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Mainstreaming agro-ecology in Southeast Asian higher education for the Sustainable Development Goals: Challenges, opportunities and policy options

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Background: This policy brief is one in a series led by Chulalongkorn University (CU) with support from the Office of the Higher Education Commission (OHEC), Ministry of Education, Thailand, in partnership with FAO. The series was initiated to support the Association of Southeast Asian Nations (ASEAN) Work Plan on Education, 2016–2020 implementation while Thailand was Chair of ASEAN in 2019 under the theme: "Advancing Partnership for Sustainability." The briefs in this series offer critical interdisciplinary perspectives on agrifood systems from social and sustainability sciences.

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Acronyms

ASEAN	Association of Southeast Asian Nations
CGIAR	Consortium on International Agriculture Research
FAO	Food and Agriculture Organization of the United Nations
HEIs	higher education institutions
IPCC	Intergovernmental Panel on Climate Change
IPES-Food	International Panel of Experts on Sustainable Food systems
SDGs	Sustainable Development Goals

An unstainable agrifood system. Currently, food systems face multiple challenges and are one of the world's greatest contributors to environmental damage, including agrochemical pollution, desertification, deforestation, drought, depleting aquifers, biodiversity loss and land degradation, and may be the world's greatest contributor to climate change (IPCC, 2018; UNEP, 2016). Agrifood systems also depend on natural resources and environmental services, yet many agriculture policies and practices undermine ecological foundations of global food and nutritional security (TEEB, 2018; UNEP, 2016). Moreover, during past decades, undernourishment, hunger and food insecurity persisted and grew. An estimated 1.6 billion people worldwide (22.8 percent of the population) were food insecure in 2015 when the United Nations Sustainable Development Goals (SDGs) were launched. Food insecurity increased to an estimated 2.3 billion (or 30.4 percent) worldwide in 2020. The COVID-19 pandemic significantly exacerbated the situation with small-holder family farmers, rural communities, women, children and indigenous peoples still among the most vulnerable. In Southeast Asia, regional food insecurity has increased, affecting 96.8 million people (15.3 percent) in 2015 since the launching of the SDGs to 18.8 percent of the population (around 125.5 million people) in 2020. In line with global trends, projections suggest that Southeast Asia is off track to meet the SDGs for zero hunger by 2030, while the global pandemic has created further vulnerabilities and future uncertainties (FAO *et al*., 2021, pp. 1, 10, 17, 18, 21, 22, passim).

Paradigm shift to agro-ecology needed to meet SDGs, nurture agrobiodiversity and ensure climate resilience. Broad, urgent action is needed to transform agriculture practices, food systems, diets, economics, investments, trade, research, education and society by scaling-up realistic measures to achieve SDGs by 2030 and support COVID-19 pandemic recovery amid the climate crisis. Scientific predictions suggest that we (now) have less than 10 years to reduce greenhouse gas emissions and limit global warming to 1.5° C requiring adaptation and mitigation strategies to avert reduced crop yields, fisheries loss and livestock disease affecting long-term global food security (IPCC, 2018). Essentially "**the world needs a paradigm shift** … a two-track approach that drastically reduces the impact of conventional agriculture, on the one hand, and broadens… ***agro-ecological*** production methods on the other…" (UNCTAD, 2013, p. i). The International Panel of Experts on Sustainable Food similarly argued for a paradigm shift to a "fundamentally different model of agriculture based on diversifying farms and farming landscapes, replacing chemical inputs, optimizing biodiversity…to build long-term soil fertility, healthy agro-ecosystems and secure livelihoods" (IPES-Food, 2016, p. 2). In Southeast Asia especially, agro-ecology can be an important method to help meet SDGs while particularly protecting or enhancing agrobiodiversity as part of a sustainable food system (Nelles, 2018, pp. 3, 6–7).

What is agro-ecology (AE)? AE is a polysemic concept with at least three core dimensions: science, movement and practice (Wezel *et al*., 2009). It promotes a systemic approach involving the whole food system. AE "is the development and application of ecological theory to the management of agricultural systems" including "the influence of social, economic, and political factors on the structure and success of farming systems" (Altieri and Francis, 1992, p. 89). Related practices include: agroforestry, organic

agriculture and conservation agriculture; integrated pest management or integrated crop management; system of rice intensification and integrated farming (Castella and Kibler, 2015). "Farming with nature" or ecological agriculture also describes some AE elements that require better understanding, policy support and implementation. FAO defines AE as "an integrated approach that simultaneously applies ecological and social concepts and principles to the design and management of a sustainable and fair food system" (FAO, 2018a). FAO also identified ten interconnected and interdependent elements of agro-ecology – diversity; synergies; efficiency; resilience; recycling; co-creation/sharing of knowledge; human/social values; culture/food traditions; responsible governance; and circular/solidarity economy – to guide the transition towards sustainable agriculture and food systems (FAO, 2018a, p.15; FAO, 2018c). The High Level Panel of Experts (HLPE) on Food Security and Nutrition further suggests an agro-ecological approach to sustainable food systems (SFSs) is:

> …defined as one that favours the use of natural processes, limits the use of external inputs, promotes closed cycles with minimal negative externalities and stresses the importance of local knowledge and participatory processes that develop knowledge and practice through experience, as well as scientific methods, and the need to address social inequalities. (HLPE, 2019, p.39)

Building upon the ten elements of agro-ecology developed by FAO, the HLPE elaborated a consolidated list of 13 principles organized around the three operational principles for SFSs: **improve resource efficiency**, **strengthen resilience** and **secure social equity/responsibility** (HLPE, 2019).

Why study, teach, apply and scale-up AE? Agro-ecology can contribute to multiple SDG***s*** while realizing the aims of the Paris Climate Agreement, the Convention on Biological Diversity, the Convention to Combat Desertification, United Nations Declaration on Rights of Indigenous Peoples, United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas, and other international legal instruments. The current research, education and extension systems, however, do not adequately incorporate AE values, knowledge or tools (FAO, 2018a). Agroforestry, organic agriculture and conservation agriculture, for example, can reduce soil erosion, prevent desertification and help sequester carbon. Organic agriculture can help reduce CO_2 emissions and poverty while meeting other SDGs (ADB, 2015; FAO, 2011). A special Intergovernmental Panel on Climate Change (IPCC) report addressing food security, agriculture and land concerns underscored that:

> agroecology (including agroforestry), conservation agriculture and forestry practices, crop and forest species diversity, appropriate crop and forest rotations, organic farming, integrated pest management, the conservation of pollinators, rain water harvesting, range and pasture management, and precision agriculture systems" can "help adapt to and mitigate climate change while…combating desertification" that "are site and regionally specific… (IPCC, 2019, p. 24).

And, the latest IPCC report with high confidence and greater urgency reinforced implications of anthropogenic climate change affecting agriculture and food security (IPCC, 2021, p. 39, passim).

Universities could partner with indigenous peoples, farmers, local experts, non-governmental organizations, governments, and others to better assess AE knowledge, technologies and impacts for various international agreements, unique ecogeographies, sociocultural groups, gender issues, specific local community concerns, crop system diversity or resilience, climate conditions, mitigation strategies and countries.

The key role of higher education institutions (HEIs). For decades, many universities through their teaching, research agendas and employed graduates contributed significantly to a multitude of sustainable development problems that SDGs now aim to address. HEIs embraced Green Revolution technologies using conventional, mono-crop, agrochemical-dependent agriculture without adequately protecting genetic crop diversity amid narrow, scientific specializations. They did so often, collaborating with the international agriculture research system. This arguably saved millions of lives from starvation, but research and agrochemical input-dependent technical solutions often ignored many complex socio-economic and agronomic problems while devaluing organic agriculture without adequately studying social issues or addressing environmental impacts (Nelles, 2011). In addition, top-down technology transfer models typically discounted participatory, interdisciplinary and ecological approaches (Ison, 1990; Nelles, 2011). Many HEIs have still not adequately reformed teaching, research, learning or extension relationships with smallholder farmers to better serve rural communities (Acker and Gasperini, 2008; Nelles, 2016). Yet promising innovations in AE theory, research and teaching among some HEIs have been ongoing over the past few decades (e.g. Altieri and Francis, 1992; Anderson, Maughan and Pimbert, 2019; Cely *et al.*, 2021; Code, 2017; David and Bell, 2018; Francis *et al*., 2017). Now, there is also good potential for many HEIs to further transform their approaches and systems in order to better transition toward more sustainable food systems (HLPE, 2019).

Five essential HEI pillars to support an agro-ecology-based transition. A transition to SFSs requires mainstreaming and strengthening AE for agrifood system literacy (essential values, knowledge and skills) embraced across the university – from teaching to enabling policies, research incentives and curricula, to food services procurement, community engagement and extension services. Transformation of food systems through AE requires transformations in the approaches used to study, measure and assess agricultural performance, and shifting from uniformity of indicators (often narrowly based on "yield" and "productivity") to a diversity of multi-dimensional indicators to address at least three core dimensions of sustainability – sociocultural, economic and ecological. The shift requires interdisciplinary knowledge and cross-departmental collaboration drawing from social and sustainability sciences, including rural development studies, sociology or anthropology, gender research, community health, political science, and other fields to better understand and empower peasant organizations, encourage genuine indigenous partnerships and support small family farming to complement agronomy, biology, botany and other technical fields for crop production knowledge.

Five HEI pillars (common in many universities worldwide) are essential to building or strengthening AE foundations: curricula, scientific research, national and campus policies, university-based extension, and institutional assessment research with campus sustainability reporting elaborated on.

1. ***AE curriculum, learning resources and teaching***. Critics long ago called for better integration of agro-ecology or agrifood sustainability issues into university curricula, learning and teaching (Ison, 1990; Altieri and Francis, 1992). In Southeast Asia, some institutions began reorienting their curricula toward sustainable agriculture, but others lagged (and still do) because of curriculum development approvals, lack of staff or faculty capacity or skills to teach sustainable agriculture, and faculty resistance or skepticism to change (Villareal *et al.*, 2002). FAO more recently stressed the need to "redesign educational programs to integrate agro-ecology in the curriculum… (including) higher education..." (FAO, 2018b, p.112). A typical AE curriculum can include learning about agroforestry, organic agriculture, conservation agriculture, integrated pest management or integrated crop management, systems of rice intensification, and more. But there are a lack of qualitative or quantitative studies about how AE is taught or learned in Southeast Asia. One curriculum reform-teaching challenge concerns critical thinking and problem-solving skills while learning AE content as well as specialized theory and technical knowledge in courses or academic programmes, typically agriculture or food systems studies. Another challenge relates to the context-specificity of agro-ecological sciences. It implies understanding ecological principles and their adaptation to a specific context, as opposed to conventional curricula that focus on specific "recipes" or "practices" under the premises of "one size fits all." Agro-ecological curricula also favour multi-disciplinary approaches. They encourage mainstreaming AE-related ideas, values, content and perspectives across other disciplines, research fields, and courses such as rural sociology, anthropology, engineering, business, education, politics, law, indigenous studies, gender studies, medicine, health policy, sustainability science and environmental studies, agronomy, mathematics, genetics, biology and others. New AE education and research investments can address essential reforms and promote innovations crucial for COVID-19 pandemic recovery (FAO, 2021, pp. 7, 11; Nelles, 2019). Moreover, AE education mainstreaming can build AE competencies and skills to help students find or create decent green agriculture or food system jobs to genuinely serve rural and indigenous communities while protecting ecosystems. One Thai case study illustrates elements of one approach to document and assess organic agriculture curricula.

Thai HEI case study: State of organic agriculture curriculum and teaching

Agriculture is important to Thailand's national economy and society (around 9 to 11 percent of gross domestic product), with some 6.5 million registered family farms. Thailand is known as the "kitchen of the world", providing agrifood related jobs for farmers, processors, traders, exporters and street food vendors. But agriculture is still a major contributor to a multitude of environmental problems fueled by agrochemical dependency and abuse, with adverse social and health impacts while organic crops cover just 0.2 percent of cultivated land area, well below the global average of 1.4 percent. The role of HEIs in reproducing or promoting unsustainable agriculture needs closer study. Preliminary Thai data suggest that 49 HEIs of 120 universities reviewed in online documentation had agriculture programmes or courses. Among them, only 26 (half) offered one or more course(s) or teaching programmes on organic agriculture topics. Only one HEI, Thammasat University, offered a full Master's Programme on organic farming management. Among the 49 HEIs, only Maejo University had an explicit aim, even a strategic "roadmap," to become a leading university in organic agriculture so ultimately all courses, research farms, and food services on the campus would become fully organic. However, despite some progress in policy thinking, new curricula and limited government support for organic agriculture practices, there is still a lack of critical thinking or strategic, integrated long-term planning for sustainable agriculture or organic agriculture education in Thai higher education. Moreover, universities, despite some study or promotion of the late King's sufficiency economy philosophy, still largely support agrochemical-dependent approaches over more sustainable organic and sustainable agriculture alternatives in research, teaching or extension services (Visetnoi and Nelles, 2018, p. 4).

Similar or related studies are needed to better understand how AE is taught and learned in HEIs across Southeast Asia and beyond, and curricula needs to be improved to address gaps.

2. ***Scientific research on AE evidence, partnerships and learning.*** There is still debate among scientists, farmers and policy-makers about land-use requirements or production capabilities of AE, or specific practices such as organic agriculture to "feed the world" while avoiding agro-chemical inputs or contentious genetically modified organisms and biotechnologies. Multidisciplinary research needs to better address AE critics with new studies providing reliable evidence on how AE can facilitate SFSs. More studies must improve organic agriculture assessments and methods for agro-ecological scaling up (DeLonge *et al*., 2016; Niggli *et al*., 2017). For example, preliminary analysis for Asia already demonstrates multiple organic agriculture values (ADB, 2015). But, if investments in general AE or, specific practices such as organic agriculture, are indeed cost-effective, then HEIs should collaborate with national and international agriculture research institutions (e.g. Consortium of International Research Centers), and development partners to study implications for the agro-ecology scaling up challenge. Social and sustainability sciences generally need strengthening in agriculture research to achieve SDGs and encourage AE innovations (Nelles *et al*., 2021; Nelles, 2019; Nelles, Vize and Wun'gaeo 2014; Nelles, 2011). AE research investments must better include socio-economic studies of AE costs and benefits (studying yields, income generation, environmental services, nutrition and health dietary improvements) for specific countries, product types, crop-fisheries-livestock systems, ecogeographies and communities. New research and knowledge co-creation tools can be developed to analyse AE performance (e.g. FAO, 2019). Egalitarian partnerships are also essential to document, analyse, apply and validate AE knowledge. Scientific

methodologies should especially include participatory AE research with rural communities, indigenous peoples, peasant organizations, family farmers, women's groups, youth or students, and others. They should prioritize understanding traditional knowledge systems, social-ecological relationships, diverse learning processes and evidence-based policies to encourage HEI reforms that enable and enhance AE transitions for sustainable food systems.

3. ***National and campus policies for AE mainstreaming.*** Enabling policies and budgets (national and campus-specific) for AE mainstreaming in HEIs are essential for countering or mitigating the adverse effects of the currently unsustainable agrifood system. New AE education investments are vital to address multiple challenges exacerbated by the COVID-19 pandemic (FAO, 2021). Many issues need policy support to incentivize study and innovation to better design, promote and strengthen AE alternatives (particularly in the field and at rural community levels) while scaling-up best practices in new curricula, faculty teaching, research, campus sustainability in food services or procurement, extension services and more. A regional workshop on AE in higher education at Maejo University, 26–27 June 2019, conducted a SWOT analysis (strengths, weaknesses, opportunities, threats) on related themes. One small SWOT group on policies noted greater potential to work with Southeast Asia Ministers of Education Organization, in particular the - Southeast Asian Regional Center for Graduate Study and Research in Agriculture, and various regional university networks (e.g. Asian Association of Agricultural Colleges and Universities) as platforms to propagate AE. The group suggested the need to: a) hold regular knowledge sharing meetings; b) solicit government support for research and development funding for AE and extension; c) set up a regional AE network or professional alliance; and d) develop university policies to support AE career paths of faculty members.

SWOT analysis of Association of Southeast Asian Nations agro-ecology policies

Strengths	**Weaknesses**
▪ National strategy to policy in organic agriculture ▪ Structural reform – Thailand's Ministry of Education, Ministry of Science and Technology, Ministry of Agriculture ▪ Ecotourism and Agrotourism	▪ Difficulty introducing AE in HEIs ▪ Difficulty attracting young students to agriculture ▪ Lack of promotion of AE (budget problems) ▪ Lack of understanding of AE among faculty ▪ Not supportive of career paths of faculty members ▪ Lack of official network for AE
Opportunities	**Threats**
▪ Change young generation mindset to agriculture ▪ Non-government and civil society organizations can bridge policy-makers & HEIs ▪ University consortium – Southeast Asian Regional Center for Graduate Study and Research in Agriculture and other university networks ▪ Integration budget for promoting organic agriculture helping farmers partnerships ▪ AE products – higher prices	▪ Co-payment of tuition fees problematic when tuition is requested to be waived ▪ Lack of policy in support of AE (e.g. Myanmar) ▪ Standards for certification of organic products (i.e. costs are too high)

Source: Chulalongkorn University, 2019

That SWOT analysis, from a small focus group, was part of one preliminary research output generated by various HEI partners from across Southeast Asia. While it was a useful first step, broader collaboration is needed to better analyse HEI policy issues through further identification, elaboration and in-depth study of data and operational imperatives to address the practical challenges arising.

4. ***University-based rural extension, farmer services and AE evidence.*** Historically, universities have not served Asian rural communities well (Atchoarena and Holmes, 2004). A weakened public extension sector and creeping privatization over the past decade encourages agrochemical dependency and inadequate public investments in independent science or farmer extension services for AE alternatives. It also reinforces farmer addiction to expensive and often unnecessary pesticides, herbicides, fertilizers and other toxic agrochemicals (Nelles and Visetnoi, 2016). Some preliminary studies also indicate that many universities still do not have agriculture extension offices or academic programmes (Nelles and Visetnoi, 2017). Moreover, many universities lack adequate vision, expertise or commitments to sustainable agriculture, rural youth or farmers. For example, in Thailand only 6 out of 49 universities teaching agriculture had extension programmes (Visetnoi and Nelles, 2018). Without further research, it is not clear how they promote AE approaches, and how HEIs contribute to reducing agrochemical use, changing farmer behaviour or long-term impacts on poverty reduction, environments, health, gender equality, human rights or food security (Nelles, 2015). However, rural advisory or extension services could be improved with HEI partnerships to better study impacts while assessing AE's multiple values. In particular, there is a timely and important opportunity for academics to collaborate with farming communities, indigenous peoples and national agriculture extension services to test and implement a new tool for agro-ecology performance evaluation (TAPE). FAO developed this tool (2019) in collaboration with more than 70 experts to build evidence and collect data while encouraging the co-creation of new knowledge about sustainable agriculture and the multi-dimensional performance of agro-ecological approaches. TAPE can provide an evidence-based framework for the re-design of research and development programmes, as well as rural advisory services or extension programmes for their improved alignment with agro-ecology principles **(**FAO, 2019).

5. ***Institutional sustainability assessments/reporting, evidence-based policy dialogue and reforms for AE*.** There are at least 6000 HEIs in Southeast Asia (ASEAN Secretariat, 2014), yet no publicly available or reliable databases collect, update or synthesize accurate statistics or document and assess HEI curricula, research or extension. Moreover, specific data on AE curriculum, learning resources, policies, enrollments and extension services as well as their impacts on student career choice, communities, labour markets and society need to be systematically collected, compared and then used as evidence to inform academic administrators, policy-makers and curriculum developers. Educational, science and technology priorities for AE by governments, international agencies and others also need better mapping, assessment and higher priority in public investments and budgets. New work could

build on organic agriculture education mapping in the Thai case noted earlier, as well as university sustainability reporting trends (e.g. Adams, 2013). Some work has also begun among HEIs to study and assess their SDG progress and implementation (SDSN Australia/Pacific, 2017). It has recently included attention to SDG2-related issues in Southeast Asia some implicating agro-ecology (Nelles *et al*., 2021). Building on related work, HEIs partnering with FAO, donors and others could develop new or improved tools, methods, evidence and databases to better track and evaluate AE education, learning processes, research and extension outputs and impacts. Such work should especially encourage participatory research, multi-disciplinary perspectives and egalitarian partnerships with small-holder farm families, local communities, indigenous peoples, rural youth or students, women's groups, and others. Moreover, we must go beyond just documentation or reforming institutionally specific policies relevant to AE mainstreaming or innovations on individual campuses. We need to better gather and analyse relevant AE data while utilizing AE studies to inform evidence-based policy dialogues that encourage broader AE-related innovations and reforms in national public education, science and technology policies and budgets. Such efforts could help to mainstream AE knowledge, values and practices across more HEIs and society at large. Improved national policies, are essential to enable agro-ecological-educational transitions that support a sustainable food system.

Conclusions and recommendations. Recent efforts have aimed at documenting, analysing and supporting sustainable agrifood systems among Southeast Asian universities and colleges while achieving the SDGs through regional cooperation (Nelles and Ferrand, 2021; Nelles *et al*., 2021). With greater support for institutional reforms based on five pillars – curricula, research, extension, policies, and sustainability assessments/reporting – more HEIs could collaborate with FAO and other agencies, regional organizations, governments and donors to scale-up AE innovations and alternatives. They all should:

1. **Commit** to developing a regional agro-ecology learning and research strategy for the **sustainable transformation of the Southeast Asian agrifood system**.

2. Systematically **survey and document AE activities of HEIs** in publications, student theses, policies, programmes, curricula, research agendas, projects, budgets, human resources, skills, training programmes and extension services in Southeast Asia.

3. **Synthesize, increase availability of and utilize** results of national and local case-specific, multi-disciplinary **empirical evidence** about multiple sociocultural, economic, environmental, agronomic and production values of agro-ecology, and contributing factors for AE transitions. Support academic partners with farmers to collect relevant data while mobilizing FAO's new **tool for agro-ecology performance evaluation.**

4. **Monitor and evaluate** agro-ecology policies, programmes, curricula, research agendas and farmer-scientist partnerships and activities among the 6000 plus HEIs

of the ASEAN region to document and understand measurable contributions of AE to achieving SDGs.

5. **Convene** multi-stakeholder **evidence-based policy dialogues** on the multi-disciplinary scientific bases for AE, aiming to overcome barriers to SFSs transitions, and reconcile technical, social, intellectual and political differences to upscaling AE in Southeast Asia

6. **Facilitate** the development of **evidence-based AE transition and upscaling plans for the HEI sector** based on five pillars: a) curricula; b) research; c) extension; d); policies; and e) sustainability assessments/reporting to address AE learning, research and extension needs and gaps.

7. **Pilot** a **common AE curriculum with ASEAN** for selected HEIs, including an introductory **massive online open course** for Southeast Asia.

8. **Design and launch an updateable online, open-source database** of AE studies, education policies, courses, modules, programmes, student theses and research projects in Southeast Asia to assist teaching, reforms, academic mobility and exchange, and research collaboration.

9. **Produce and publish** (triennially) a high-quality, data-rich, evidence-based, peer-reviewed technical-analytical ***Report on the state of agro-ecology research, learning and extension in Southeast Asian higher education institutions,*** including national assessments and case studies with a companion volume on ***Best Practices and Programmes***.

10. **Establish, build and grow** a new ***Southeast Asian university network on agro-ecological transitions (SEA-UNAET)*** to support and sustain regional teaching, learning, research collaboration, extension and capacity building for all the above.

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Web resources for further consultation

- Agroecology Learning Alliance in South East Asia (https://ali-sea.org/online-library/)
- FAO Agroecology Knowledge Hub (http://www.fao.org/agroecology/home/en/)

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