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At global level, 2.3 billion people still lack access to clean cooking (IEA, 2023). Ghana, 2012

Bioenergy and nutrition:

Reflections from a week of learning in Bangkok

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What we know:

Access to energy remains an essential prerequisite for achieving many Sustainable Development Goals (SDGs). Modern bioenergy – renewable energy produced from organic matter – can play an important role in nutrition security, particular through improved soil quality, enhanced rural livelihoods, and better cooking practices (Global Bioenergy Partnership, 2022).

What this adds:

This two-part article summarises a recent paper on the linkages between bioenergy and nutrition (Testa et al, 2023), exploring novel solutions for achieving the SDGs, before reflecting on the 10th edition of the Bioenergy Week, which took place in Bangkok on 24–27th October 2023. This piece offers an important entry point for those in the nutrition sector to engage more broadly with colleagues working in food, energy, and economic systems.

By 2050, nourishing a global population of almost 10 billion people will require a radical transformation in how food is produced, processed, traded, and consumed. Access to affordable, reliable, sustainable, and modern energy in many developing countries will represent a crucial dimension of this transformation.

However, progress toward the achievement of affordable and clean energy (SDG 7) is slow. More than 2.3 billion people (around 30% of the global population) still do not have clean cooking facilities and roughly 800 million people do not have access to electricity (IEA, 2023). This constitutes a fundamental barrier to reducing hunger, achieving food security, and promoting sustainable agriculture (SDG 2).

To explore the challenges and opportunities that building an affordable and clean energy system can bring to global nutrition – specifically the role of bioenergy within this – we first consider a literature review of 53 studies, published between 2006 and 2021 (Testa et al, 2023) (Figure 1). This review includes peer-reviewed papers, technical articles, documents published by non-profit organisations, government documents, and examples of good practices from case studies at national and local level.

Six main practices were identified where modern bioenergy value chains can positively impact food security and nutrition:

Phytoremediation: Can reverse soil erosion, contamination, desertification, and acidification by removing pollutants and utilising green plants. Phytoremediation is shown to be a cost-effective solution and the use of perennial bioenergy crops, which can lower soil contamination, is the subject of current research. As an example, heavy metals (from animal waste) can be removed using species such as *Eichhornia crassipes*.

Integrated biomass production systems: Strategies such as crop rotation (planting different types of crops sequentially on the same plot of land, such as leguminous and cereal species, e.g., *alfalfa* and corn) and intercropping (cultivating multiple crop species simultaneously in the same field) may allow for biomass crop production in agricultural or forestry contexts. This is possible, despite public perception that food and biomass crops will compete for resources. Indeed, intercropping with leguminous species has the potential to increase soil nitrogen content and improve soil fertility (e.g., intercropping *Gliricidia sepium* with cash crops, which reduces soil degradation).

> ***"The positive relationship between bioenergy and nutrition is an overlooked nexus, whose analysis has been too often limited to the competition for resources, such as land, water, energy, and other inputs."***

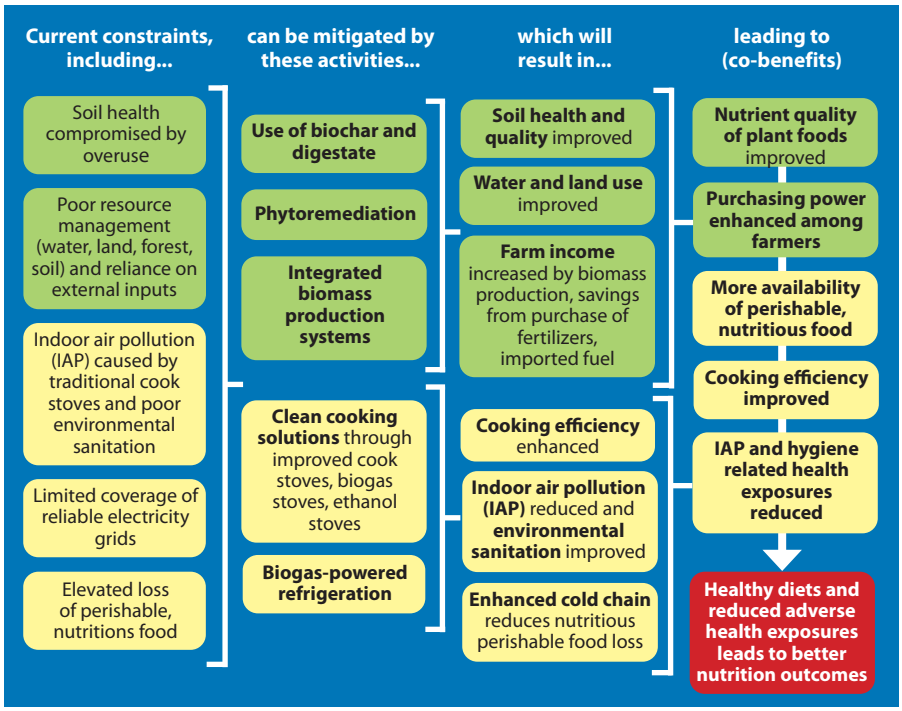
Using biochar: Can improve soil health by boosting the concentration of plant nutrients (such as calcium, magnesium, sodium, and potassium), detoxifying pollutants, and improving soil water-holding capacity. Biochar is the solid, carbon-rich by-product derived from the thermochemical conversion of biomass, which produce syngas, a gaseous biofuel, as main product. Adding biochar to soil was shown to favourably impact fruit production, fruit quality, and resistance to powdery mildew – a fungal disease.

Using digestate: As the main by-product of converting organic matter into biogas, digestate (or 'bioslurry') has been shown to be an effective biofertiliser for crops – highlighting its value within a circular economy. Evidence on the efficacy of digestate as a fertiliser in the long term is mixed, although it remains an important tool in the nutrition security toolbox.

Clean and modern energy for cooking: Switching from conventional to improved feedstock (e.g. pellet, briquettes) and cooking technologies (e.g. cookstoves) could led to improved indoor air quality as well as dietary diversity. Lower respiratory infection – which is more prevalent in those who use conventional cookstoves – is one of several infectious states which has a bidirectional relationship with malnutrition. Cleaner cooking, mediated via reduced carbon monoxide and black carbon, can ameliorate this problem. In India, improved stoves offer higher cooking temperature and time control, which allowed participants to introduce novel foods into their diets that would otherwise be too time-consuming or too at risk of spoilage to cook. This, in turn, can increase dietary diversity and reduce the risk of infection.

Food transport and storage: Traditional cold storage technologies may not be viable in areas with limited reliable grid electricity. Biogas, by contrast, can be sustainably used for chilled storage to extend the shelf life of crops and other perishable goods. The initial cost of biogas-powered refrigeration remains high, but longer-term returns on this investment are positive – highlighting the importance of innovative financing from donors and governments to support local communities and businesses in these efforts.

Figure 1 Overview of the linkages between bioenergy and nutrition[a]



[a]Figure taken from Testa et al (2023)

Reflecting on a week of bioenergy learning

The summary above highlights key linkages between modern bioenergy and nutrition. In many cases, one supports the other and enhancing each has the potential to sustainably improve food security and subsequent nutritional status. This interdependence was also highlighted during the 10th edition of the Bioenergy Week, which took place in Bangkok on 24–27 October 2023.

The event was organised by FAO in the context of the GBEP, kindly hosted by the Government of Thailand, with the contribution of the United Nations Industrial Development Organization (UNIDO). The aim was to enhance the learning from positive experiences on sustainable production and use of bioenergy integrated within food production value chains, to support the design and implementation of bioenergy policies in Asia and the Pacific.

The GBEP Bioenergy Week brought together a large network of bioenergy stakeholders, including international experts, decision makers, and private sector representatives, to discuss current trends, future opportunities, and challenges. The Bioenergy Week successfully contributed to an exchange of learning on ways to improve agricultural productivity, enhance feedstock logistics, and increase the use of modern conversion technologies.

The work on energy-smart agrifood systems transformation evolves around three main pillars: (1) renewable energy for agriculture; (2) sustainable energy from agriculture; and (3) energy efficiency in agriculture. For this to happen, it is important to ensure coherence of policies and programmes with the common aim of achieving the 2030 Agenda for Sustainable Development.

Food, feed, fibre, fuel

Around 30% of all energy is consumed within agrifood systems, with 70% occurring in transport, processing, packaging, storage, and marketing.

Over the past 200 years, there has been a shift away from a natural economy – characterised by being land-intensive, low-tech, and renewable – towards a fossil economy, which is non-land intensive, high-tech but non-renewable. The emergence of the 'bioeconomy' provides great potential for renewable energy with moderately intensive land use. This requires both tech solutions and sustainable land management. Especially in the Global South, there is an increased need for mid-tech solutions that add value, are cross-cutting, and can be adapted in innovative ways to diverse contexts and needs. Policies must respond to 'polycrisis' through the engagement of all sectors – including agriculture, forestry, and fishery. This calls for a negotiated space that brings coherence across alternative visions for the bioeconomy.[2]

> *"The sector wastes around 38% of energy and approximately one-third of food is lost or wasted."*

Asia is experiencing a significant rise in both the supply and demand for bioenergy, driven by robust incentivising policies implemented in key countries within the region, such as India, Indonesia, Thailand, the Philippines, and Vietnam. There is a recognised role of bioenergy in meeting SDG 7 targets and many more.

Significant experience is available in using metrics assessing the contribution of bioenergy across several SDGs that are linked to environ-

Box 1 Bioenergy facts and figures

- Bioenergy is the largest source of renewable energy worldwide, with a share of around 10% of global primary energy supply (International Energy Agency (IEA), 2021).
- In the IEA 2°C scenario[1] bioenergy is expected to provide 17% of final energy demand in 2060 compared to 4.5% in 2015 (IEA, 2017).
- The role of bioenergy is recognised as key by the IPCC Report on Climate Change and Land (IPCC, 2019) for the 1.5°C objective, which requires substantial carbon capture and storage alongside emissions reductions.

[1] This scenario describes an energy system which is predicted to give an 80% chance of limiting global temperature increase to 2°C

[2] Presentation title: Bioenergy and bioeconomy pathways in the global South: resources, strategies and governance (Francis X. Johnson, Stockholm Environment Institute Asia)

mental, social, and economic dimensions of the sustainability of all forms of bioenergy. GBEP has developed the most widely recognised set of 24 voluntary sustainability indicators[3] for bioenergy, including validated indicators such as "life cycle greenhouse gas emissions", "biological diversity in the landscape", "price and supply of a national food basket", "capacity and flexibility of use of bioenergy", and "change in mortality and burden of disease attributable to indoor smoke".

Sustainable solid biofuels

Wood energy (including fuelwood and charcoal) holds immense importance in Asia and is projected to remain a crucial energy source. Notably, Vietnam emerged as one of the top five wood pellet exporters in 2020. In many countries, wood accounts for a substantial portion of energy demand, ranging from 20% to 80%. While the utilisation of wood fuel continues to increase, its growth rate is not as rapid as that of fossil fuels.

One session of the Bioenergy Week was dedicated to efficient management practices to produce feedstock and technologies for achieving environmental and climate targets. The use of bamboo as a potential bioenergy feedstock at household, large, and industrial scale was discussed in the context of China and India[4]. Key advantages of bamboo are that it does not compete with food and can be harvested on an annual basis – representing a sustainable source of energy. In Thailand, the cassava value chain, which employs 1 million farmers, has limited uptake as an edible food – therefore offering the greatest potential to produce cassava chips and pellet for fuel[5].

Both Indonesia and India are exploring different models to integrate bioenergy and food security at the landscape level. In Indonesia, the agroforestry model is based on the intercropping of the tamanu (*calopyllum inophyllum*) with maize, paddy, and peanuts for food production, including enhancing honeybee activity. In India, bamboo-based agroforestry has proved to be more commercially viable than single crops, especially for smallholders[6].

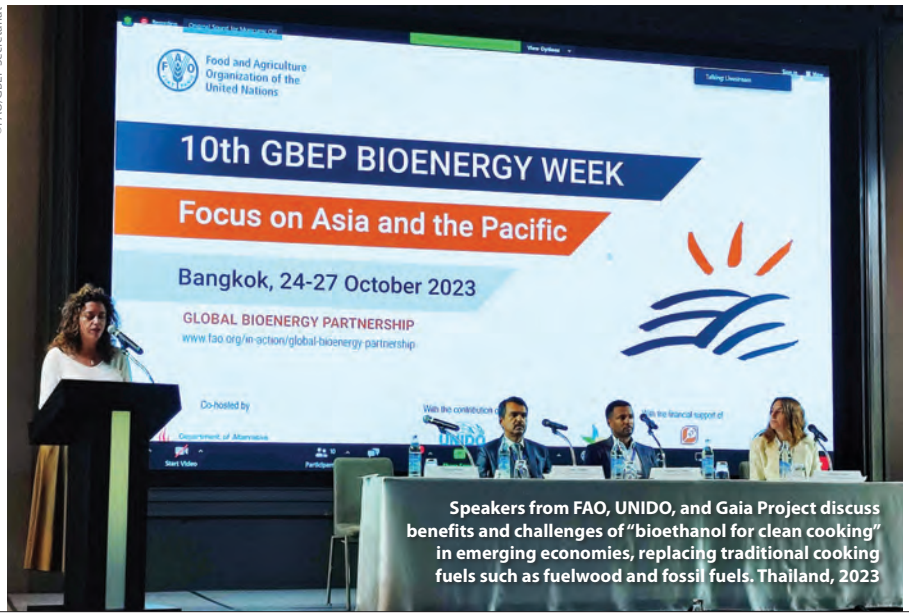
Given the huge demand for up to 35–50 million tonnes of biomass in India, the development of a market ecosystem with a 150–200 km radius is the suggested model to ensure sustainability through rural networked agriculture waste management (e.g., soybean husk or cotton stalk aggregation)[7].

The experience of improved cook stoves in rural India touches upon several aspects of interest along the bioenergy value chain – from the provision of fuel improved cook stoves, to the local production of improved biofuels, such as pellet from rice straws, to a campaign to ensure the sustainable uptake and use of improved cookstoves. The design of the improved cook stoves is done with a clear understanding of the needs of users, recognising the centrality of cooking as a dimension of individual and collective identity[8].

Sustainable gaseous and liquid biofuels

Within the Asia-Pacific region, there exists vast potential to produce biogas and biomethane on a global scale – owing to the abundance of suitable feedstock and the recent surge in consumption and imports of natural gas. China, Thailand, and India stand as the largest producers of biogas in the region. Notably, China has recently introduced policies aimed at encouraging the installation of household-scale digesters in rural areas, aiming to enhance access to modern energy sources and clean cooking fuels.

The production of liquid biofuels in the region is poised to surpass that of Europe by 2026, as projected by the IEA in 2021. Anticipated growth in demand amounts to approximately 10.8 billion litres per year (between 2021 and 2026). Indonesia currently holds the highest biodiesel blending mandate globally, set at 35%. Moreover, India, which aims to achieve a 20% ethanol blending target by 2022, recently established the Global Biofuel Alliance during its G20 presidency.



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Speakers from FAO, UNIDO, and Gaia Project discuss benefits and challenges of "bioethanol for clean cooking" in emerging economies, replacing traditional cooking fuels such as fuelwood and fossil fuels. Thailand, 2023

The Bioenergy Week was also an opportunity to discuss progress in Africa, including the ongoing effort to scale up ethanol clean cooking[9] and ensuring safety standards and regulations to increase uptake and adaptation in different contexts[10].

In summary

With the 2030 timeline for the SDGs rapidly approaching, the 10th Bioenergy Week provided an opportunity to discuss important, transformational issues that are at play within the broader nutrition, food security, and energy ecosystem. Both the literature review and our reflections from the conference highlight a myriad of opportunities that can be leveraged by focusing on the benefits that bioenergy can bring.

Interconnected challenges with food, feed, fibre, and fuel call for integrated approaches that bring together dimensions of biotechnology, bio-resources, and bio-ecology. Researchers, practitioners, and policymakers should look beyond traditional, siloed approaches to each of these areas – instead pursuing a multisectoral approach that encourages collaborative endeavour. The inclusion of SDG 2 (end hunger, achieve food security and improved nutrition, and promote sustainable agriculture) in this negotiated space would add a clear human dimension to policy dialogues, removing barriers and enhancing enablers.

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[3] **https://www.globalbioenergy.org/programmeofwork/task-force-on-sustainability/gbep-report-on-sustainability-indicators-for-bioenergy/en/**

[4] Presentation title: Bamboo – a potential bioenergy feedstock at household, large and industrial scale: experiences from China and India (Jayaraman Durai, Director, Global Programmes, INBAR, China)

[5] Presentation title: Bioeconomy innovations in Thailand (Warinthorn Sangkhasiri, National Center for Genetic Engineering and Biotechnology, Thailand)

[6] Presentation title: Integrating bioenergy and food security at landscape level (Yustina Artati, CIFOR-ICRAF)

[7] Presentation title: Revitalizing biomass resources: strategies for enhancing supply and sustainability (Jitesh Kumar, GIZ, India)

[8] Presentation title: Improved cookstoves in India (Ketaki Kokil. Ecosense Appliances Pvt Ltd, India)

[9] Presentation title: Scaling ethanol clean cooking through Council on Ethanol Clean Cooking (CECC) (Jossy Thomas, Bioenergy Programme, UNIDO)

[10] Presentation title: Safety standards and regulations for bioethanol for clean cooking: lessons from Africa (Wubshet T. Tadele, Gaia Clean Energy, Ethiopia)

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