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Bioeconomy in Thailand: a case study

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Matthew Fielding

May Thazin Aung

Stockholm Environment Institute
Linnégatan 87D Box 24218
104 51 Stockholm Sweden
Tel: +46 8 30 80 44
info@sei.org
Author contact: Matthew Fielding, matthew.fielding@sei.org
Editing: Caspar Trimmer
Layout: Richard Clay
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In partnership with the private sector, the Thai government is making a major commitment to building a modern bioeconomy to export to markets around the world. Thailand's emerging bioeconomic development is unique in its institutional set-up as well as its scope. In particular, the private sector reportedly sets the agenda for development, while the government provides financial, regulatory and human capacity support. Additionally, the current approach to bioeconomy development in Thailand is top-down, and assumes that the success of major industrial players will benefit all actors in the system, including small farmers. In terms of scope, Thailand's roadmap for the bioeconomy is unique in that it focuses on adding value and making derivative products out of commodities that Thailand already produces in world-leading quantities. Yet despite the private sector's stated willingness to take the bioeconomy forward, it is still a calling on the government to ease regulations.

This report represents a snapshot of the emerging Thai bioeconomy as it was in 2017 and can serve as a case study for national planning and further research on the emergence of modern bioeconomies. The information and opinions provided in the interviews have been supplemented by additional relevant research. It was not always possible, given the limited resources for the study, to independently verify information provided in the interviews. Additionally, only English-language sources were consulted.

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1. Introduction

The bioeconomy has been identified as a key component in the global sustainability transition (El-Chichakli et al. 2016; Kircher 2014). A key driver has been the world's heavy reliance on non-renewable, fossil-based resources, which has serious ecological, socio-economic and environmental impacts (Kircher 2012; Langeveld et al. 2010). At the same time, farming and forestry in developing economies often operate at low levels of productivity and create poverty traps, as a result of climate change impacts, soil erosion and other challenges (El-Chichakli et al. 2016; Fielding et al. 2015).

Neither these modes of production nor a fossil-based economy is sustainable in a world with growing populations and material needs. Within this context, the bioeconomy offers a more productive and prosperous future for those depending on agricultural systems. Yet the transition towards a modern bioeconomy depends on commitment from stakeholders, enabling regulatory and trade environments, and technology for success.

In 2016–2017, SEI carried out three scoping case studies of national approaches to bioeconomy development, in a developing economy (Kenya), in an emerging economy (Thailand) and in a developed economy (Sweden). These were supported by seed funding from the Swedish International Development Cooperation Agency (Sida). These studies were used to inform the development of the new SEI Bioeconomy Initiative (2018–2021). Each case focused on issues that were disproportionately relevant in the country's development context but also represented the economic conditions in the respective regions. The case studies were not intended to be exhaustive and comprehensively address all components and inter-relationships within the bioeconomy. Rather, they offer insights into key aspects of each case.

The present study looks at Thailand. The information presented in the study is largely drawn from interviews with three Thai bioeconomy stakeholders, between December 2016 and February 2017. In addition an independent smallholder rice farmer was interviewed specifically for the section on Farmers and SMEs.

2. Overview of the Thai bioeconomy

Thailand is currently the world's second largest exporter of refined sugar (Workman 2017b) the largest exporter of natural rubber, and the second largest exporter of rice globally (Workman 2017a).

Despite much of the economy already being bio-based, in January 2017 it was announced that Thailand was developing a roadmap for further development of the bioeconomy. The plans focus on developing high-value products from existing economic crops, starting with sugarcane and cassava (Thailand Public Relations Department 2017). Based on our research we have established that the approach appears to have two key elements:

- Improving production efficiency and yields through better farming techniques, improved technology
- Value-adding and diversification of products derived from existing commodities

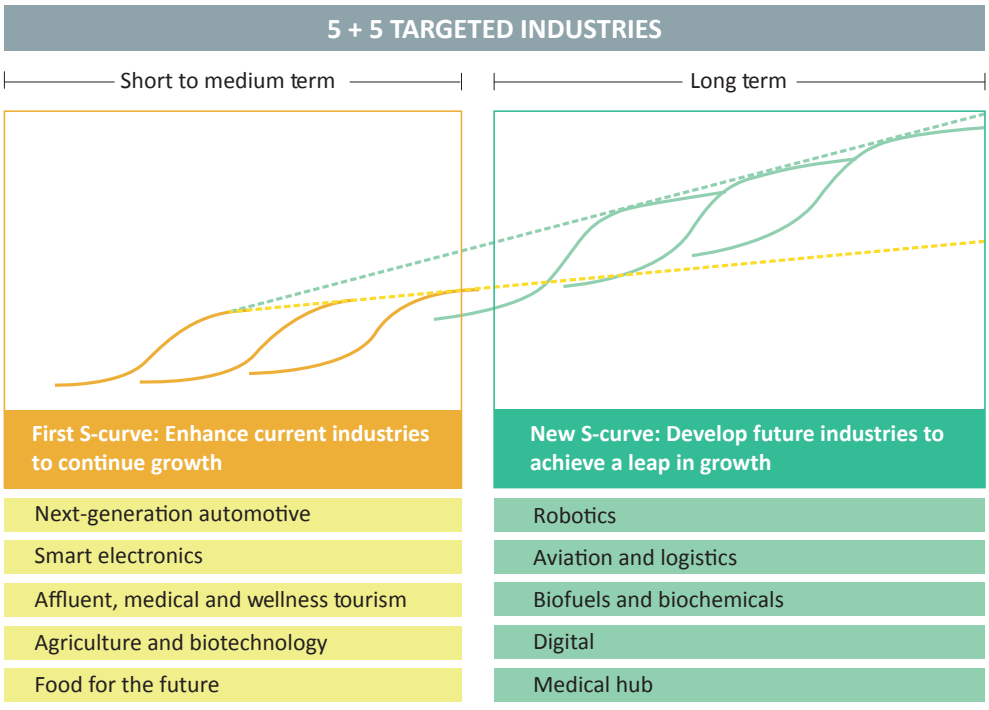
Due to its relatively developed infra-structure, Thailand has many more options than its neighbours within specific areas of the bioeconomy

According to one interviewee, the roadmap does not include extending cultivation of major crops such as rice, sugarcane, rubber and cassava, which are already produced on a large scale. The Deputy Prime Minister explicitly stated that "existing economic crops would be used to develop high-value products in an effort to build a bioeconomy . . ." (Thailand Public Relations Department 2017).

Parts of the bioeconomy feature in both of the "short to medium term" and "long term" plans to develop key industries under the Thai government's phased economic development plan, Thailand 4.0 (see Figure 1). Under the short to medium term plans, the bioeconomy is included in *agriculture and biotechnology* and *food for the future*; and under *biofuels and biochemicals* in the long-term plan. Thus, the bioeconomy should be seen as part of a much wider effort to bring Thailand to the forefront of global industrial development.

However, one interviewee noted that despite this openness and initial support for the bioeconomy, a clear national policy and roadmap for growth still needed to be finalized.

Figure 1: The near-term and long-term priority industries under the Thailand 4.0 development plan



Competitive advantages in bioeconomy development

Due to the relatively developed infrastructure Thailand has built over the last 20 years, Thailand has many more options to choose from than its neighbouring countries within specific areas of the bioeconomy. These have been separated below into three groups:

- Biochemical
  - bio-plastics (using extracted plant starches – lysine)
  - bio-pharmaceuticals (medicinal herbs, extracts, Chinese medicines)
  - bio-additives (starches, antioxidants, vitamin powders to enrich food/feed)
- Bioenergy
  - bioethanol
  - biodiesel
  - bio-electricity
- Biofarming
  - improved farming methods – (precision farming – co-developed with other industries)
  - bio-based agricultural inputs – (herbicides, fertilizers and pesticides)
  - germplasm improvement – (disease/drought resistance)
  - bio-control (using soil micro-organisms and fungi to treat crops against pests).

Thailand offers a number of competitive advantages for the development of bioeconomy. The Dutch company Corbion identified the following reasons for investing in a new bioplastics plant on Thailand's Eastern Seaboard (Van der Linden 2017a):

1. Excellent sources of multiple raw materials
   - sugar
   - starch (rice, cassava and sugarcane)
   - and for the future: biomass
2. Well-developed country
   - government
   - education
   - infrastructure
   - utilities
3. Excellent support from authorities
   - Board of Investment, Ministry of Commerce, Office of Sugarcane and Sugar Board, Industrial Estate Authority of Thailand
   - co-funded R&D (government and private sector)
4. Excellent logistics location
   - close to two main seaports
   - air links regionally and globally.

According to one interviewee, the proposed institutional support system for the bioeconomy has a top-down structure that is intended to benefit all actors within the system and ensure the external competitiveness of the sector. The system is steered by a high-level committee called the Steering Committee on Cluster Development for New Growth Industries, including industry actors from state-owned energy enterprise PTT; the Mitr Phol Group, Thailand and Asia's largest sugar and bio-energy producer; and Charoen Pokphand Group, Thailand's largest conglomerate, with interests ranging from in agribusiness and food, retail and distribution, to telecommunications industries. Government representation on the committee includes the Department of Agriculture and the public-private research institute BIOTEC[1], which leads the committee. Roles and expectations between private firms and the government are clearly defined. Private firms who drive innovation in technology, research and implementation of the bioeconomy through investments are given tax incentives.

1 The National Center for Genetic Engineering and Biotechnology (BIOTEC) is a public-private research institute under the National Science and Technology Development agency with specialized laboratories conducting research on agricultural, biomedical and environmental sciences. It is a semi-public administrative body outside the civil service but receiving financial support from the government, which makes senior appointments to it.

3. Roles of government and private sector

Government

The Thai government's role is closest to that of a facilitator, supporting the private sector by financing research and development (R&D), easing regulations on the industry and building capacity in the labour force. One interviewee stated that it is the private sector which will spearhead bioeconomic development. The government is interested in supporting a "value adding" process, as it believes that Thailand is stuck in a middle-income trap.

Finance

On the finance side, the government and the Thai Board of Investment (BOI) have deemed investments within bioeconomy as "privileged" according to one interviewee and would be "ready to discuss" extra incentives for these investments (Changsorn 2017). These "privileged" investments can take advantage of a 0% import tax for equipment produced outside Thailand and exemption of corporate income tax for up to eight years, with an additional 50% reduction for five years (Thailand Public Relations Department 2017). The government and BOI are also planning to prioritize support for investments within the Eastern Economic Corridor (EEC)[2] and provide over 1.5 trillion THB (45.7 million USD) in financial support over the next 10 years (Changsorn 2017) to ensure success.

Additionally, the government has already invested significantly in R&D. For example, in 2007 it allocated 120 million USD for biotechnology research, of which public research centres received 46%, academic institutions 39%, and private-sector actors 15% (Waramit 2012).

Regulation

On the regulatory side, the government was in the process of revising the 1984 Cane and Sugar Act in 2017 and at the time of the interviews was reportedly prepared to rescind regulations limiting the use of food crops in biofuel production. This law, designed in part to ensure an adequate domestic supply of sugar, requires that to sell sugarcane to a sugar mill, a farmer must be registered as a "sugarcane planter". These planters are members of one of 33 planters associations, and each of the associations must sell at least 55% of its members' total harvest to a sugar mill for production of sugar (Manivong and Bourgois 2017). Public opinion holds that removing the law would then allow an increase in the production of bioethanol. An interviewee added that removing such regulations faced opposition from civil society related to the GMO and food/fuel debate (see e.g. Rosillo-Calle and Johnson 2010).

The interviewees commented that there is a sense that the government is waiting for the "green light" from BIOTEC and the private sector before fully backing bioeconomy development. There are clear indications, however, that the government will indeed move ahead with developing the bioeconomy. The Minister of Industry cautiously suggested that PTT and other private investors were "nearly committed" to the first phase of bioeconomy projects (Changsorn 2017). Thailand's growth has attributes previously seen in South Korea, which was itself modelled on the post-war recovery strategy of Japan: subsidizing industrial growth as a means of accelerating the adoption and expansion of a new industry in order to make it competitive enough to compete in a global market.

In early 2017, launching the national "bioeconomy scheme", the government announced that it was hoping to attract 400 billion THB in investment in the bioeconomy projects in three phases:

Phase 1 (2017–2018): 51 billion THB (1.5 billion USD)

Phase 2 (2019–2020): 182 billion THB (5.5 billion USD)

Phase 3 (2021–2026): 132 billion THB (4 billion USD)

2 The Eastern Economic Corridor is a strategic investment zone located on Thailand's Eastern Seaboard, southeast of Bangkok. The area contributes 20% of the country's GDP (Government Public Relations Department 2016). For more information see www.eecthailand.or.th/en.

These projects would be in Rayong province (in the EEC), which has existing infrastructure (Changsorn 2017).

Capacity building

The government is already offering scholarships to support the development of the future bioeconomy workforce and is making progress within academia and in fields related to the bioeconomy (Waramit 2012). The National Biotechnology Framework for 2012–2021 describes increased support to develop human capacity within the biotechnology field through the Human Resource Development Program (Ministry of Science and Technology 2012). The aims are to increase the number of individuals working within related fields to the bioeconomy through scholarship, research and training support (Waramit 2012) and to support over 400 PhD candidates over the next few years. Specifically, one interviewee noted that the National Science Technology and Innovation Policy Office in 2016 aimed for 4000 new PhDs in food and agriculture, medicine and health, bioenergy and the bio-based industries. The government also plans to improve biotechnology curriculums at undergraduate and graduate levels (Ministry of Science and Technology 2012). According to interviewees, firms within the bioeconomy sector can access generous 300% matching funds for investments in R&D.

The National Biotechnology Framework for 2012–2021 describes increased support to develop human capacity within the biotechnology field

Bioethanol

Under Thailand's Alternative Energy Development Plan 2015, by 2036 the total share of renewable energy in the energy mix should reach 30%, and the share of biofuel energy in total renewable and alternative fuel energy use is targeted to increase substantially from 7% to 25%. (GAIN 2017).

The bioenergy sector is supported by the government's commitment to develop the biofuels market. The target under the Alternative Energy Development Plan 2015 is to increase ethanol consumption from 1.18 billion l. to 4.1 billion l. by 2036, and biodiesel consumption from 1.24 billion l. to 5.1 billion l. by 2036 (GAIN 2017).[3] As part of this, through fuel price subsidies and excise tax incentives, the government is supporting increasing the vehicle fleet that can run on E20 and E85 ethanol-gasoline blends (GAIN 2017).

Sugarcane and cassava are the two main feedstocks for bioethanol production, with sugarcane dominating the market (70% of all ethanol production) due to its lower production cost (Lakapunrat and Thapa 2017).

The Mitr Phol Group is positioning itself to pursue the highest-value for sugar derived products and for this reason, is a major pioneer in the development of the bioeconomy. Based on its political clout, financial capacity, advanced infrastructure, human and research capacity and market power.

Figure 2 shows how the Mitr Phol group sees opportunities for adding value in the sugarcane value chain. It has already been using by-products of the sugar production process to produce energy for 10 years, and currently intends to develop the biochemical business. It intends to produce products as diverse as cosmetics, fertilizers, bioplastics and cement blocks from fly ash.

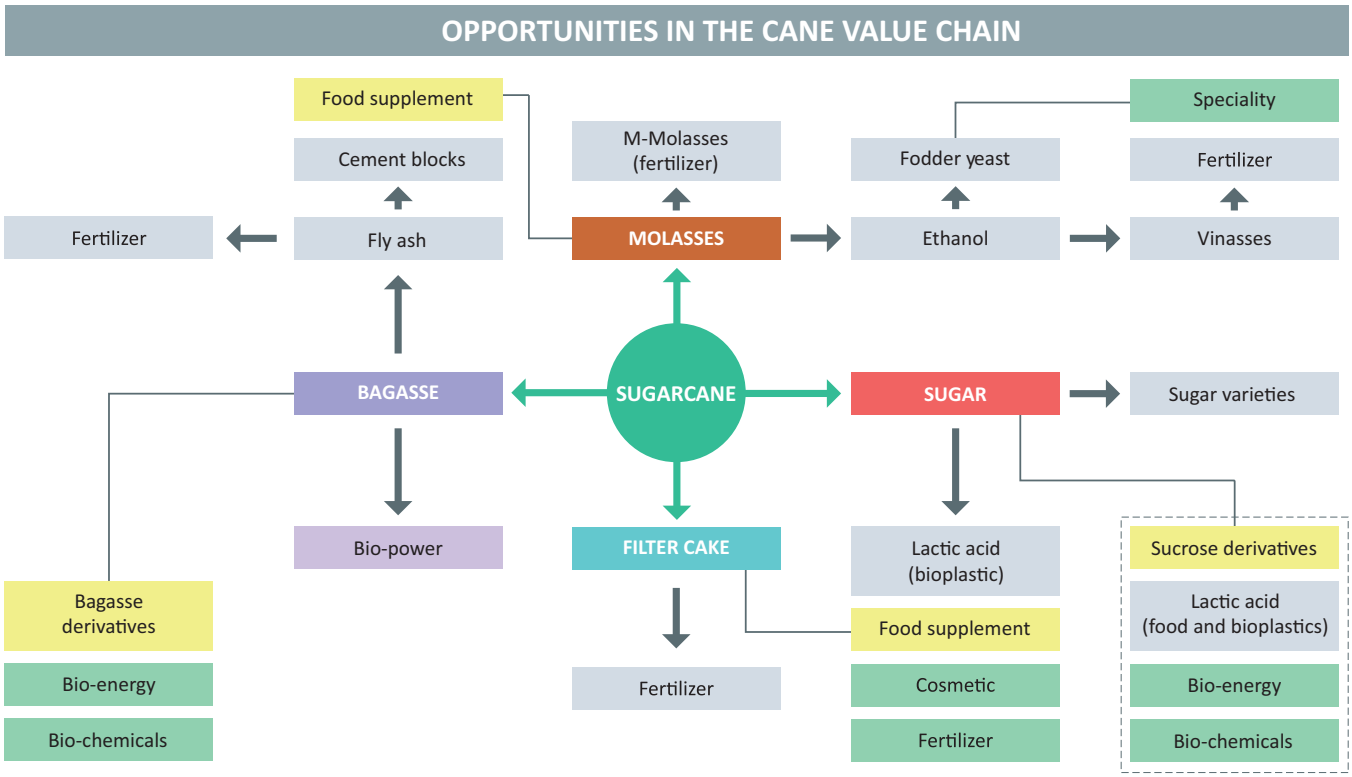
Food additives and bioplastics

Lysine starch is produced from sugarcane or cassava. It can be used in a multitude of food/feed uses and to produce bioplastics. It is widely cited as a key area in which Thailand is equipped to lead global production.

The Dutch company Corbion has been active in Thailand since 2005. It produces lactic acid, which can also be used in bioplastic (PLA) production, using sugar as a raw material. The Corbion factory in Thailand is the largest lactic acid factory in the world, producing 120 000 tons of acid annually (Van der Linden 2017a). The lactic acid is used in food processing and for the production of over 25 000 tons of bioplastics. Corbion exports bioplastic packaging to the European Union, north Asia, Taiwan, Japan and South Korea in the form of food packaging, food storage products and plastic bags.

3 Note that "...the Ministry of Energy is reportedly revising the plan's targets downward due to lower petroleum price expectations and limited feedstock supplies of ethanol and biodiesel." (GAIN 2017).

Figure 2. Mitr Phol's vision for the sugarcane value chain



Source: Based on "Cane value chain: opportunity" by Mitr Phol Group

Corbion is an example of a foreign firm that sees much potential in Thailand's bioeconomy. The abundant availability of inputs for their products such as sugar, starch and biomass has much appeal. Additionally, Corbion sees that support from government authorities such as the Thailand Board of Investment, the Ministry of Commerce and others creates favourable conditions for investment.

Other sectors

Another emerging industry in Thailand is biopharmaceuticals. One interviewee highlighted that currently the sector is reportedly operating "at the SME level", with around 80% of drug companies being local companies. The government is supporting this industry by funding R&D in biotechnology, offering tax privileges and investing in science infrastructure (Thailand Board of Investment 2015).

Thailand has a strong germplasm improvement programme. In addition, one of the innovations that Thailand wishes to prioritize is described as "bio-farming". This refers to efforts to reduce the application of chemical inputs such as herbicides, fertilizers and pesticides through techniques such as precision farming. Thailand is developing bio-controls and bio-fertilizers from micro-organisms and food waste to reduce traditional chemical inputs. BIOTEC reportedly has the biggest collection of micro-organisms in Southeast Asia, which can be used in a variety of applications (e.g. for pest control). Thailand also intends to transfer innovations in this sector to other countries in South East Asia, according to one interviewee.

4. Farmers and small and medium-sized enterprises

The consolidation of smallholder farmers into small and medium-sized enterprises (SMEs) and cooperatives was raised in several interviews. This practice by the regional governments is not only intended to promote knowledge sharing among farmers but also makes it logistically easier for the government to interact with farmers. One interviewee gave an example of this support: "BIOTEC is trying support cooperatives/SMEs through new market development, for example in organic produce and bio-fertilizers, which the government sees a potential niche markets for Thai industries". The government, under the current biotechnology policy framework, is working to establish a private business-led biotechnology fund to help SMEs access advanced technology, enhance research and access private low-interest loans. The government also plans to develop regional infrastructure such as labs, technology parks and incubators linking R&D with business to improve access for SMEs (Ministry of Science and Technology 2012).

At present, there appears to be no successful government mechanism for aggregating smallholder farmers into larger groups such as cooperatives and there is a lack of information about how the government has operationalized smallholder farmer conversion into formal SMEs. While the specific mechanisms for agricultural reform under the bioeconomy are unclear, in the past Thailand has implemented programmes targeted at supporting smallholder farmers in moving towards the state vision of modernized agriculture. One major form of support has been in preserving the smallholder farming sector itself and to this day, Thailand still has a large proportion of smallholder farmers (Rigg et al. 2016; Schoenberger et al. 2017). This is a legacy of the state protection of smallholders through a programme during the 1960s and 1970s, when the state moved millions of smallholder farmers to forested upland areas to cultivate cash crops which prevented the take-over of land by large foreign owned plantations (Schoenberger et al. 2017).

While these farmer-focused programmes might have had benefits, issues such as inequality have not been addressed. For instance, the government has encouraged contract farming since the 1980s and it remains a widespread practice throughout Thailand (Tukaew et al. 2016). In contract farming, a farmer makes an agreement with an agribusiness to purchase a specific amount of a crop for a predetermined price. Whilst the benefits allow farmers to access technical knowledge, improved farming methods, price stability and sometimes better access to loans, its downsides are that farmers have little negotiating power and little say in the production methodology, limited freedom and lack of social welfare benefits and lack of a safety net if things go wrong (OECD 2013; Tukaew et al. 2016).

While farmer-focused programmes may have had some benefits, issues such as inequality have not been addressed

The Thai government borrowed $200 million in order to accelerate land titling in Thailand in the 1980s as part of the World Bank land reform programme. The programme had many complications and reportedly for some, led to the loss of public lands and village lands to outsiders (Lang 2012). Other state programmes such as subsidies or cash initiatives to switch from rice to more profitable crops such as sugarcane and rubber have had a disproportionate impact on untitled farmers, as many have required formal title deeds and contracts for participation. Aside from formal land tenure, other factors such as land holding size, availability of farm labour, type of commodity and age of farmers have limited the success of these programmes (Lakapunrat and Thapa 2017; Sakayarote and Shrestha 2017).

An interview with an independent rice farmer gave us some insight into the government's attempts at grouping small farmers. According to the interviewee, rice farmers in Thailand have an active peer support network. They communicate mainly through social media to share pricing information, farming techniques and troubleshooting issues. Many such networks exist all over Thailand, with the organic farmer network being a particularly active. There is a strong sense of solidarity when these farmers come together. The Department of Agriculture in recent years has recognized the strength of these groups and tried to use them as a channel for offering better technology such as farming equipment. However, in the interviewee's view, while the government's intentions are good, its interventions are misaligned with the culture of farmer networks. Typically, the extension agency, charged with supporting farmers, imposes a top-down management approach by selecting a "leader" or focal point to interact with, which goes against the spirit of the community. As a result, the extension agency's efforts to use existing farmer networks have not been successful. Yet there has been some progress, as some farmer groups have emerged as strong

voices within their communities and are now invited to public consultation hearings, where in the past, only government and private sector has been involved.

It is the authors' opinion that the main aim of the process of aggregating smallholder farmers into larger "cooperatives" is to establish manageable units of production large enough to satisfy the raw materials needs of growing bioeconomy industries, rather than to support rural transformation or benefit the farmer or rural communities. As discussed, Thailand's bioeconomy development is being driven top-down, largely by major corporate actors, and the tendency is towards loosening regulations rather than building in protections. It is hard to avoid a sense that the economic rationale is shaping policy, and the other benefits are at best assumed as side-effects. However, as has been seen in other regions (see e.g. Fielding et al. 2015) it is rarely a safe assumption that these will occur. The benefits of unbridled development tend to go to those who are already comparatively wealthy and better educated, while and those who are already poor or marginalized – especially women – tend to lose out if they are not specifically targeted.

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5. Conclusion

The government has made substantial efforts to seed the development of the bioeconomy. For example, it has a strategic **financing** strategy focused on improving technological innovation, research and investment in the bioeconomy. Firstly, it will funnel financing to develop the cassava and sugarcane sectors in Rayong province. Secondly, it plans to stimulate technology and innovation by providing 300% matching funding for R&D. Thirdly, it will offer tax incentives for investments in the bioeconomy.

The government is also seeking to ease **regulatory** obstacles to private-sector investment in the bioeconomy. **Capacity building** is an integral part of the government's bioeconomy strategy, targeting academics, entrepreneurs and farmers. The government has plans to provide scholarships and enhance human capacity in specific fields (particularly in science, technology, engineering and mathematics) relevant to the bioeconomy.

Our stakeholder interviews identified four key challenges that Thailand still face:

1. Sustainability: Environmental challenges that inhibit production on agricultural land. These range from overuse of fertilizers to sub-optimal seed selection. As only a small percentage of agricultural land is irrigated, this also constrains production.
2. Regulation: There are legal and regulatory challenges which prevent industry actors from maximizing the full impact of the bioeconomy (for example, the 1984 Cane and Sugar Act).
3. Technology: Despite Thailand's intention to rapidly advance the bioeconomy and diversify the market, technological constraints remain.
4. Social equity: Thailand has a history of policies aimed at protecting and mobilizing smallholder farmers yet, it is unclear to what extent farmers and communities have a say in determining how they will engage with the bioeconomy.

It is clear that the government's efforts are creating favourable conditions for private-sector investment in the bioeconomy. The main indicator of success the government is using for these initiatives appears to be ability to attract investment, from both local companies and large foreign companies like Corbion.

Areas for further research

Based on this scoping study, the authors suggest that the following areas are relevant for study as part of a wider SEI initiative on the bioeconomy.

- How have other countries addressed gender and social equity in bioeconomy promotion; for example, in land reform policies, R&D programmes, and decision-making processes?
- What are the indicators of success used in other case studies and do they address sustainability and social equity concerns?
- To what extent have innovations from farmers and farming communities been incorporated into the bioeconomy and related policies? How do Thai farmers envisage the development of the bioeconomy, and what do they think of state bioeconomy promotion programmes to date?
- What aspects of the Thai approach could be useful to support the development of the bioeconomy in other regions, and lessons from other regions could be useful to Thailand?

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Contact us

SEI Stockholm and SEI HQ

Linnégatan 87D Box 24218
104 51 Stockholm Sweden
Tel: +46 8 30 80 44
info@sei.org

Louise Karlberg
Centre Director

SEI Africa

World Agroforestry Centre
United Nations Avenue
Gigiri P.O. Box 30677
Nairobi 00100 Kenya
Tel: +254 20 722 4886
info-Africa@sei.org

Stacey Noel
Centre Director

SEI Asia

15th Floor Witthyakit Building
254 Chulalongkorn University
Chulalongkorn Soi 64 Phyathai Road
Pathumwan Bangkok 10330 Thailand
Tel: +66 2 251 4415
info-Asia@sei.org

Niall O'Connor
Centre Director

SEI Tallinn

Lai str 34 10133
Tallinn Estonia
Tel: +372 627 6100
info-Tallinn@sei.org

Lauri Tammiste
Centre Director

SEI Oxford

Florence House 29 Grove Street
Summertown Oxford
OX2 7JT UK
Tel: +44 1865 42 6316
info-Oxford@sei.org

Ruth Butterfield
Centre Director

SEI US Main Office

11 Curtis Avenue
Somerville MA 02144-1224 USA
Tel: +1 617 627 3786
info-US@sei.org

Michael Lazarus
Centre Director

SEI US Davis Office

400 F Street
Davis CA 95616 USA
Tel: +1 530 753 3035

SEI US Seattle Office

1402 Third Avenue Suite 900
Seattle WA 98101 USA
Tel: +1 206 547 4000

SEI York

University of York
Heslington York
YO10 5DD UK
Tel: +44 1904 32 2897
info-York@sei.org

Lisa Emberson
Centre Director

SEI Latin America

Calle 71 # 11–10
Oficina 801
Bogota Colombia
info-LatinAmerica@sei.org

David Purkey
Centre Director

SEI Stockholm Environment Institute

sei.org

@SEIresearch, @SEIclimate