, along with unsustainable biomass harvesting, contributes approximately 1.9%–2.3% of global emissions of CO₂e.³⁶ Burning solid fuels for cooking in homes is responsible for more than 50% of human-generated emissions of BC,

whose climate warming impact is 460 to 1,500 times the impact of CO₂.³⁷ In South Asia, cookstove emissions are the largest source of BC.³⁸ Climate modeling studies have suggested that, in India, anthropogenic emissions of aerosols such as BC are affecting monsoons and rainfall distribution, leading to an increase in severe droughts.³⁹ BC deposition on plants reduces the ability to absorb light, directly inhibiting photosynthesis and limiting the plant’s ability to produce food. This can lead to a reduction in crop yields and agricultural productivity. Elevated levels

of CO₂ in the atmosphere can also diminish the nutritional value of foods by decreasing their quantities of zinc and iron.⁴⁰

Fuelwood used for household cooking and heating makes up roughly 55% of harvested wood globally.⁴¹ This has serious negative climate impacts, as roughly 30% of global greenhouse gas emissions from forest degradation are derived from fuelwood harvesting. In 12 countries—Belize, Burundi, Eritrea, Ethiopia, Guinea-Bissau, Haiti, Kenya, Lesotho, Liberia, Nepal, Rwanda, and Uganda—fuelwood emissions account for more than 50% of national emissions.⁴² Unsustainable biomass harvesting for cooking leads to habitat loss and reduced biodiversity, exacerbates soil erosion, and disrupts local water cycles. In Africa, fuelwood collection and charcoal production are the primary drivers of forest degradation, and the use of fuelwood for cooking accounts for 75% of sub-Saharan Africa’s energy demand.²¹ In the Democratic Republic of Congo (DRC), where 90% of the population relies on charcoal for cooking, over a million acres of primary forest were reportedly lost in 2020, mainly due to the expansion of agriculture and demand for wood and charcoal.⁴³



Sudan—German Embassy mission to Geneina.
Leni Kinzli / World Food Programme

Table 1: Comparison of climate and food systems policies in countries with a high prevalence of polluting cooking fuel use.

*2020 data⁵²

COUNTRY	Range of woodfuel contributions to total emissions ⁴⁶ % (2009)	Mitigation potential (reduced wood fuel harvest) ⁴⁷ Million tCO ₂ e per year	Share of population with lack of access to clean cooking ⁴⁸ % (2009)	Inclusion of clean cooking in NDCs ⁴⁹ Yes/No	Prevalence of severe food insecurity ⁵⁰ % (3-year average 2019–21)	Food system policies in place ⁵¹ Yes/No
ANGOLA	5% – 16%	3.8	50.4	Yes	31.2	No
BANGLADESH	9% – 10%	4.49*	77	Yes	11	Yes
BURKINA FASO	23% – 38%	3.2	89.9	Yes	21.2	No
CENTRAL AFRICAN REPUBLIC	0.1% – 0.3%	3.5	99.5	Yes	61.8	No
DOMINICAN REPUBLIC	5% – 9%	0.9*	95.5	Yes	22	No
DRC	2% – 4%	NA	95.5	Yes	40.7	No
ETHIOPIA	64% – 79%	31.4	93.4	Yes	21.1	Yes
GUATEMALA	8% – 21%	2.91*	51.2	Yes	21.1	No
HAITI	70% – 77%	1.19*	95.7	Yes	42.9	No
KENYA	47% – 56%	8.6	83	Yes	28	Yes
LESOTHO	65% – 79%	0.34*	60.6	Yes	32.8	Yes
MALAWI	17% – 48%	41.8	98.1	Yes	52.2	No
MAURITANIA	3% – 8%	1.2	56.6	Yes	9.5	No
MOZAMBIQUE	21% – 44%	26.5	95.1	Yes	39.6	No
NAMIBIA	2% – 3%	0.02	53.7	No	33	No
NEPAL	48% – 55%	5.23*	69	Yes	13.2	Yes
NIGER	14% – 29%	3.3	97.6	Yes	30.5	Yes
PAKISTAN	16% – 17%	10.37*	50.9	Yes	12.9	No
SENEGAL	8% – 21%	25.8	75.5	Yes	11.1	No
SOMALIA	21% – 40%	1.88*	97	Yes	43.4	Yes
UGANDA	50% – 66%	42.1	99.5	Yes	24.9	No
ZAMBIA	6% – 14%	33.4	84.3	No	32.1	No
ZIMBABWE	16% – 43%	0.5	70	Yes	28.6	No

Some 275 million people live in these “hot spots” of unsustainable woodfuel depletion, mainly in the tropical forest areas of South Asia and East Africa.⁴⁴ These hot spots mirror where people are most heavily dependent on nature for their basic needs—energy, food, water, housing materials, and livelihoods—and where agricultural production is essential. Sub-Saharan Africa is home to the largest proportion—78 million—of highly nature-dependent people for all their basic needs. Populations are concentrated in the Congo Basin and East Africa and have a particularly strong reliance on wood and charcoal as fuel for cooking. More than a quarter of the population of the Asia-Pacific region—278 million people—are highly nature-dependent.⁴⁵ As populations continue to grow in these areas with a high dependence on nature and unsustainable fuelwood harvesting, it will be increasingly critical to ensure that communities are at the center of conservation, restoration, and climate-smart agriculture activities and rapidly scaling access to clean cooking solutions to reduce reliance on unsustainable biomass fuels.

A sustainable food system requires healthy soil and sustainable agricultural practices before the planting of crops to set the stage for a nutritious harvest. Soil health is paramount for the long-term sustainability of the food system as fertile soils are more resistant to pests, diseases, and extreme weather events, and they provide essential nutrients that enhance plant growth, resulting in higher agricultural yields. However, today, 52% of all land used for food production is moderately or severely affected by the erosion of healthy soil.⁵³ Repeated or intensive wood harvesting can lead to soil degradation, reduce soil fertility, and contribute to erosion and other forms of land degradation.⁵⁴ Forest degradation can increase water temperature by up to 4°C, and it lowers oxygen levels in streams. This in turn depletes aquatic fauna, reduces water quality for local wildlife and communities, increases sediment by up to 550 times, and enhances the risks of landslides and flooding.⁵⁵ At current rates of soil destruction due to decarbonization, erosion, desertification, and chemical pollution, there will no longer be enough arable topsoil to feed the global population within 50 years.⁵⁶ It will be impossible

to feed the world, keep global warming below 1.5°C degrees Celsius, or halt the loss of biodiversity without protecting and regenerating the soil across billions of acres of cultivated farmland, pasture, and forests.

Clean cooking technologies, such as efficient stoves and modern fuels like biogas, ethanol, and LPG, reduce the demand for firewood and charcoal, alleviating pressure on forests and ecosystems and reducing climate-harming emissions.

Clean cooking interventions can reduce fuelwood use, halting degradation and even allowing forests to recover. Today’s highly efficient stoves can reduce fuel use by 30%–60%, resulting in fewer GHG and black carbon emissions.⁵⁷ In the Central Highlands of India, households situated within the forest fringe that adopted non-fuelwood, alternative energy sources for cooking were linked to reduced forest degradation.⁵⁸ In degraded forests in Karnataka, India, biogas interventions were shown to be associated with higher forest biomass and showed a long-term potential for regeneration.⁵⁹ In West Africa, the Global Bioenergy Partnership (GBEP),

which is led by the Food and Agriculture Organization of the United Nations (FAO) found that planting wood lots on degraded land can provide sustainable wood energy while restoring natural forests and agroforest areas.⁶⁰ Using degraded land for bioenergy production represents an innovative solution due to the inherent unsuitability of such land for food crops.⁶¹

New research demonstrates that a concerted transition from

burning wood, charcoal, and crop residues to cooking with LPG, electricity, or a combination of both would result in significant climate benefits.⁶² Cumulative emissions of CO₂e would decrease by about 3 billion tons—equivalent to the annual emissions from about half a billion cars (one-third of the automobile fleet on the planet today). This transition to clean cooking fuels would also dramatically reduce short-lived climate forcers, specifically black carbon but also organic carbon,

volatile organics, and carbon monoxide, which would induce a rapid cooling effect because they impose an immediate climate response. Although many developing countries are transitioning toward modern, cleaner types of energy such as ethanol, LPG, and electricity, global demand for firewood and charcoal continues to increase due to rapid population growth as well as the lack of alternative, readily available, and affordable energy sources.⁶³



Kenya—Aerial view of biodigester.
Sistema.bio

WITH CLIMATE CHANGE, ENVIRONMENTAL DEGRADATION, AND BIODIVERSITY LOSS OCCURRING FASTER THAN AT ANY TIME IN HUMAN HISTORY AND THREATENING GLOBAL FOOD PRODUCTION, THE URGENCY TO ACCELERATE THE TRANSITION TO CLEAN COOKING PRACTICES CANNOT BE OVERSTATED.



2. Supporting Restoration and Climate-Smart Agriculture

Humans have transformed more than 70% of the Earth's land area from its natural state, causing unparalleled environmental degradation and contributing significantly to global warming.⁶⁴

More than half (52%) of total agricultural land is currently degraded, and if current land degradation trends continue during this century, scientists are predicting more severe climate-related shocks, resulting in food supply disruptions. Land restoration⁶⁵ is a proven and cost-effective solution to reduce emissions, sequester carbon, and enhance human and environmental resilience to cope with the impacts of climate change.

The international community has pledged to restore 1 billion hectares of degraded land by 2030.⁶⁶ Almost half of the area to be restored is in sub-Saharan Africa, with significant commitments also in Asia and Latin America. Restoring forests and farmland accounts for three-quarters of the area pledged. These restoration activities must

be integrated with complementary measures in order to meet energy needs while drastically reducing greenhouse gas emissions; address food insecurity while shifting to more sustainable production and consumption; and accelerate a transition to a regenerative, circular economy that reduces waste and pollution.

Clean cooking can play a pivotal role in supporting land restoration and climate-smart agriculture.⁶⁷ By reducing environmental degradation through efficiently using biomass resources or alternative fuels, producing biogas slurry or biochar to enhance agricultural productivity, and supporting sustainable livelihoods, clean cooking aligns with the principles of sustainable agricultural systems, which aim to improve soil health, crop productivity, ecosystem vitality, and resilient communities. Land restoration and climate-smart agriculture efforts will need to consider clean cooking value chain approaches to address drivers of both degradation and deforestation.

In woodfuel hot spots, the success of reforestation and restoration will depend on how centrally access to clean cooking access is considered.

For example, the DRC holds the second-largest stretch of tropical forest cover globally—130 million hectares—and is third in line globally for levels of forest loss. This is due in large part to slash-and-burn agriculture and cooking demand for charcoal. In recognition of this linkage, the Central African Forest Initiative is directly requesting projects on clean cooking to apply for funding through the DRC's National REDD+ Fund—funded by the UK Government—that would direct US\$ 500 million to halt deforestation and restore degraded lands.⁶⁸ Regreening Africa, which aims to reverse land degradation on 1 million hectares across eight countries in sub-Saharan Africa, has also recognized this critical intersection and is including clean cooking projects in Ghana to both curb rapid forest degradation and reduce the

time spent on cooking as a labor-saving mechanism for women and girls, who are an integral part of the agriculture workforce in rural communities.^{69,70}

Integrated restoration and clean cooking projects that are delivering results for climate and communities need to be replicated and scaled.

Since 2013, the Hifadhi-Livelihoods project in Embu County, Kenya, has distributed 120,000 locally manufactured cookstoves alongside more than 250,000 tree seedlings.⁷¹ This is helping Kenya's fragile forestry to recover, educating local people on the importance of their forests, and even providing families with incomes and a sustainable source of wood. Sustainable Harvest International has worked with farmers in Central America to halt deforestation and restore land, coupling agroforestry technology and capacity building with improved cookstoves, which reduce household fuelwood demand by 50%.⁷²

Combining climate-smart agriculture practices, such as agroforestry or biochar, with clean cooking interventions enhances both food security and energy access.

Agroforestry—planting trees alongside crops—creates microclimates that shade crops

from intense sun and rain, protect against erosion and floods, improve soil fertility, and provide sustainable woodfuel for cooking.⁷³ Woodfuel production in agroforestry systems can be a more sustainable alternative to collection from natural forest and woodlands, providing multiple benefits for smallholder farmers while limiting land degradation, raising incomes, and improving health and nutrition.⁷⁴ Sourcing firewood from tree pruning on farms can promote income generation by selling surplus firewood and eases the burden on women gathering fuelwood.⁷⁵ Households with increased income from tree products sometimes spend the additional income to diversify their diets and buy healthy foods.⁷⁶ In Uganda, where the impacts of climate changes are already affecting productivity in the agriculture sector, Mercy Corps is implementing the Restoring Ecological Vitality In Vulnerable Ecosystems (REVIVE) program to regenerate and improve ecosystem services and provide clean cooking stoves and fuels at landscape level to improve the resilience and climate adaptive capacity of smallholder farmers, refugee communities, and women. Through an incentive-based model, Mercy Corps aims to increase forest cover over 10,000 hectares of degraded

landscape and work with smallholder farmers to implement agroforestry and woodlots over 2,000 hectares.⁷⁷

Scaling the use of biogas cooking can also play an important role in restoring soil health and improving agricultural yields.⁷⁸

Biodigesters harness organic waste to generate clean energy and organic fertilizer, recycling organic matter and nutrients back into the farming ecosystem and supporting smallholder farmers. Sistema.bio manufactures and distributes biodigesters across Latin America, Asia, and Africa, installing over 80,000 biodigesters that have reached over 450,00 people to date, mitigating an estimated 715,000 tons of CO₂e.⁷⁹ The company provides training and financing to farmers to increase their productivity, produce clean energy, and promote climate-smart agricultural practices that focus on rebuilding degraded soils to improve biodiversity. For smallholder farmers, biodigesters provide significant economic savings by producing digestate, a nutrient-rich bioslurry that can be used as an organic fertilizer, allowing the farmers to avoid high chemical fertilizer and fuel costs. In 2023, a United Nations Development Programme (UNDP) project introduced HomeBiogas technology to



Bangladesh—Woman with biodigester. KM Asad / Clean Cooking Alliance

500 rural farmers in Rwanda. Over the next 10 years of the project, the HomeBiogas systems, which convert animal manure into cooking gas and biofertilizer, project to save 14,652,000 kilograms of firewood, produce 194,000 cubic meters of digestate, and save 1.71 million work hours for women.⁸⁰

Biochar-producing cookstoves and use of biochar as a soil amendment can enhance soils, sequester carbon, and improve conditions for smallholder farmers.

A study of 150 rural farmers in Kenya found that biochar produced in gasifier cookstoves from local biomass considerably increased yields in maize cultivation.⁸¹ Further, the climate impacts in a life-cycle perspective were considerably

lower for the system with cookstove production of biochar and use of biochar in agriculture than for current cooking practices. This biochar system achieved net negative greenhouse gas emissions in a 100-year perspective at the current rate of deforestation in Kenya. In Cambodia, Khmer Green Charcoal, a subsidiary of Otago, produces and sells eco-friendly charcoal briquettes and sustainable charcoal made from coconut shells and other biomass wastes from existing agriculture and industrial waste streams. The company estimates that it has so far avoided 42,000 tonnes of CO₂e and saved about 1,000 hectares of forest area from deforestation caused by charcoal production.⁸² Given supply chain constraints

for its charcoal briquettes, Otago established KjuonGo, a sustainable charcoal product produced from tree plantation residues and managed community forests. The company worked with the Cambodian forestry administration to establish offtake agreements with 11 community forests to improve the sustainable management of 4,000 hectares of managed forests. The program involves replanting 1,000 hectares, reintegrating biochar into the soil of the community forests, and introducing agroforestry practices to diversify production and incomes. The forestry administration has further committed to scale the approach to an additional 80,000 hectares, working with Otago as the private sector partner and offtaker of biomass residues.⁸³



Panama—Farmer cultivates yams.
Sustainable Harvest International

Table 2: Integrated cooking and climate-smart agriculture in woodfuel hot spots.

	AFRICA	ASIA	LATIN AMERICA
Unsustainable woodfuel harvesting in hot spots ⁸⁴	<p>East Africa is the largest hot spot for unsustainable woodfuel depletion, with a stretch of heavily affected landscape from Eritrea through to western Ethiopia, Kenya, Uganda, Rwanda, and Burundi. In these regions, almost 50% of woodfuel harvesting is unsustainable, across an area inhabited by 26% of the region’s population. Other hot spots in the region are less contiguous but found in western and southern Africa (including Angola, Cameroon, Central African Republic, the DRC, Mali, Mozambique, Nigeria, South Africa, Tanzania, Zambia, and Zimbabwe).</p>	<p>In Asia, hot spots occur in parts of Bangladesh, Bhutan, Indonesia, Nepal, and Pakistan. Pakistan has the highest share of non-renewable biomass—79%—and in two subnational districts the share of non-renewable biomass harvesting exceeds 90%. Meanwhile, although China and India are the largest woodfuel-consuming nations, both experienced net afforestation in recent years. At a national level, the share of non-renewable biomass is 10%–22% in China and 23%–24% in India.</p>	<p>Latin America hosts the lowest traditional woodfuel consumption, with Haiti as the only country in the region where over 50% of woodfuel is collected from non-renewable biomass. Other pressure points in the region (where the share of non-renewable biomass exceeds 30% in many subnational units) include Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Mexico, Paraguay, Peru, and Venezuela.</p>
Clean cooking and climate-smart agriculture in action	<p>Urbanization rates in Africa are increasing the demand for charcoal. The production of charcoal in rural areas to fill the energy requirements of growing urban populations is as a primary driver of forest degradation drylands, leading to biodiversity loss.⁸⁵ Reducing the demand for charcoal is therefore key to addressing forest loss. In Kampala, Uganda, FabStove is promoting a sustainable alternative to charcoal by manufacturing innovative gasifying pellet cookstoves. Using pellets derived from agricultural waste, the stove reduces emissions by over 80%. FabStove also generates biochar, which can be added to soil to enrich plant growth. Biochar is a promising tool for carbon sequestration and regenerative agriculture as it promotes soil quality, which is critical for a healthy ecosystem.</p>	<p>In Bihar, India, the practice of drying animal dung for fuel is widespread, but it poses significant health and environmental risks. Roughly 4 million people in Bihar, constituting over 20% of households, depend on dung cakes as a primary fuel source for their stoves, resulting in significant health impacts.⁸⁶ Heifer India is helping farmers transition to biogas, a cleaner energy source. Biogas units, installed in partnership with Sistema.bio, process organic waste, including animal dung, to produce clean biogas for cooking. In India, Sistema.bio launched the world’s largest manufacturing facility for biogas plants. The facility can manufacture 100,000 biodigesters every year, impacting the livelihoods of 600,000 farmers.</p>	<p>Sustainable Harvest International (SHI) provides training to smallholder farmers in Central America to promote regenerative practices. By increasing and diversifying farmer income year-round through diverse and integrated agroforestry systems that add value to crops, SHI’s programs have a positively impact on nutrition, income diversification, regional food security, landscape restoration, and carbon drawdown. SHI helps farmers produce value-added products from agroforestry systems, which can provide additional income streams and nutritional products such as tortillas, baked goods, canned fruits and vegetables. SHI has been promoting the use of clean cooking technology in Central America for 25 years. To date, SHI has constructed 2,600 wood-conserving stoves that reduce families’ firewood consumption by 50%.</p>

CLEAN COOKING AS A DRIVER OF SUSTAINABLE BIOECONOMIES

Clean cooking is a powerful catalyst for fostering sustainable bioeconomies, which use renewable biological resources sustainably to produce food, energy, and industrial goods in a variety of contexts. By harnessing the potential of biogas, the production of briquettes and pellets, and the application of biochar, communities are not only addressing energy access challenges but also contributing to economic growth, environmental conservation, and improved food security.

In Kenya, clean cooking initiatives have gained momentum, particularly in rural communities where traditional cooking methods and reliance on biomass were prevalent. Biogas systems, which transform organic waste, including livestock dung and crop residues, into a sustainable energy source, have been widely adopted. The [Kenya Biogas Program](#), supported by SNV Netherlands Development Organization and other organizations, has installed thousands of biogas digesters in rural households.⁸⁷ Biogas surplus in Kenya is also harnessed for productive use, such as running small-scale agro-processing businesses like milk pasteurization and crop drying units. In Kenya, between 2020 and 2022, [Sistema.bio](#) installed 3,000 biodigesters at smallholder farms with a focus on women sales agents and beneficiaries.⁸⁸ The systems created more than 120 jobs, 51% for women. The systems generate



5271 MWh of clean energy per year, save EUR 805,752 annually in energy-related expenditure, and reduce 210,774 tonnes of CO₂e emissions by replacing wood, charcoal, and other non-renewable energy sources. With a 10-year warranty for each biodigester, the long-term impact of the project is significant.

In Uganda, [Green Heat International](#) provides energy, waste, and fertilizer solutions for homes, schools, farms, and commercial buildings through biodigesters and briquettes. Working with over 120 farmers, Green Heat uses agricultural waste to create briquettes as an alternative to wood and charcoal, employing women sales partners.⁸⁹

[Biomasters](#) makes pellet fuel in Rwanda out of biomass waste materials and supplies Tier 4 gasification pellet stoves to customers on a lease-to-own basis. [FAO's](#) evaluation of bioenergy potential in Rwanda from crops, livestock, and woody residues revealed a substantial opportunity, producing enough energy to provide clean cooking to 400,000 households across Rwanda.⁹⁰

In Ghana, the [Consortium of International Agricultural Research Centers](#) explored the potential of various waste materials to create high-quality fuel briquettes.⁹¹ Using such waste products for cooking and heating can reduce demand for wood and

charcoal and help manage municipal solid waste, supporting a circular and bioeconomy. Such approaches may be a crucial solution for regions such as sub-Saharan Africa, where urbanization rates and population growth are increasing demand for fuelwood. It is estimated that a 1% increase in urbanization is correlated with a 14% increase in charcoal consumption.⁹²

New stove technologies can produce both heat for cooking and biochar for carbon sequestration and soil restoration. When incorporated into soils, biochar improves soil fertility, water retention, and nutrient availability, fostering healthier plant

growth and higher crop yields. In Kenya, kale and potatoes are some of the most valued staple food crops, but degraded soils are hampering their productivity. A study by [World Agroforestry](#) in Kapchorwa, Kenya, assessed the potential of biochar on crop yields, and found that use of biochar plus diammonium phosphate (DAP) fertilizer led to a 48% higher yield of potatoes than those grown from solely DAP treatments and a 114% higher yield of kale.⁹³ Farmers can also increase their agricultural productivity, reduce the need for chemical fertilizers, and access new income streams by selling surplus biochar to neighboring communities or industries.

KENYA

3,000 biodigesters installed by Sistema.bio at smallholder farms created more than 120 jobs, 51% for women.



▲ Kenya—Two people with biogas stove. [Sistema.bio](#)

BIOETHANOL FOR CLEAN COOKING

Achieving universal access to clean cooking will require a mix of technologies and solutions. Bioethanol, a biofuel derived from a variety of feedstocks such as sugar cane, corn, and cassava, has gained attention for its reduced emissions at the point of cooking. Transitioning from polluting fuels to bioethanol can reduce harmful emissions from polluting stoves, improve public health, and provide cost savings for the 2.3 billion people who lack access to clean cooking.

Multilateral organizations and industry associations play a key role in promoting the use of bioethanol in clean cooking initiatives. International alliances promoting bioenergy, such as the [Global Biofuel Alliance](#) and

the [Global Bioenergy Partnership](#), are driving multilateral support for bioethanol value chains. [Pivot](#), a global bioethanol coalition, aims to increase global access to bioethanol for household energy; create enabling environments in developing economies with smart policy that provides greater access to safe and affordable bioethanol solutions; and strengthen the supply infrastructure.⁹⁴ At COP 27, the [Council on Ethanol Clean Cooking](#) (CECC) was launched by Côte d'Ivoire, Kenya, Madagascar, and Mali as a multistakeholder platform of developing economy members, development partners to support the creation of a sustainable ethanol industry and strengthen actions toward achieving SDG 7 and climate goals.⁹⁵

A variety of bioethanol cooking implementation models are being employed around the world. In Nairobi, [Koko Networks](#) is promoting the widespread adoption of liquid bioethanol cooking fuel to help families switch from charcoal and other polluting cooking fuels. The bioethanol is produced in East Africa from sugar cane and distributed through Koko vending machines hosted inside neighborhood stores to ensure last-mile accessibility. To improve customer affordability, Koko Networks has harnessed the power of carbon markets to undercut the price of charcoal. The company has used over US\$ 100 million in carbon finance to reduce the cost of its stove by 85% and reduce fuel costs by 25%–40%. This model is being

expanded beyond Kenya to Rwanda and other countries in sub-Saharan Africa.

In Tanzania, [United Nations Industrial Development Organization](#) (UNIDO) is implementing a bioethanol cooking project to help develop a market for bioethanol in Dar es Salaam.⁹⁶ Tanzania has 11 sugar factories across the country but produces less than 28 million liters of bioethanol every year, signaling an opportunity to scale up sustainable production. In Ethiopia, more than 1.8 million tons of sugar cane are produced each year, generating 300,000 tons of molasses byproduct that is often wasted, dumped in rivers, polluting ecosystems.⁹⁷ [Project Gaia](#) helps communities create new markets for farmers' produce and agricultural waste, generating additional income and the ability to grow more food. Project Gaia is harnessing waste molasses for use in bioethanol microdistilleries to avert environmental degradation and provide employment for women. Waste molasses is a favorable option for bioethanol production due to its widespread availability, affordability, and lack of competition with food crops.⁹⁸

[FAO](#) developed the Bioenergy and Food Security (BEFS) Approach to help governments develop sustainable bioenergy policies that promote food and energy security.⁹⁹ This framework helps policymakers, researchers, and practitioners make informed decisions around the development of bioenergy projects while minimizing negative impacts on food security.



3. Improving Nutrition and Food Security

Lack of access to clean cooking has an impact on food security by negatively affecting the quantity, quality, and nutritional content of meals consumed.¹⁰⁰

Research by [FAO](#) in Kenya highlighted the nutritional impacts of severe energy shortages caused by environmental degradation.¹⁰¹ As a result, people traveled farther to gather fuelwood and reduced their cooking frequency from three meals a day to two. The nutritional consequences of having to travel large distances over a substantial amount of time to collect fuel also led some families to switch to foods that are fast to cook but low in nutrition.¹⁰² Other dietary adaptations to fuelwood shortages in sub-Saharan Africa include consuming fewer cooked meals, changing cooking fuels or preparation methods, and substituting purchased food for home-cooked meals.¹⁰³ In Nairobi, one study found that approximately 30% of households skipped more meals in 2022 than in 2021, partially due to higher LPG prices.¹⁰⁴ The proportion of food-insecure households that reduced their clean cooking consumption (38%) was double that of food-secure households (19%).

Food insecurity is exacerbated by lack of clean cooking access in humanitarian and displacement settings.

Today, a record 339 million people worldwide need humanitarian assistance.¹⁰⁵ While most of the food that humanitarian agencies provide to displaced people must be cooked, cookstoves and fuel, when provided, are rarely sufficient.¹⁰⁶ Available evidence shows that 80% of displaced people in refugee camps have only



KENYA

Koko Networks is promoting liquid bioethanol to help families switch from charcoal and other polluting cooking fuels.



Kenya—Woman lights bioethanol stove.

Peter Irungu / Clean Cooking Alliance

minimal access to cooking energy.¹⁰⁷ Competition for fuel access can be a source of tension between refugees and host communities, and lack of energy sources for cooking may lead refugees to sell or exchange a portion of their food to obtain the firewood.¹⁰⁸ In Kakuma and Dadaab refugee camps in Kenya, it is estimated that an average

of 25% of food was bartered to supplement cooking energy.¹⁰⁹ In Malawi, a severe fuelwood crisis forced refugees to use butter fat that was distributed for preparing food as a source of cooking fuel.¹¹⁰ In refugee camps in Chad, three-quarters of households (76%) prepared only two meals per day due to the high cost of fuelwood.¹¹¹

Transitioning to affordable, reliable clean cooking solutions can increase both the quantity and quality of dietary intake, improving overall food security.

A traditional wood-burning stove makes it challenging to regulate heat and maintain an adequate flame. This can result in households avoiding cooking certain heat-sensitive dishes

such as meat or fish, given the higher risk of spoilage.¹¹² In India, higher dietary diversity was attributed to biogas cookstove users due to improved cooking efficiency, the ability to multitask, and the ability to adjust cooking temperatures.¹¹³ This allows households to incorporate a wider selection of items into one dish and broaden the variety and

quantity of food served in a meal. In 2018, Rohingya refugees in Ukha, Bangladesh, received LPG stoves and a six-month supply of LPG, which improved household dietary diversity.¹¹⁴ Households specifically increased their intake of vegetables and milk and had a significantly higher average Food Diversity Index score than households without LPG access.¹¹⁵

Clean cooking solutions such as pay-as-you-go LPG technologies enable flexible payments that allow families to adjust their budgets for food and fuel purchases based on financial circumstances.

This was shown to be particularly beneficial during a COVID-19 lockdown in Nairobi: The ability to shift to smaller, more frequent payments when families had less income due to stay-at-home orders enabled 95% of households to continue cooking with LPG and feed their families.¹¹⁷ Further data from informal settlements in Nairobi demonstrated a 15% increase in dietary diversity and consumption of protein-rich foods (legumes, meat, fish) among households headed by women after they switched to pay-as-you-go LPG for cooking.¹¹⁸ In Cox's Bazar, Bangladesh, provision of LPG to Rohingya refugees to replace firewood for cooking,

was associated with improved food security, demonstrated by increased spending on food (from US\$ 7.19 per month to US\$ 8.55).¹¹⁹

The use of clean fuels and stoves in institutional settings can reinforce efforts toward climate-smart and sustainable food systems that deliver better nutrition and more diverse diets.

Schools, clinics, religious centers, and other institutions can provide meals to hundreds of vulnerable people at once. School meal programs, for example, are a widely implemented social safety net, with 418 million children around the world receiving a meal in school.¹²⁰ Cooking undertaken regularly in institutional settings often constitutes a significant portion of the cooking fuel demand in a community, and when firewood is insufficient to cook school meals, children are forced to skip meals or eat undercooked food.¹²¹ The World Food Programme (WFP) provides more than 15 million schoolchildren with nutritious meals and snacks each year and has installed over 28,000 improved institutional stoves in schools since 2003. Over the next decade, WFP aims to ensure that 73 million primary school children have access to meals in schools, including in 30 of the most fragile and low-income countries.¹²²

CASE STUDY

VOICES FROM THE FIELD

Between 2021 and 2023, the Clean Cooking Alliance (CCA) and 60 Decibels interviewed 4,812 customers from 18 clean cooking companies in nine countries across sub-Saharan Africa and Asia.¹¹⁶ The interviews revealed improved nutrition and dietary patterns among customers who switched from a polluting to a clean cooking solution. Cost savings from switching to more efficient cookstoves enabled some households to cook meals of higher quantity and quality. For example, one customer who switched from an artisanal charcoal cookstove to an improved Nenu Engineering cookstove, said, "I can now afford to cook more meals than I usually cook before." Another Nenu customer stated the benefit of being able to cook multiple dishes simultaneously: "I can now cook more meals at the same time and eat a balanced diet. This makes me happy." A customer using a Powerstove cookstove said, "The whole family members now enjoy the act of cooking without considering the cost implications. We can now cook foods like beans and cow legs. These are foods that we used to enjoy but we have been avoiding because of the cost involved in the cooking."

Kenya—Woman uses biomass stove. ▶
Nick Wambugu / Clean Cooking Alliance



CCA & 60 DECIBELS REPORT
81% of customers surveyed said their quality of life had improved thanks to clean cooking solutions.





CLEAN COOKING IN SCHOOLS

While many clean cooking interventions focus on household access, commercial and institutional settings such as schools, restaurants, and hotels constitute a significant portion of communities' fuel demand. Schools contribute to the food security of schoolchildren as they often have one or more meals a day at school. Gathering cooking fuel for school meals usually falls under the responsibility of children and their parents, posing an additional time and economic burden.

The preparation of school meals demands energy, and in certain countries, families are asked to contribute to fuel costs or supply firewood. If they don't, it could result in their children being denied access to school meals.¹²³ This can exacerbate hunger and malnutrition, as lunch may be the only or main meal the children consume during the week. School feeding programs should

integrate clean cooking solutions to ensure that children do not have to skip meals or school due to a dwindling supply of fuelwood.¹²⁴

In addition, use of solid cooking fuels in schools generates high levels of air pollution in communal kitchens and surrounding classrooms. Levels of fine particulate matter (PM_{2.5}) in classrooms, where children can spend six to eight hours a day during the school week, often exceed WHO-recommended levels.¹²⁵ The lengthy time of cooking in schools also places the cooks at high risk for burns and imposes significant energy expenses on schools.

Although the prevalence of solid fuel use for cooking in institutional settings is high, there is increasing momentum to transition public institutions to modern cooking technologies. **Rwanda** and **Kenya** are targeting an expansion

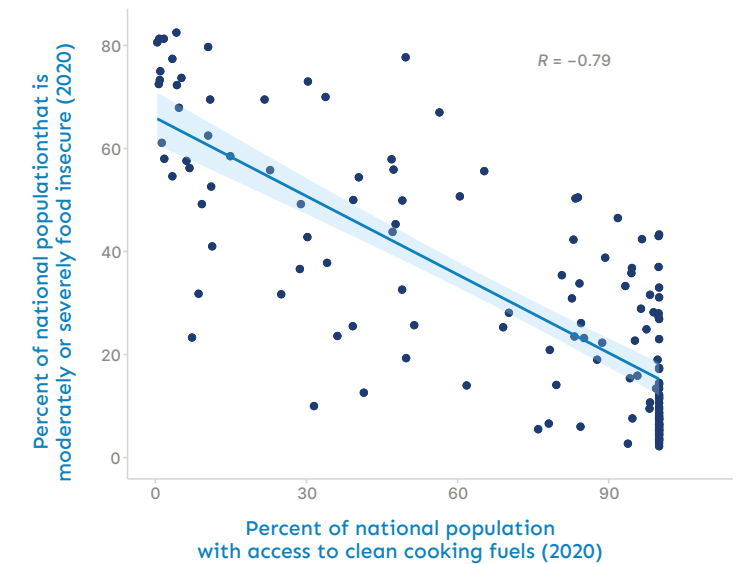
of liquified petroleum gas (LPG) for cooking in all public institutions. In Rwanda, where approximately 90% of the country cooks with solid fuels, the government aims to have 40% of public institutions cooking with LPG by 2024.¹²⁶ A pilot program is underway in 20 schools in the southern part of the country to replace wood fuel and charcoal with LPG, aiming to reduce deforestation and degradation of agricultural land. If successful, the program could save approximately 263,000 hectares of degraded forests and lead to a significant reduction in the use of firewood for cooking, from 80% to 42%.¹²⁷

In February 2023, the President of Kenya issued a directive that all public boarding schools in Kenya must transition to LPG for cooking by 2025.¹²⁸ This plan, which has funding of 2.5 billion Kenyan shillings (US\$ 17 million) annually, has the

ambitious target of facilitating a switch to LPG among 5,000 public boarding schools.

In Haiti, 95% of schools rely on wood or charcoal to cook their daily meals.¹²⁹ To help schools shift to clean cooking solutions, **CCA** has partnered with **WFP** to help convert 400 schools from firewood stoves to improved charcoal or LPG stoves. This project will benefit the health of over 600 kitchen workers and improve air quality in the school areas targeted by the study. Following this pilot, the project will be scaled up to reach 1,600 Haitian schools. WFP further developed a Clean Cooking Haiti project of distributing cost-effective heat retention bags that reduce a school's energy consumption by up to 70%.¹³⁰ WFP's food assistance is also inherently linked with cooking in humanitarian settings. Chad not only has the 10th-largest displaced refugee population in the world but also suffers from the twin burden of high levels of malnutrition and low levels of access to clean cooking.¹³¹ In response to this growing problem, WFP distributed LPG to 5,388 households and 38 enterprises in camps and host communities.¹³² Moreover, in 2022, WFP provided 136,850 improved stoves to households and upgraded 10,738 institutional cookstoves in 955 schools.¹³³

Figure 4: National-level association between the proportion of the population with access to clean cooking fuels and the prevalence of food insecurity.



There is a strong negative correlation between country-level clean cooking access and national rates of food insecurity.

Importantly, both food insecurity and lack of access to clean cooking solutions are inextricably linked to poverty. A rise in extreme poverty in developing economies is intricately connected to the global food insecurity crisis.¹³⁴ In many low- and middle-income countries (LMICs), households allocate a significant portion of their income to purchase expensive and often inefficient cooking fuels, exacerbating their economic hardship.¹³⁵ Polluting cooking methods that rely on biomass fuels or open fires lead to health problems and also consume valuable time and resources that could be invested in income-generating activities or improving overall living standards. The financial burden of health care costs related to indoor air pollution and the drudgery of collecting expensive, polluting fuels further entrench poverty.¹³⁶ By recognizing the linkage between clean cooking access, food security, and poverty, it becomes evident that comprehensive solutions are needed. Addressing these intertwined challenges requires a multifaceted approach that includes not only providing clean cooking technologies but also broader strategies to reduce poverty, enhance livelihoods, and empower communities.



HAITI

CCA has partnered with WFP to help convert 400 schools from firewood stoves to improved charcoal or LPG stoves.



◀ Uganda—Students are served hot water.

Arete/Siegfried Modola / World Food Programme



PART THREE

Mainstreaming Clean Cooking into Sustainable Food Systems Agendas

- ▶ Food systems policy, financing, and interventions can leverage clean cooking to achieve climate and development goals, empowering and building resilience in the communities that are responsible for producing an outsized share of the world's food.

Malawi—Solar powered irrigation scheme.
Eulalia Berlanga / World Food Programme

WORLDWIDE, GOVERNMENTS SPENT AN AVERAGE OF US\$ 630 BILLION ANNUALLY BETWEEN 2013 AND 2018 TO SUPPORT THE FOOD AND AGRICULTURE SECTOR.¹³⁷

However, not enough is reaching farmers or supporting sustainable, climate-smart food production. Some 600 million smallholder farmers around the world working on less than 2 hectares are estimated to be responsible for 28%–31% of total crop production and 30%–34% of food supply on 24% of gross agricultural area.¹³⁸ And in Africa, on average, women comprise 62% of the agricultural labor force, responsible for both farm and domestic work.¹³⁹ The world's reliance on smallholder farmers cannot be overstated, and yet the risk and responsibility these farmers face is not matched by the financial, climate, and technological support they need to prosper. Tackling poverty, addressing food insecurity, and financing food systems must begin with long-term rural transformation and empowering smallholder farmers, especially women. This means ensuring climate and economic resilience for those producing the world's food, which, for the reasons outlined in the previous chapters, can be accelerated by rapidly scaling access to clean cooking solutions.



1. Ensure Integrated Food Strategies Include Clean Cooking

Energy access, and clean cooking specifically, must be part of robust food system transformations and national plans and policies.

The UN Food Systems Summit (UNFSS) and two of the climate change Conference of the Parties, COP 26 and COP 27, provided important moments for shaping the future of global food systems, highlighting the need for integrated approaches to agriculture-led growth and development. Since 2021, the recent UNFSS+2 Stocktaking moment revealed that progress countries have made in addressing the broken food systems includes adopting 126 national pathways for food systems transformation and submitting 107 voluntary reports on their food systems journeys.

While these pathways make reference to promotion of climate resilient options such as engaging in agroforestry, investing in energy and rural infrastructures, empowering women in the food system, and adopting circular

economy approaches, only a very few explicitly refer to clean cooking solutions.

For example, Mozambique includes “disincentives for wood fuels’ usage” and “reduction of wood fuel consumption related to household demands through the promotion of household gas availability.”¹⁴⁰ Malawi’s pathway includes a near-term action to “enforce laws to limit charcoal production and selling and promote alternative livelihoods or sources of income.”¹⁴¹ Tanzania outlines a number of mitigation measures geared to addressing harmful impacts of climate change, including investments in the forestry, energy, transport, and waste management sectors, highlighting that “these projects will help in reducing emission from deforestation as currently 80–90% of domestic cooking energy in Tanzania comes from biomass energy.”¹⁴² The Food and Agriculture Organization, World Economic Forum, Mercy Corps, and other organizations that

are supporting countries in implementing people-centered approaches to food systems innovation and transformation can help elevate the importance of clean cooking and identify opportunities to incorporate clean cooking into emerging initiatives and mechanisms, such Food Innovation Hubs and the 100 Million Farmers platform to strengthen national and local capacity.¹⁴³

Similarly, most (93%) of the 134 nationally determined contributions (NDCs) to the Paris Agreement that were updated in 2022 include at least one measure related to food systems, yet additional measures and implementation of these plans are needed.¹⁴⁴ Clean cooking is gaining traction as a critical climate and energy transition solution, and there is an opportunity to leverage the intersection points of the food system and clean cooking around climate-smart agriculture, agroforestry, mitigation measures

for forests, circular food waste systems, and supporting smallholder farmers and local communities to drive ambition and funding for integrated food system and clean cooking approaches. As of March 2023, 98 LMICs have already included household energy or clean cooking measures in their NDCs.¹⁴⁵ Of those, 72 LMICs include specific clean cooking targets in their NDC, while the remaining 26 include adjacent goals, such as household energy efficiency, forest conservation, or air quality, that could be partially met through clean cooking activities. The Clean Cooking and Climate Consortium and other initiatives are supporting countries' efforts in using cooking energy interventions to achieve climate goals as part of their NDC targets or through the international carbon market.¹⁴⁶

There is an urgent opportunity within food system strategies and policies to explicitly and proactively incorporate clean cooking into associated climate, nature, livelihood, and nutrition interventions and to stimulate cross-sectoral collaboration. Across the five action areas of the UNFSS national food transformation pathways,

there are numerous themes where clean cooking can help address a driving cause or be an accelerator of progress, including agrobiodiversity; soil health; food systems for women and girls; resilience to health crises and shocks; and school meals (see Appendix). Yet, the success of these cross-sector holistic approaches will require improved policy coherence among key ministries, better intersectoral coordination, and the need for greater awareness of the clean cooking—food system nexus among government officials, policymakers, researchers, and farmers. National and local clean cooking strategies and plans should also highlight the benefits to the food system, increasing the data and evidence of clean cooking on climate, land, forests, health, and livelihoods of agricultural communities, to support further integration and collaboration.

Initiatives, such as a dedicated clean cooking delivery unit, can help facilitate essential collaboration across the clean cooking and food sectors.¹⁴⁷ When national governments create mechanisms like a dedicated clean cooking delivery unit, they are demonstrating that clean cooking is a national

priority that requires governmentwide action and dedicated funding. By having a delivery unit, various ministries and agencies can be brought together to build rigorous clean cooking frameworks; progress against national targets can be tracked and reported; policies can be refined to encourage more private sector investment; and clean cooking can be embedded into national health, climate, nature, food, gender equality,

and development agendas in a whole-of-government approach.

Governments are increasingly recognizing that clean cooking is the energy, climate, and development issue that has been left behind for far too long. They want to change that narrative, and they see delivery units as an opportunity to tackle the issue in a transformative and targeted way. At the Africa Climate Summit in September,

the Government of Kenya announced the inaugural Clean Cooking Delivery Unit, a team of experts embedded within the office of the President.¹⁴⁸ With an emphasis on unlocking private sector capital and carbon finance to deliver Kenya's ambitious climate and clean energy goals, the delivery unit will be housed at the highest level of government and will report to Special Climate Envoy Ali Mohamed. Kandeh Yumkella,

Chairman of the Presidential Special Initiative on Climate Change, Renewable Energy, and Food Security in Sierra Leone, announced that his country is prepared to join Kenya with its own Clean Cooking Delivery Unit. Several additional African presidential offices are in discussion to join the Delivery Units Network, which will offer technical support, capacity building, and funding to support national-led clean cooking transitions.



Malawi—Dzaleka Refugee Camp.
Badre Bahaji / World Food Programme



2. Align Climate Financing for Food Systems and Clean Cooking

It is increasingly recognized that the transition to a sustainable food system represents an incredible opportunity to drive progress against climate change.

Emissions attributed to the food system are projected to increase 60%–90% between 2010 and 2050, and climate change is expected to put millions of people at risk of hunger, malnutrition, and poverty unless transformative measures are taken.^{149,150}

The global food system is valued at US\$ 14 trillion, yet the vast majority of the hundreds of billions of dollars invested in food systems each year is misaligned, driving negative outcomes valued at US\$ 12 trillion in social, economic, and environmental costs.¹⁵¹

While a staggering US\$ 1.8 trillion is directed toward environmentally harmful agri-food subsidies, only US\$ 20 million—roughly 3% of total public climate finance—is allocated to food systems each

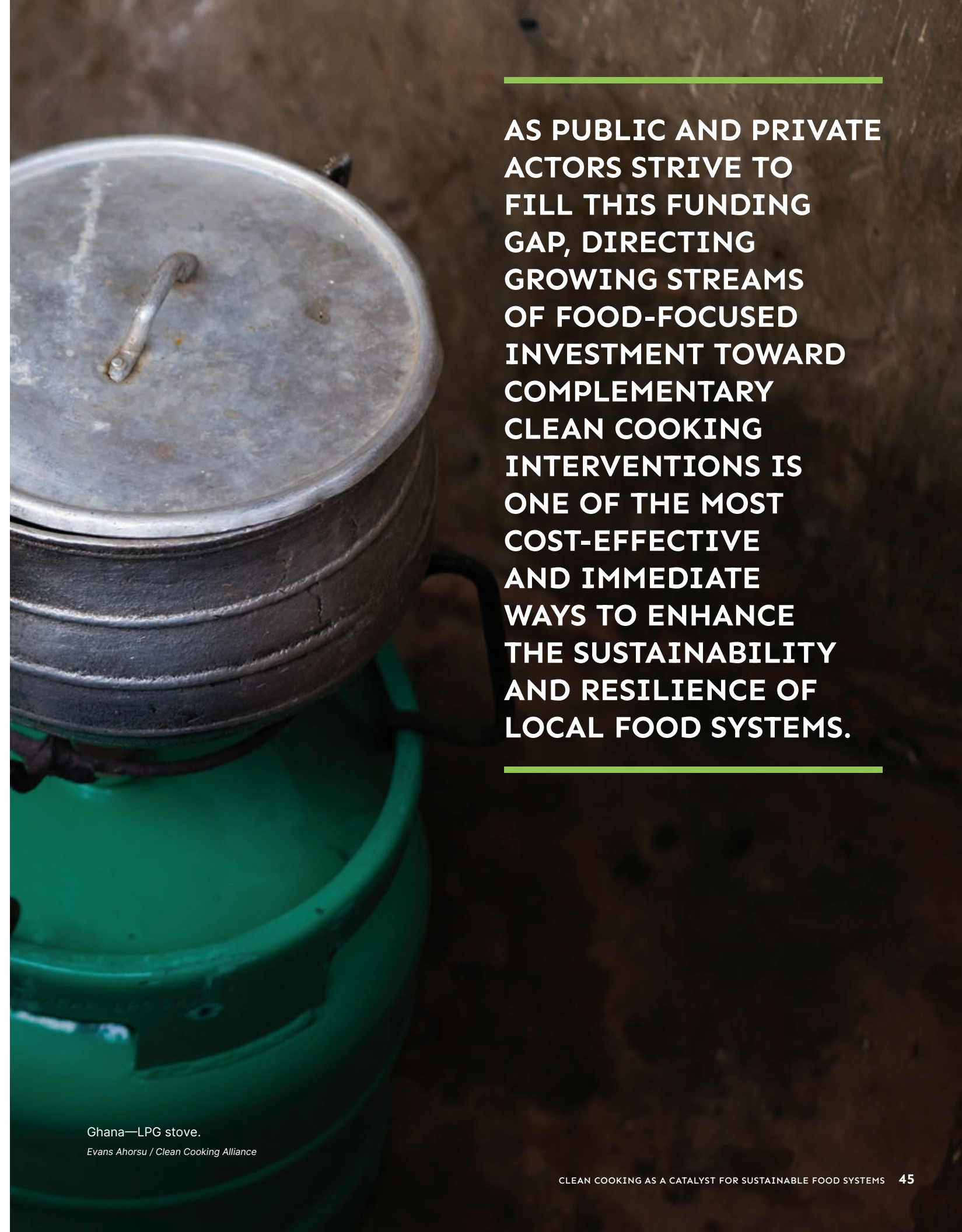
year.^{152,153} Considering that more than half of the world's GDP—US\$ 44 trillion—is moderately or highly reliant on nature, it is crucial to align public and private investments with evidence-based interventions such as clean cooking that support sustainable and resilient food systems.¹⁵⁴

Scaling climate finance for clean cooking within the context of sustainable food systems can harness co-benefits that reach far beyond the immediate provision of energy and are essential to food security.

Among them: mitigating climate change, safeguarding restoration and climate-smart agriculture investments, and maximizing the impact of nutrition programs. Each year, cooking with polluting fuels and stoves costs the world more than US\$ 2.4 trillion in damage to health, climate, and women's productivity,¹⁵⁵

yet investment in the clean cooking sector is only US\$ 215 million per year, a small fraction of the US\$ 8 billion per year required to achieve universal access.¹⁵⁶ The required investment in clean cooking is minuscule compared to the estimated US\$ 300–350 billion investment needed to transform the world's food systems,¹⁵⁷ yet it would provide trillions of dollars in benefits to climate, health, and women's productivity that are crucial to sustainable and resilient food systems.

AS PUBLIC AND PRIVATE ACTORS STRIVE TO FILL THIS FUNDING GAP, DIRECTING GROWING STREAMS OF FOOD-FOCUSED INVESTMENT TOWARD COMPLEMENTARY CLEAN COOKING INTERVENTIONS IS ONE OF THE MOST COST-EFFECTIVE AND IMMEDIATE WAYS TO ENHANCE THE SUSTAINABILITY AND RESILIENCE OF LOCAL FOOD SYSTEMS.



Ghana—LPG stove.

Evans Ahorsu / Clean Cooking Alliance

Table 3: Significant gaps in climate finance for food system transformation and clean cooking.

FOOD SYSTEM ¹⁵⁸	CLEAN COOKING ^{159,160}
US\$ 300–350 billion investment needed to transform the world’s food system.	US\$ 8 billion per year required to achieve universal access to clean cooking.
Only 3% of climate finance attributable to banking and capital markets targets the agriculture, forestry and other land-use sector.	Less than half of one per cent of privately sourced climate investments go into clean cooking companies.
Only 5.5% of total philanthropic giving towards climate change mitigation is allocated to decarbonizing food systems and agriculture (2016–2020).	Only 0.7% of total philanthropic giving towards climate change mitigation was allocated to clean cooking companies over the same time window (2016–2020).
Food systems receive only 3% of public climate finance, while renewable energy, energy efficiency and sustainable transport receive 18%, 30% and 43%, respectively.	Only 0.01% of total public climate finance made its way directly into clean cooking companies. Note that this only considers investments in companies, rather than civic infrastructure. It also does not include capital invested via an intermediary, such as a private fund manager.
Climate investments in food systems must increase by 15x to fill the current gap.	Climate investments in clean cooking must increase by 37x to fill the current gap.

THERE IS A TRANSFORMATIONAL OPPORTUNITY TO RETHINK CLIMATE FINANCE TOWARD FOOD AND AGRICULTURE SYSTEMS THAT HARNESS THE BENEFITS OF CLEAN COOKING TO GENERATE POSITIVE IMPACTS AND FINANCIAL RETURNS.

Now is the time to leverage intensified focus and investment on sustainable food systems to accelerate progress on clean cooking as part of a holistic approach that boosts resilience and food security. Aligning finance for food systems and clean cooking can generate and reinforce shared financial, economic, environmental, and social outcomes that can be packaged to a range of investors—public and philanthropic funds, financial and capital markets, carbon markets, and emerging biodiversity markets. The focus on finance for transformation of food systems to address climate change has increased since 2021, after featuring prominently at UNFSS, COP 26, and COP 27. Each of the five UNFSS Action Tracks included financial proposals and several coalitions were formed, including the Public Development Banks Platform for Green and Inclusive Food Systems, the Good Food Finance Network, and the School Meals Coalition to catalyze capital and create an

enabling financial environment for the transition to sustainable and equitable food systems.^{161,162,163} These comprehensive financing efforts must recognize the role clean cooking plays in sustainable food system transformation, promote integration of energy access solutions, and direct funding to complementary clean cooking interventions.

Blended finance is an increasingly attractive tool to scale up funding for climate and sustainable development. It involves the targeted use of concessional financing to attract new sources of investment in projects that may otherwise be perceived as too risky for private finance. Blended finance models targeting broader climate and food system outcomes could readily integrate clean cooking, providing the required patient capital to accelerate large-scale clean cooking transitions with mutually reinforcing benefits to climate and smallholder farmers.¹⁶⁴ In 2022, SouthBridge Investments announced a groundbreaking partnership with the African Forest Landscape

Restoration Initiative (AFR100)—which aims to bring 100 million hectares in Africa into restoration by 2030—and the Arab Bank for Economic Development in Africa (BADEA), to develop a US\$ 2 billion fund, blending US\$ 500 million of concessional finance with US\$ 1.5 billion in private investment to support local restoration efforts across the continent. Bezos Earth Fund announced US\$ 50 million in aligned philanthropic support.¹⁶⁵ Directing a fraction of this restoration finance to complementary clean cooking solutions through an initiative like the new African Conservation and Clean Cooking Collective, a partnership between the Clean Cooking Alliance, African Wildlife Foundation, and African Development Bank, would enhance and safeguard these investments by addressing one of the main drivers of land degradation and improving the health and resilience of agricultural communities.¹⁶⁶



Bangladesh—Man with livestock.
KM Asad / Clean Cooking Alliance

Carbon markets also have the potential to provide funding at the scale and speed necessary to bring about large-scale transitions in the world’s energy and food systems. For smallholder farmers, carbon markets represent an opportunity to restore land, improve farming practices, access clean cooking solutions, and be rewarded for their contributions to global climate solutions. Yet, while smallholder farmers produce one-third of the world’s food, they receive only 1.7% of climate finance.¹⁶⁷ In 2020, the Dutch financial services company Rabobank established a platform called Acorn, which has helped smallholder farmers access carbon markets.¹⁶⁸ As farmers implement more sustainable practices on their farms and transition to high carbon stock agroforestry production systems, they can offer their sequestered carbon as carbon removal units (CRUs) for purchase. The addition of clean cooking solutions could enhance

and safeguard these agroforestry efforts while providing additional health and environmental benefits. In Burkina Faso, the Livelihoods Fund is supporting an efficient cookstoves and sustainable agricultural practices project that aims to, first, reduce wood consumption and hence decrease deforestation and, second, to restore degraded land with agroforestry techniques that increase yields and resilience to droughts.¹⁶⁹ The project, which will affect 150,000 people, will be supported by the Livelihoods Fund over 10 years.

The carbon market can help fill the sizable funding gap in the agri-food and clean cooking sectors, but it can thrive only if it is based on sound, evidence-based methodologies and is accessible to a wide range of companies and project developers delivering solutions that serve local people.

The increased scrutiny and attention carbon markets are

receiving today can play an important role in helping to move the offsets market forward and to ensure that clean cooking carbon finance is done right. Projects must deliver on their promises, or they risk undermining the offsets market—and worse, failing to deliver the widespread climate, health, and livelihood benefits to the food system that clean cooking brings. CCA and partners across the sector have long advocated for clean cooking projects to be grounded in sound methodologies and realistic assumptions that reflect integrity, transparency, and accountability. These efforts include initiatives such as the Responsible Carbon Finance for Clean Cooking¹⁷⁰ and the Clean Cooking and Climate Consortium,¹⁷¹ as well as partnerships with organizations including UNFCCC and Gold Standard to ensure that methodologies are up to date and based on the latest science available.¹⁷²



3. Improve Data, Monitoring, and Evaluation

To help catalyze the required political will and investment in clean cooking, it is essential to increase the amount of research and create robust monitoring and evaluation frameworks that assess the positive impacts of clean cooking within sustainable food systems. This report has highlighted several potential linkages between expanding access to clean cooking and more sustainable food systems, however, the evidence supporting these linkages remains sparse. One area of focus in particular that should be expanded is the investigation of potential associations between clean cooking access and food security and nutritional outcomes across diverse geographic contexts. Although energy poverty is prevalent in the regions most affected by food insecurity, very few studies have quantified the link between the two issues.¹⁷³ Historically, linkages between energy and food security have been mostly considered in the context of broader agri-

food systems, rather than the relationship with cooking energy access at the household level.

An expanded evidence base of these linkages can motivate governments, investment decision-makers, nonprofit organizations, and the private sector to incorporate clean cooking into their agendas and policies. This will further build momentum and help elevate the importance of clean cooking as a critical factor toward achieving food security and building resilience for sustainable livelihoods. The data needed to achieve these gains could increasingly be generated by clean cooking organizations that are scaling up their products to new customers. In addition to providing valuable data for policymakers, the companies may increase their own profit margins by demonstrating potential nutritional co-benefits associated with the use of their technologies. Food systems players and academic researchers should also increasingly direct

their attention toward the benefits of clean cooking on food security and dietary diversity.

As the volume of data that can be collected is rapidly expanding, it is also important for data stewards to make the instruments used and results available across sectors and allow stakeholders to benefit from the latest evidence. The sharing of information among clean cooking enterprises, research institutions, and food systems players can help streamline data collection and lessen the burden for initiating future interdisciplinary research in the sector. Developing harmonized surveys and other systematic methodologies for documenting the benefits of clean cooking on food systems can also facilitate comparisons across settings and identify particular contexts where the nutritional benefits of clean cooking expansion are promising and where there may be gaps in some existing clean cooking programs. One leading example of a data hub for information on



Kenya—Two people cooking on a biogas stove.
Sistema.bio

food systems indicators is the Food Systems Dashboard. The FSD contains hundreds of country-level indicators across multiple components of the food system to promote deeper understanding on the drivers and outcomes related to food and nutrition. The FSD includes 87 policies and actions aimed at improving diets, nutrition, and environmental sustainability that stakeholders can leverage to decide actions based on the needs of their food systems. However, the FSD does not yet feature a dataset or policy action related to cooking fuels, appliances, or practices, which presents an immediate opportunity for action.

Technology and data improvements are also important for developing a more accurate and cost-effective generation of impact metrics, which can support carbon and other results-based finance. Smart data, such as pay-as-you-go LPG or electricity, can remotely track the usage of fuels, which can be used to evaluate the effect of clean cooking interventions. The availability of such real-time data can uphold higher integrity standards and streamline impact measurements related to health, food security, gender, livelihoods, and environment while reducing data collection

costs. As decreases in food security have been shown to be coupled with declines in PAYGo LPG consumption,¹⁷⁴ digital fuel consumption data may be useful for linking clean cooking to food security to enable real-time SDG 2 tracking. Thus, smart data measurements can simplify monitoring procedures and accelerate the time until funding from carbon credits can be received by project developers.¹⁷⁵



Nepal—Woman cooks with electric induction stove.
Pratik Shresha / Clean Cooking Alliance

PART FOUR

Recommendations

- ▶ There is an urgent need for stakeholders to integrate clean cooking into global, national, and local food agendas and to increase finance and collaboration to support sustainable food systems transformation.

WITHOUT COLLABORATIVE AND INNOVATIVE APPROACHES FROM ALL FOOD SYSTEM STAKEHOLDERS, ANY GOALS OF ENDING GLOBAL HUNGER, FOOD INSECURITY, AND ENERGY POVERTY WILL BE UNACHIEVABLE BY 2030.

Intensifying conflict, climate extremes, inequality, and rising food and energy prices are veering us off track from meeting climate and development goals. Holistic approaches that consider food systems and clean cooking jointly can build resilience against these shocks. Thus, governments, multilateral organizations, investors, and the private sector need to dramatically accelerate action, finance, and collaboration for clean cooking as an integral component of a sustainable and resilient food system. Below, we outline recommendations for specific stakeholders to help achieve this goal.

GOVERNMENTS

A nationwide transition to clean cooking should be a policy priority for governments in low-income countries to improve climate and environmental outcomes and the food security of their citizens.

- Integrate clean cooking into national food system transformation pathways and nutrition strategies, strengthening linkages in NDCs and related policies.
- Foster coordination across relevant ministries and agencies through a clean cooking delivery unit. This must also include strengthening the financial policy and regulatory environment to encourage capital to flow to clean cooking, restoration, and nutrition programs.
- Account for domestic cooking emissions as well as forest degradation in national and international GHG accounting to better manage emissions exposure and land use change from the sector.
- Ensure a gender lens to national food, energy, and climate policy to address particular vulnerabilities, needs, and outcomes for women.
- Incorporate clean cooking into national school feeding or other nutritional programs. This has been recently implemented by the President of Kenya under a directive that all public boarding schools in Kenya must transition to LPG for cooking by 2025.¹⁷⁶

Developed country governments must recognize and support the interrelationship between clean cooking and food security programs.

- Provide de-risking support to catalyze the growth of integrated clean cooking and restoration/climate-smart agriculture initiatives.
- Support large-scale clean cooking programs in key food-producing regions, encouraging clean cooking transitions aligned with landscape conservation and restoration through blended finance instruments and international carbon markets.
- Pilot innovative finance mechanisms for both carbon and other outcomes that can diversify public and private finance for a broader range of benefits across climate, health, and gender.
- Focus initiatives on supporting women farmers and enhancing women's health and resilience with clean cooking access.
- Ensure that support for school feeding programs includes clean cooking.



Malawi—Tapumuluka Irrigation Scheme.
Badre Bahaji / World Food Programme



Kenya—Woman with biodigester.
Sistema.bio

MULTILATERALS AND CONCESSIONAL CAPITAL PROVIDERS

Acknowledge the role of clean cooking in sustainable food systems and increase multilateral and development finance institution involvement in cross-sector efforts.

- Enhance coordination across SDG 2 (zero hunger) and SDG 7 (energy access) agendas, including through UNFSSS, COP, and other major forums
- Expand financial instruments to improve the terms of entry for clean cooking companies and associated restoration, agroforestry, regenerative agriculture developers. This can include increasing the use of partial credit risk guarantees, first loss capital, political risk insurance, foreign exchange risk, and private sector loan guarantees.
- Pair investments with technical assistance funds to advance the use of enhanced digital monitoring, reporting, and verification (MRV) solutions that can better reward clean cooking companies and projects serving farmers, particularly women, and rural communities.
- Incorporate questions on cooking fuels used, cooking time, fuel gathering time, and associated socioeconomic impacts when organizations that routinely administer surveys or monitor food security status and nutritional outcomes across LMICs document potential associations, ensuring gender disaggregation of data.
- Share and harmonize the data collection process to systematically inform the development of innovative policies that jointly address clean cooking and food security.

DONORS AND INVESTORS

Identify and leverage new opportunities for clean cooking through the growing focus on food security, climate, and nature.

- Work with investees, restoration/agriculture projects, and clean cooking companies and projects to identify opportunities to diversify and attract innovative finance holistic programs that address food security and energy access.
- Promote innovative solutions for results-based finance that value the co-benefits of clean cooking to nature, food security, women's empowerment, and livelihoods.
- Evaluate food system investments to understand where clean cooking is a cost-effective and powerful risk mitigation tool to ensure the permanence of return-seeking investments in restoration/climate-smart agriculture.
- Collaborate with clean cooking companies, researchers, and other organizations to identify and streamline metrics for documenting the benefits of clean cooking to the food system.

AGRI-FOOD CORPORATIONS

Integrate clean cooking into strategies for supporting smallholder farmers, nature-based investments (including carbon projects), and distribution.

- Ensure a screening process is in place in sustainable agriculture supply chain programs that engage smallholder farmers to identify where a high prevalence of unsustainable fuelwood collection requires investments in clean cooking solutions, alongside other agroecological interventions.
- Promote investment in clean cooking solutions to safeguard other nature-based carbon removals and climate-smart agriculture, ensuring that they deliver environmental and social benefits to the food system.
- Invest in high-quality clean cooking carbon projects if carbon offsets are part of the corporate's net zero emissions strategies.
- Assess opportunities to use their distribution channels to enhance the accessibility of clean cooking solutions in the markets they serve.



Zambia—Naomi prepares breakfast for her family.
Andy Higgins / World Food Programme

CLEAN COOKING COMPANIES

Partner with agri-food and nutritional organizations to leverage clean cooking value chains to deliver improved environmental, health, and livelihood outcomes that are essential to food security.

- Work with agri-food organizations to identify scalable opportunities where the delivery of clean cooking solutions could accelerate conservation, restoration, or regenerative agriculture efforts.
- Integrate clean cooking delivery models into other agricultural capacity building and technological access strategies to reach farmers in rural areas.
- Support the transition to a more sustainable fuelwood and charcoal value chain by using agroforestry to reduce the pressure on forests and diversify income streams for both the companies and their community stakeholders. This may require new partnerships with local restoration and agroforestry organizations.
- Partner with nutrition organizations to implement multimodal interventions that combine clean cooking technologies with healthy food provision to maximize the health benefits for consumers.
- Provide consumers with training and support to cook additional, healthy meals using modern stoves and provide access to markets to sell nutritious foods.
- Devise innovative solutions that extend the shelf life of nutritious foods and make them easier to prepare using clean cooking technologies.
- Educate customers on how clean cooking is beneficial to food security. As food insecurity is a daily stressor, the immediate benefit of clean cooking on their quality of life may be an incentive for adoption of the new fuel or technology.¹⁷⁷



Kenya—Employee assembles biomass cookstove.
Nick Wambugu / Clean Cooking Alliance

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South Sudan—Cooking demonstration.
Eulalia Berlanga / World Food Programme

Glossary

Acute food insecurity	When a person’s inability to consume adequate food puts their life or livelihood in immediate danger. ¹⁷⁸
Agroforestry	A collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, and the like) are deliberately used on the same land management units as agricultural crops or animals, in some form of spatial arrangement or temporal sequence. ¹⁷⁹
Biochar	A charcoal-like substance that’s made by burning organic material from agricultural and forestry wastes (also called biomass) in a controlled process called pyrolysis. ¹⁸⁰
Bioeconomy	A new model for industry and the economy, also known as biobased economy, that involves using renewable biological resources sustainably to produce food, energy, and industrial goods. Bioeconomy also exploits the untapped potential stored within millions of tons of biological waste and residual materials. ¹⁸¹
Black carbon	A component of fine particulate air pollution (PM2.5), commonly known as soot. Black carbon is formed by the incomplete combustion of wood and fossil fuels, a process that also creates carbon dioxide (CO ₂), carbon monoxide, and volatile organic compounds. ¹⁸²
Clean cooking solutions	A suite of fuel-stove combinations with emissions performance that meets the World Health Organization’s guidelines for indoor air quality. This category includes high-efficiency charcoal and biomass pellet stoves, liquefied petroleum gas (LPG), biogas, ethanol, and electric stoves and pressure cookers.
Climate-smart agriculture	An approach that helps guide actions to transform agri-food systems toward green and climate-resilient practices. Climate-smart agriculture aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing or removing greenhouse gas emissions, where possible. ¹⁸³

Food insecurity	A person is food insecure when they lack regular access to enough safe and nutritious food for normal growth and development and an active and healthy life. ¹⁸⁴ (See acute food insecurity)
Food system	The entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption, and disposal of food products that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal, and natural environments in which they are embedded. ¹⁸⁵
Forest degradation	A reduction or loss of the biological or economic productivity and complexity of forest ecosystems resulting in the reduced overall supply of benefits from forest, such as wood or biodiversity. ¹⁸⁶
Forest landscape restoration	The ongoing process of regaining ecological functionality and enhancing human well-being across deforested or degraded forest landscapes. FLR is more than just planting trees—it is restoring a whole landscape to meet present and future needs and to offer multiple benefits and land uses over time. ¹⁸⁷
Hunger	An uncomfortable or painful physical sensation caused by insufficient consumption of dietary energy. Hunger becomes chronic when an individual does not consume a sufficient amount of calories (dietary energy) on a regular basis to lead a normal, active, and healthy life. ¹⁸⁸
Malnutrition	Deficiencies, excesses, or imbalances in a person’s intake of energy or nutrients. The term addresses three broad groups of conditions: undernutrition, micronutrient-related malnutrition, and overweight and obesity. ¹⁸⁹
Undernourishment	When a person is not able to acquire enough food to meet the daily minimum dietary energy requirements over a period of one year. FAO defines hunger as being synonymous with chronic undernourishment. ¹⁹⁰
Woodfuel hot spots	Regions in which the expected fraction of non-renewable biomass utilization (fNRB) exceeds 50%, that is, regions in which most harvested is unsustainable. ¹⁹¹

Appendix

National Pathways for Food Systems Transformation Themes

Source: UN Food Systems Summit Dialogues Gateway

ACTION AREA	THEME	NUMBER OF COUNTRIES
1: Nourish All People	Achieving Zero Hunger	111
	Healthy Diets from Sustainable Food Systems for Children & All	95
	Food Loss and Waste	89
	Food Quality and Safety	86
	Family Farming	73
	School Meals: Nutrition and Health and Education for Every Child	72
	Social Protection for Food Systems Transformation	57
	Different Forms of Malnutrition	47
	Sustainable Consumption	37
	The True Value of Food	22
2: Boost Nature-Based Solutions of Production	Sustainable Productivity Growth	104
	Water	89
	Aquatic/Blue Foods	83
	Agroecology	80
	Land	74
	Sustainable Livestock	64
	Agrobiodiversity	49
	Soil Health	49
	Nature-Positive Innovation	47
	Halting Deforestation & Conversion from Agricultural Commodities	35
Restoring Grasslands and Shrublands and Savannahs	16	

ACTION AREA	THEME	NUMBER OF COUNTRIES
3: Advance Equitable Livelihoods and Decent Work and Empowered Communities	Decent Work and Living Incomes and Wages for All Food Systems Workers	90
	Food Systems for Women and Girls	86
	Youth Food Systems	74
	Vulnerable Peoples Food Systems	69
	Indigenous Peoples Food Systems	47
	Urban Food Systems	23
	Equitable Livelihoods	17
	4: Build Resilience to Vulnerabilities and Shocks and Stresses	Climate and Disasters Resilient Development Pathways (CRDP)
Resilient Food Supply Chains		95
Resilience to Health Crises		46
Resilience to Shocks and Violent Conflicts and Food Crisis		40
Resilience to Stress and Vulnerabilities		22
5: Means of Implementation	Policy and Regulation	120
	Innovation and Knowledge	116
	Human Resource Capacities	104
	Finance and Investment	100
	Better Data	91
	Trade	86
	Partnerships	83
	Infrastructure	81
	Public Information	81
	Governance for Sustainable Food Systems	65
	Digital	51
	Human Rights	19

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Kenya—Woman cooks
with LPG stove.

Peter Irungu / Clean Cooking Alliance