5 Clusters and new industry path development

This chapter examines new industry path development opportunities in advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai. These can occur through the integration of scientific biotechnology knowledge in the products of start-ups and scale-ups together with integration of engineering and marketing knowledge in these firms. A regional cluster management organisation could enable the exploitation of these opportunities by creating linkages between SMEs and universities and research organisations for the exchange of knowledge to promote new product development and sales.

Introduction

SMEs in Thailand show the following problematic characteristics (according to OECD, 2011):

- A "missing middle" – i.e. a shortage of medium-sized firms with the capability to grow. This limits the innovativeness and competitiveness of the SME sector and its potential to participate in national and global value chains and to co-operate with large firms and universities.

- An overly large share of entrepreneurs driven by necessity rather than by opportunity. These "necessity" entrepreneurs often have weak productivity and absorptive capacity for innovation, lack growth potential and suffer from low incomes and poor employment conditions.

- A large gap in the level of entrepreneurship and SME activity between the higher-income central region and the other regions of the country. Entrepreneurial activity in the regions is about one-half the rate of Bangkok. Similarly, around two-fifths of recorded SMEs are located in Bangkok region and its surrounds, where only one-tenth of the population lives. This weak SME and entrepreneurship activity is likely to hold back the catch up of other regions with Bangkok as well as the development trajectory of the country as a whole.

- A large brain drain from peripheral regions to Bangkok, which makes it difficult to retain educated youth with a bachelor degree in the Northern cities of Chiang Mai (even if this is the second largest city in Thailand) and Chiang Rai.

This chapter focuses on how cluster policy actions at regional level can help overcome these problems at the same time as developing higher value-added industry development trajectories in Thailand. It takes the case of the advanced agriculture and biotechnology and food-for-the-future regional innovation cluster in Chiang Mai and Chiang Rai. The analysis emphasises the importance of supporting start-ups and scale-ups in the cluster to develop and exploit advanced agricultural products, based in particular on biotechnology as a key enabling technology (KET), and proposes how to design appropriate cluster policies to support them.

Box 5.1 presents the relevance of the cluster concept for organising policy interventions to support the contribution of SMEs to new industry path development at regional level. It stresses the importance of seeing agglomerated regional clusters as being embedded within non-agglomerated national clusters, and the importance of start-ups and scale-ups to exploit the knowledge generated by universities and research organisations regionally and nationally. It shows how an expanded cluster policy in Chiang Mai and Chiang Rai is relevant to the objective of upgrading and diversifying its advanced agriculture and biotechnology and food-for-the-future industries.

Box 5.1. The relevance of cluster policies

Changing terminologies in regional innovation policies

A range of terms have been used in recent years to refer to policies that seek to build regional agglomeration economies to stimulate innovation and entrepreneurship. They include work on regional innovation systems, regional innovative milieux and clusters. While the terms come in and out of fashion, governments across the world are supporting various aspects of the development agglomeration economies. These policies have a strong emphasis on creating conditions for knowledge generation, exchange and exploitation in given sectors and regions. This report refers to these actions as cluster policies.

Cluster policies remain at the forefront of policy thinking about how to stimulate agglomeration economies in OECD countries. For example, most European Union countries have developed regional smart specialisation strategies identifying their areas of future industrial competitive advantage and how they will support them with innovation and entrepreneurship measures. These strategies are currently in the process of being updated for the new EU programming period 2021-27. These interventions can potentially support multiple clusters in a given region, if the region has a sufficiently diverse and specialised economy.

The best practice cluster interventions tend to see the regional clusters as being embedded in broader geographically-disaggregated clusters at national or international levels and to focus on promoting diversification of the clusters into higher value-added activities.

The relevance of regional agglomeration economies

Marshall is often referred to as the first scholar using the idea of industrial clustering. He argued that specialised industrial districts dominated by SMEs and embedded in the structures of society can be very competitive by generating and exploiting localisation economies, i.e. advantages from co-location of industries belonging to the same or supporting sectors (as opposed to urbanisation economies involving co-location of different sectors) (Asheim, 2000).

In his key 1998 article in Harvard Business Review, Porter focused on this kind of regional cluster, constituted by "geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialised inputs such as components, machinery, and services, and providers of specialised infrastructure. Clusters also often extend downstream to channels and customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies, or common inputs" (Porter 1998, 78).

The importance of non-agglomerated knowledge spillovers in national clusters

As a result of the growing complexity and diversity of contemporary knowledge creation and innovation processes, firms increasingly need to acquire new knowledge to supplement their internal, core knowledge. They can do this either by attracting human capital with different knowledge or by acquiring new knowledge by collaborating with external firms or universities and research institutes through R&D co-operation, outsourcing or offshoring of R&D. Thus a shift is taking place to a greater reliance on globally 'distributed knowledge networks' and 'open innovation' (Chesbrough, 2003). The absorptive capacity of SMEs is very important in the latter process as well as access to other players in national clusters.

In his 1990 book on 'Competitive Advantage of Nations', Porter referred mainly to non-agglomerated industrial clusters, arguing that "a nation's successful industries are usually linked through vertical

(buyer/supplier) or horizontal (common customers, technology etc.) relationships" (Porter 1990, 149), even if some of the case studies (e.g. industrial districts in the 'Third Italy') referred to agglomerated regional clusters. This type of clustering remains important today.

The emphasis on knowledge exploitation

The general strength of the cluster concept is that it has a strong firm focus. Firms in clusters can be seen to constitute the knowledge exploitation sub-sector of a regional innovation system. The exploitation sub-sector connects to the knowledge exploration sub-sector, which consists largely of universities, research organisations, science parks and technology transfer organisations.

The dual emphasis of cluster policies

Recent applications of the cluster concept in policy in OECD countries focus on both strengthening regional agglomerated clusters and building linkages in national/international non-agglomerated clusters, where regional clusters are seen as being part of national clusters. This dual definition of clusters is becoming more important as a consequence of globalisation and digital technologies.

The importance of cluster diversification

In addition, the cluster concept and cluster policies are evolving to focus not on supporting existing in-situ industry specialisations, but on identifying opportunities to diversify existing specialisations into more innovative and higher value creating activities, in relation to the existing industries in the region as well as with respect to industries in other regions.

The key focus of modern cluster policies

These two key features of the modern concept of clusters and cluster policy fit well with the regional innovation situation in Thailand, namely the focus on :

- Supporting both regionally-agglomerated linkages (including knowledge exchanges) and national and internationally non-agglomerated linkages through clusters.

Thailand's cluster policy today supports both national and regional clusters. Thus the national advanced agriculture and biotech clusters, Food Innopolis and Thailand Food Valley, are constituted by regional clusters, which are supported by linkages to a national research centre of biotechnology.

- Supporting the diversification of regional and national industry specialisations into higher value-added and more innovative activities where a region can achieve future competitive advantage.

This requirement of industrial diversification fits very well with the cluster strategy of the national and regional cluster policy in Thailand of upgrading and diversifying agricultural production to become more advanced and innovative.

A key feature of clusters which cluster policies seek to promote according to this logic include (see also Porter, 2000):

- Innovation collaborations regionally and nationally and internationally, including among firms, universities and research institutes, particularly where they promote industrial diversification.
- The development of a specialised labour market providing cluster firms with skilled labour.

A well-functioning cluster management organisation (CMO) is a key component of an effective cluster policy. The CMO increases the absorptive capacity of SMEs by facilitating co-operation among firms in a cluster when approaching knowledge-generating institutions in the exploration sub-sector of the regional innovation system. In addition, being part of a national cluster increases the efficiency of cluster

co-operation for SMEs as it provides easier access to important national R&D resources as well as regional resources.

Recent international policy experience with innovation clusters

During recent years, 'clustering' has increasingly been recognised as a pivotal tool for innovation policy. This includes policy interventions at the level of the European Union. Clusters have increasingly been taken into consideration in the definitions of the fundamental European Union innovation and regional development programmes, such as the European Structural and Investment Funds, H2020, COSME, etc., and are a key element in implementing smart specialisation (S3) policy. It also includes a wide range of recent cluster policy interventions in individual countries, such as Austria, Norway, and Sweden (see Boxes 5.2-5.4).

Relevance of the cluster concept for innovation policy in Thailand

The cluster concept is very useful for highlighting how policy can reinforce the role of firms in exploiting knowledge generated in Thailand's strategic sectors for future innovation-based growth, by creating regional and national knowledge linkages and building relevant regional skills and SME absorptive capacities. It can help to diversify cluster activities into higher value-added activities and to develop industrial competitiveness in areas outside the high-income core metropolitan region of the country.

In Chiang Mai and Chiang Rai, there is co-operation between regional universities, science parks and firms in advanced agriculture and biotechnology and food-for-the-future. Cluster policy is important to facilitate this co-operation by overcoming the problem of lack of absorptive capacity in SMEs with limited human and financial resources for innovation and lack of internal R&D capacities, and by helping build regional skills and knowledge networks.

New industry path development opportunities in Chiang Mai and Chiang Rai

Table 5.1 describes the main types of industry path development possible in regions and their mechanisms. Using this typology, Chiang Mai and Chiang Rai can realistically aim to achieve the following types of new industry path development:

- Path upgrading (through climbing Global Production Networks, Renewal, and/or niche development).
- Path importation.
- Unrelated diversification.

The region has clear opportunities for path upgrading and path importation, as discussed below. However, the most powerful of the path development opportunities in advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai is unrelated diversification, also discussed below. The main emphasis of policy for advanced agriculture and biotechnology and food-for-the-future should be on promoting unrelated diversification.

Table 5.1 Types of new regional industrial path development

Types	Mechanisms
Upgrading	
I – Climbing Global Production Networks	Major change of a regional industrial path related to enhancement of position within global production networks; moving up the value chain based on upgrading of skills and production capabilities
II – Renewal	Major change of an industrial path into a new direction based on new technologies or organisational innovations, or new business models
III – Niche development	Development of niches through the integration of symbolic knowledge
Diversification	
I – Related	Diversification into a new related industry for the region, building on competencies and knowledge of existing industries
II – Unrelated	Diversification into a new industry based on unrelated knowledge combinations
Emergence	
I – Importation	Setting up of an established industry that is new to the region (e.g. through non-local firms) and unrelated to exiting industries in the region.
II –New creation	Emergence and growth of entirely new industries based on radically new technologies and scientific discoveries or as an outcome of search processes for new business models, user-driven innovation and social innovation

Source: Based on Grillitsch, Asheim, and Trippl (2018) and Isaksen, Tödtling, and Trippl (2016)

Opportunities for path upgrading and path importation

The following opportunities can be pursued for path upgrading and path importation in the cluster.

Path upgrading by renewal or climbing global production networks

Path upgrading by moving firms up the value chain is achievable in advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai by introducing new technologies (e.g. Industry 4.0) and major organisational changes, including upgrading skills and production capabilities in SMEs. Being part of a dynamic cluster will boost this development.

Path upgrading by niche development

Path upgrading is also possible in the cluster through niche development in mature industries. An example of this taking place in advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai is the promotion of organic agriculture and food production. This has been driven by the use of symbolic, intangible knowledge in the marketing of the products. This could be for example in the form of story-telling about the history of the product, the environment in which it is being grown etc. (i.e. marketing innovation).

Path importation

Path importation to the Chiang Mai and Chiang Rai advanced agriculture and biotechnology and food-for-the-future cluster can be achieved through successfully attracting FDI and an inflow of skilled individuals with competences and production capabilities not available in the region. The successful national biotech strategy, and the competences at the regional universities and science parks, increase the attractiveness of Chiang Mai and Chiang Rai for foreign firms and individuals. The development of strong cluster policy actions will also increase the region's attractiveness.

However, these strategies are not as radical in terms of path development as strategies for unrelated diversification. They are more likely to lead to 'path extension', which is the outcome of incremental innovations in firms, which may result in stagnation and decline (path exhaustion) (Isaksen and Trippl 2016).

Opportunities for unrelated diversification in the cluster

The opportunities for unrelated diversification in the cluster offer the greatest steps towards diversifying the economy into more technologically-advanced specialisations that move up the ladder of higher knowledge complexity and value creation compared to the present level in the region. They should therefore be the main focus of the cluster policy efforts.

Unrelated diversification involves firms moving into new industries or areas of production by combining their existing knowledge bases with new, unrelated knowledge. The food industry in Chiang Mai and Chiang Rai can be characterised as a traditional industry based on synthetic, engineering knowledge. However, start-ups and scale-ups can combine this knowledge with new analytical, science-based knowledge in KETs (particularly biotechnology, but also nanotechnology and digitalisation) to diversify into advanced agricultural products, functional food and beverages, food-for-the-future, medical food and cosmetics. Internationally, the introduction of science-based, analytical knowledge from biotechnology has led to the generation of high value-added functional foods with particular health benefits (Zukauskaite and Moodysson, 2016), and there are firms in Chiang Mai and Chiang Rai that are already doing this, supported by the national and regional food clusters.

The outlook for future unrelated diversification in Chiang Mai and Chiang Rai is very promising. On the demand side, there is an almost unlimited international market for safe and healthy food, functional food and beverages, non-chemical plant and herb-based medicine and cosmetic products. On the supply side, Northern Thailand seems to have the natural resources and scientific knowledge to successfully develop products to meet this demand. Overall, the food and beverage industry in Thailand contributes 23% of GDP and Chiang Mai and Chiang Rai have key agricultural production and processing specialisations in vegetables, fruits and herbal products. Thailand, both nationally and in the Chiang Mai and Chiang Rai regions, also has the knowledge exploration capabilities in KETs – in particular biotechnology, together with nanotechnology and digitalisation – that are critical to generate new and advanced agricultural products in start-ups and scale-ups, particularly in functional foods.[1]

Longan is a good example of how biotechnology can be integrated in agricultural products to increase their value. Longan contains a number of active, healthy ingredients, and research aimed at extracting compounds from longan seeds is ongoing at several universities, which are seeking to develop other important by-products to be used for medical purposes. For example, in the Northern Food Valley, biotechnology is being used to produce an anti-aging agent. In another case, a functional food is being produced in the form of a beverage to help sleeping, based on research conducted by Chiang Rai University in co-operation with Natural Beverage Corporation, Ltd.

There are also examples of using research in biotechnology to add value to other agricultural products in Chiang Mai and Chiang Rai:

- A start-up called Sleep Well manufactures beverages that aid sleep using vanilla and honey.
- Tofusun produces bed-time milk from soybeans fortified with melatonin to aid sleep.
- A start-up called Morinaga produces a candy with lactic acid bacteria to prevent the common cold.
- A tech start-up called Juiceinno8, and funded by TukTuk500 Venture Capital, produces fruit juice without natural sugar to help prevent diabetes.
- The Tea Gallery Group, a group of SMEs in Chiang Mai, produces fermented tea, called "Kombucha", with documented health benefits including reduced cholesterol, blood pressure, inflammation, migraines and fatigue.

Unrelated diversification in advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai can build on the actions of the Thailand Industrial Development Strategy 4.0. This targets a broad set of "s-curve", "locomotive" industries and aims to help them grow by supporting the introduction of advanced technology and innovation, in particular in SMEs. In the case of advanced agriculture and biotechnology and food-for-the-future, the policy targets applications of research in functional food, medical food, food supplements and food innovation, as these are among the most dominant industries in Northern Thailand, as well as in biofuels and bio-chemicals and medical, health and cosmetics products made from herbs and plants. These sectors are also supported by Thailand's National Biotechnology Policy Framework 2012-2021, which targets agriculture and food, medicine and public health, bio energy, and bio industries.

The Thailand Industrial Development Strategy 4.0 and the National Biotechnology Policy Framework are successfully building Thailand's research capacity in biotechnology. There are a number of key components to this:

- The National Centre for Genetic Engineering and Biotechnology (BIOTEC), established in 1983, has multiple laboratories for conducting research and providing technical services in agricultural, biomedical and environmental sciences. For example, the BIOTEC Food Biotechnology Laboratory helps improve and upgrade the processing and quality of traditional Thai fermented food.
- The National Science and Technology Development Agency (NSTDA) acts as a bridge between research in BIOTEC and industry. It does this by providing resources to industry to develop a critical mass of industry researchers to apply biotechnological research in product and process innovations. NSTDA has focused on five target sectors, including agriculture and food, energy and environment and health and medicine.
- The regional universities in Chiang Mai and Chiang Rai undertake applied research directed to developing applications for local industry.
- The regional science parks (especially NSP) play a key role in applied R&D, connecting universities with industry. At NSP, for example, specialists and researchers from industry, universities and NSTDA collaborate to develop biotechnology applications to be exploited by regional industry. NSP is part of a system of Thailand Science Parks (TSPs), which further serve as a one-stop service centre to assist foreign and domestic firms engaged in scientific and technological research.

It may be rather surprising that Thailand, as a middle-income country, has developed cutting-edge biotechnology research in many areas with a strong focus on application. However, Thailand's effort to build a strong biotechnology research capacity must be seen in the context of the country's position as a global leader in agriculture and as one of the top exporters of food in the world. This led to a strategic decision to transform agriculture into a knowledge-based industry using biotechnology as a KET with applications in agriculture and the aquatic field, but also beyond in the medical and industrial (e.g. bioeconomy) sectors.

Similar use of biotechnology as a KET has been seen in several high-income countries in the last ten years. Several European countries have developed industrial policies at national level to support biotechnology, and several European Union regions have included advanced agriculture and food-for-the-future as part of their regional smart specialisation (S3) strategies.

Thus Thailand has embarked on industrial and innovation policies that are broadly state-of-the-art internationally. These policies are not only a set of "paper plans", but have been implemented and are starting to produce promising results. Thailand has demonstrated exemplary policy design by building up an advanced basic research capacity in biotechnology at BIOTEC in Bangkok directed towards applications in sectors that are of significant importance for the Thai economy and linking it to applied research at regional universities and science parks located in proximity to the regional firms and specialisations that should integrate the new technologies to advance their products and processes, e.g. agriculture and food in Chiang Mai and Chiang Rai.

However, the missing link in the current arrangements to develop the advanced agriculture and biotechnology and food-for-the-future strategic sectors in Thailand is a more effective cluster policy that can increase the absorptive capacity of start-ups and scale-ups and put them in a position to exploit the produc-relevant research results being generated nationally and regionally. A policy is needed that:

- effectively introduces scientific and marketing knowledge to start-ups and scale-ups in order to secure the exploitation of research; and
- operates in regions outside of the capital region in order to spread the economic growth generated.

These are the major missing pieces in the policy puzzle that will help unlock the potential of SMEs for the development of the s-curve, strategic driving sectors at regional level in Thailand. The potential design of this policy is discussed in the section below.

Developing a regional cluster policy for Chiang Mai and Chiang Rai

There are two main components of the proposed cluster development policy for advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai regions:

- creation of an overarching cluster management organisation (CMO); and
- introduction of direct cluster development actions for the regional innovation cluster (in addition to the existing tax incentives for innovation).

Adequate and long-term funding is required for these actions. For example, funding is made available to supported clusters for 10 years in Norway and Sweden, where the support comes partly from government and partly from matching funding from the other triple helix stakeholders (research and business actors) participating in the cluster. Adopting the principle of matching funding brings a strong commitment by the stakeholders to seriously engage in systematic and long-term co-operation to promote innovativeness and increased (global) competitiveness.

Creation of a cluster management organisation

The creation of an overarching cluster management organisation (CMO) aims to create a structure to:

- create new networks and collaborations between start-ups and scale-ups and universities, science parks and research laboratories to help start-ups and scale-ups acquire new and more advanced technology;
- increase the knowledge absorption capacities of start-ups and scale-ups by offering advice and coaching and supplier development programmes; and

- help create an overall shared vision and development plan for the cluster by bringing together cluster stakeholders to discuss challenges and plans.

A CMO can be seen as a formal organisation, including a set of cluster management agents who undertake actions to create networks and co-operations between participants in the cluster. The cluster management agents can play the role of account managers working with specific firms and research organisations to identify their development needs and collaboration opportunities.

In addition, some of the specific roles that the CMO can play are discussed in chapters 2-4 with respect to developing a vision for regional entrepreneurship development in the cluster and co-ordinating policy actions in this area, targeting higher-quality business development services (BDS) on start-ups and scale-ups with innovation and export potential in the cluster, and attracting FDI to the cluster and supporting the development of FDI-SME linkages in the cluster as the scale of the FDI grows.

The CMO should also undertake vision building and strategy development work for the cluster. This should be undertaken through a bottom-up Entrepreneurial Discovery Process (as referred to in the European Union Smart Specialisation Policy) involving ideas generation and consensus building by regional entrepreneurs in business and institutional entrepreneurs at universities, research organisations and science parks, as well as regional and local government authorities to identify projects to support the development of the cluster. The CMO can help combine this local vision with top-down national government policies.

Direct expenditure and long term financial support is required to build a strong CMO for advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai. Much of the current cluster networking work undertaken by the existing small-scale cluster initiatives in Chiang Mai and Chiang Rai appears to be undertaken as unpaid work outside of normal working hours. This makes it difficult to put enough time into developing the clusters to fulfil their potential and leads to important tasks not being carried out or carried out too slowly. It also reduces the commitment of firms participating in the cluster initiatives to engage wholeheartedly in developing the clusters.

Direct cluster capacity-building actions

In addition to the creation of a CMO and cluster management agents, direct funding is needed for cluster firms to participate in a range of projects that will increase their innovation and exporting activities. One of the main areas for this funding is for applied research projects undertaken by research organisations, which could be undertaken on behalf of selected groups of start-ups and scale-ups.

Thailand's existing cluster policy initiatives offer support that is largely indirect and available in a non-targeted manner. The main existing initiative is Thailand's Cluster-based Special Economic Development Zones Policy, which came into effect in 2015 and is led by the Ministry of Industry. This offers tax and non-tax incentives to companies for R&D and innovation investments in co-operation with academic institutions or other research organisations in specific sectors and locations in the country. There are two types of cluster: Super Clusters and Other targeted clusters.

- Super Clusters include 'first s-curve' industries, e.g. automotive and parts and smart electronics, which develop by using advanced technology, and 'new s-curve' industries, which involve future industries (e.g. robotics and medical hub). Food Innopolis is one of the first-wave Super Clusters, and the only representative of agriculture and biotechnology.[2] It is a national initiative built up of regional clusters with different industrial specialisations. It is expanding to regional science parks, among them the Northern Science Park in Chiang Mai, which will focus on rice, fruits, vegetables and organic products, and is financing co-operations with a range of regional universities in these areas.

- Other targeted clusters include the Thailand Food Valley agro-processing cluster, which was established in 2014 to support SMEs in the advanced agriculture and food sectors in

collaboration with the Ministry of Agriculture and Cooperatives, Department of Industrial Work, Ministry of Science and Technology, Thai Chamber of Commerce and the Federation of Thai Industries. The cluster focuses on sustainability, improving the value chain, food quality, increasing exports, and bringing technology and innovation to the sector (www.behance.net). Launched in 2016, Chiang Mai is the first pilot location for the Thailand Food Valley programme, defined as Northern Food Valley 1, including a focus on coffee ("the city of coffee") as an important sub-sector, while Chiang Rai will belong to Northern Food Valley 2, with tea ("the city of tea") as a sub-sector (www.northernfoodvalley2.com).

The downside of the strong reliance of these programmes on R&D tax incentives is that they are provided to all firms in sectors and regions designated as clusters. The incentives may therefore go both to firms in need of this support, and firms that would have undertaken the subsidised R&D and innovation activities without the support. In addition, start-ups and scale-ups very often only generate a taxable surplus after some years of operation, which means that in the first years, when they are in most need of support, they do not have any advantage from tax exemption.[3] These issues reduce the effectiveness of tax incentives as a cluster development measure.

In addition, support needs to be introduced that is focused more on networking and capacity-building for selected firms with strong growth potential. These activities, for example, could include training programmes to increase the absorptive capacity of cluster firms, R&D projects between cluster firms and universities and science parks, and creating meeting places locally, regionally and nationally for learning and knowledge exchange among firms. They could also include business advisory services and supplier development programmes. In addition, cluster firms could identify needs-driven R&D projects that could be funded for groups of start-ups and scale-ups.

In designing these activities much can be learned from successful cluster development policies in Norway and Sweden presented in Box 5.2-Box 5.3 below.

Box 5.2. Norwegian Innovation Cluster Programme, Norway

Description of the approach

The Norwegian Innovation Cluster programme aims to increase the attractiveness and dynamics of clusters in Norway, improve the innovativeness and competitiveness of individual companies within clusters, and trigger and enhance collaborative development activities in clusters. It is organised by Innovation Norway (the public innovation agency), in collaboration with Siva (the public industrial development corporation of Norway) and the Norwegian Research Council.

The programme was launched in June 2014, building on a national cluster policy that has evolved since the early 2000s. It adds new levels, modules and elements to the pre-existing Arena and the Norwegian Centres of Expertise (NCE) programmes in order to further develop existing and potential new cluster initiatives.

Important distinctions are made in the programme between a cluster, a cluster organisation and a cluster development project, with support being targeted at cluster development projects and cluster organisations in order to improve the performance of the clusters:

- *A cluster* is seen as a geographical concentration of enterprises and related knowledge communities linked by complementarity or a similarity of interests and needs. The enterprises in the cluster can gain easier access to important production factors and ideas for and impulses to innovation through interaction and co-operation. A cluster emerges over time, on the basis of location advantages and natural dynamics.
- *A cluster organisation* is a formal institution that is established to facilitate increased interaction and co-operation between participants in the cluster. A cluster organisation is based on an organised partnership between the participants in the cluster, often with public development agencies as important contributors.
- *A cluster development project* is a targeted effort over a limited period to strengthen and accelerate the development of the cluster. This is generally achieved by means of a wide range of strategic activities aimed at strengthening the cluster's and cluster participants' competitive position.

Clusters compete to be part of the programme through annual open calls for funded cluster development projects. There are strict selection criteria for a cluster to be able to participate in the programme. The cluster resources, potential for growth and position in the industry is important. However, just as important is the participation and leadership of enterprises in the cluster project, i.e. the proposed initiative must be led by enterprises and meet their common interests and have their common ownership. In evaluating the applications for project funding, the emphasis is set on how far the enterprises of the cluster have set their strategic goals for collaboration and growth and how they have made their common plans for implementation of the cluster development project.

The programme distinguishes between clusters on three levels – providing different strands of programme support:

Arena (*Immature clusters*): Clusters that are in an early phase of organised cluster collaboration. They can vary significantly in their pre-conditions and potential. They can be small or large, and the participants can be in a regional, national or international competitive position.

Norwegian Centres of Expertise (*Mature clusters with a national position*): Clusters that have already established systematic and dynamic collaborations among their participants with high

interaction and a broad strategic action area. The enterprises in these clusters have considerable potential for growth in national and international markets.

Global Centres of Expertise *(Mature clusters with a global position)*: As with the Norwegian Centres of Expertise, these clusters have already established systematic and dynamic collaborations among their participants with high interaction and a broad strategic action area and the cluster enterprises have considerable potential for growth in national and international markets. However, in addition, these clusters form part of a strong innovation system, including privately-funded R&D by the participants and not only publicly-funded R&D.

The clusters are supported with partial funding for a cluster management organisation, as well as advisory services, cluster development support, networking activities and profiling services. The Arena support is given over 3-5 years, whereas the Norwegian Centres of Expertise and Global Centres of Expertise give support over a 10 year period. There are annual evaluations of the activities of each cluster determining whether they are on the right track according to the strategies they put forward for funding and whether they deliver at sufficiently high quality to continue as part of the programme.

Factors for success

The Norwegian Innovation Clusters has received positive evaluations by national and international experts. The most important factors behind this success are: 1) the three levels of clusters, which make cluster organisation open to firms of all sizes and phases of development, as well as the possible progression between the levels; 2) the long term and quite generous funding of the cluster management organisations and other forms of strategic cluster assistance through the cluster development projects; 3) the strict criteria for selection of clusters to become members of the programme, where the emphasis is on the common ownership of stakeholders in the cluster project as well as the yearly evaluations of the progress of the cluster development strategies.

Obstacles encountered and responses

The main obstacles that have been encountered to the success of the programme lie either in a lack of cluster resources (the critical mass of participating firms was not large enough; firms of critical importance withdraw from the cluster project) or in a leadership at firm and cluster levels that was not strong and/or motivated enough to develop the cluster. Responses to these problems have been either to terminate the cluster project before its originally envisaged end-date or to use more strategic support (other than economic funding) to resolve the obstacles encountered.

Relevance for Chiang Mai and Chiang Rai regions

The Chiang Mai and Chiang Rai advanced agriculture and biotechnology and food-for-the-future cluster can be seen as corresponding to the first level of support provided by the Norwegian Innovation Clusters Programme – i.e. Arena (for immature clusters). Arena has been important in creating cluster management organisations and strategic cluster development projects in this type of cluster and has built positive momentum. It illustrates a type of approach that emphasises long-term and generous direct funding for cluster management organisations, advisory services for SMEs, and networking activities as well as R&D funding. This type of support could be added to the existing cluster policy in Thailand, which currently focuses on tax credits for investment. It also highlights the importance of a thorough selection process for supported clusters, the criteria applied for selection of clusters for support, and annual evaluations of the progress made in delivering the cluster strategies, which leads to withdrawal of support or remedial action in the case of missed objectives.

Sources of further information: https://www.innovationclusters.no/english

Box 5.3. Vinnväxt programme, Sweden

Description of the approach

Vinnväxt (Win Growth) is operated by Vinnova, Sweden's public innovation agency. Its mission is to support sustainable innovation-led regional growth through stimulating the emergence of internationally-competitive regional research and innovation environments targeting specific high value-creation growth industries.

The programme has issued five calls for proposals for institutional development and needs-driven R&D projects since its launch in 2001, the latest finalised in 2016. The funding is selective and awarded to regions through a competitive process. To be selected, the region must propose a strategic idea to develop clusters by forming collaborations with other sectors or technologies creating synergy effects and by exploiting key enabling technologies (KETs).

Some 230 regional development initiatives, each promoted by a set of regional stakeholders, have applied for funding under Vinnväxt's five calls. Of these, 18 "functional regions" have been selected for support. The winners share a number of common features including: a shared strategic concept among the regional cluster actors; a strong research and innovation milieu; strong regional leadership for the cluster development activity; and the active participation of the public (regional government), private (business and industry) and research (university and research organisations) sectors, namely all elements of the "Triple Helix". Perhaps the most important factor, however, is that all appear to have excellent growth potential.

Vinnväxt adopts a long-term outlook, providing winning regional initiatives with funding of up to EUR 1 million per year for 10 years. This funding can be extended in some cases up to as far as 16 years to help the regional initiative to bridge the transition from long-term public funding to other funding sources. The winning regions must contribute at least the same amount. The projects aim to support the development of infrastructure for innovation, rather than direct support to businesses. Furthermore, winners are offered 'process support' in the form of seminars, coaching, networking and experience sharing. The selected regional initiatives are evaluated every three years by international experts to ensure compliance with the terms of the programme.

From 2013, the programme has introduced a stronger focus on initiatives that support sustainable development, green growth and societal benefits.

Factors for success

Key factors for success have been:

- The long-term and generous public funding.
- The use of the collaboration among the Triple Helix actors (government, research and business) to develop shared policy proposals.
- The strong financial and other commitments of the Triple Helix constellation in the regions as part of the funding arrangements.
- The combination of support for knowledge exploration (research) and knowledge exploitation (innovation) and a strong focus on innovation and international competitiveness.
- The design of the programme as both a top-down and bottom-up initiative.

The programme has led to better enterprise development results in supported regional clusters; strengthened collaboration between universities, research institutes and industry in the clusters; and expanded R&D capacity in industry leading to product development. Vinnväxt has made the Triple Helix

a well-known concept throughout Sweden, and has strengthened regional innovation systems and their support structures. In turn the Vinnväxt initiatives have taken significant steps in becoming internationally competitive and sustainable regional innovation environments.

Obstacles encountered and responses

The most common problems that have arisen for the programme in developing stronger and internationally-competitive regional research and innovation milieus have been when industry specialisations do not connect well to the existing research capacity of the region or when there is a lack of absorptive capacity in the regional industry, which implies that it cannot make use of and exploit the research results of the research organisations for innovation. Through evaluations of the regional initiatives every 3 years, such imbalances in the regional innovation system can be discovered and efforts put in place to try to correct them.

Relevance for Chiang Mai and Chiang Rai regions

This programme illustrates a long-term approach to supporting the development of regional innovation clusters. It illustrates how to engage regional actors in common vision building on the actions needed to support the development of the cluster by offering funding to bids put together by coalitions of Triple Helix actors. It also illustrates an approach to support the exploitation of KETs in SMEs by involving them in close co-operations between universities, research organisations and industry.

Sources for further information: https://www.vinnova.se

Further inspiration for developing a regional CMO and direct strategic support measures for cluster development in advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai can be drawn from the example of a cluster specifically focused on food innovation in the region of Scania in southern Sweden (Box 5.4).

Box 5.4. The Food Innovation at Interfaces Project, Scania, Southern Sweden

Description of the approach

The Food Innovation at Interfaces project is one of the regional initiatives funded by the national Vinnväxt programme supporting food innovation in a regional cluster in Scania, Sweden. It supported a large number of small-scale incremental innovations among food industry SMEs in the region in collaboration with the region's university, Lund University. Over time, this reoriented the regional industry towards higher value-added markets and increased exports.

The project was established by a partnership of firms, research organisations and local government organisations that came together to form the Scania Food Innovation Network (Skånes Livsmedelsakademi or SLA). The Network was originally created in 1994 with a membership encompassing university faculties, the regional government of Scania, dairy firms, and leading food production actors. Lund University is a key actor in the Network. Its representatives held several posts in the Board of Directors and it was a leading partner in several of the research projects.

The Network put together a successful application for support from the national Vinnväxt programme in 2001. This led to an award of government funding of EUR 2 million per annum for 10 years. To win this funding, the Network had to demonstrate a broad, supportive coalition of public and private sector actors with a track record of effective collaboration in innovation. Although the programme has now ended, the networks and linkages that it generated continue, involving Lund University, the regional science park and regional industry. The Scania Food Innovation Network continues to operate, and Vinnova still provides funding for specific projects, such as research on food for elderly health care.

The key issue that the project responded to was that although it had a combination of an existing food cluster and world-leading R&D in food, the SMEs in the regional food industry had very low levels of R&D and few connections with the region's research organisations. They had identifiable needs for knowledge inputs of different kinds that the regional university and other research organisations could supply to support them in product and process development. However, the typical inputs required from the University for each individual firm were very small and scattered across different university departments. These inputs were much smaller on average than the types of research contracts that the University typically dealt with and the university did not have experience of combining these needs into viable projects or collaborating with SMEs on individual small projects.

One of the issues for the University was that the knowledge inputs required for innovation stretched across a range of different academic disciplines. Particular firms could have simultaneous demands for science-based analytical knowledge (bio-sciences), engineering-based synthetic knowledge (mechanical engineering, automation) and symbolic knowledge (marketing, advertisement). Linkages therefore had to be made across various research departments of the University and needs aggregated into larger projects.

With the substantial government funding for this project, Lund University was able to prioritise supporting SMEs and becoming a linking node between appropriate sources of knowledge and expertise within the University and other regional partners.

Factors for success

A key success factor for this project was a decade of prior interactive network building in Scania around food innovation embodied in the Scania Food Innovation Network. This had generated a latent innovation network in which the University (as key knowledge supplier to SMEs) already played an important role.

The process of developing the funding application to the Vinnväxt programme was also coordinated and written by the Scania Food Innovation Network. The presence of the prior connections was one of the reasons for its selection for support by the national government.

The Vinnväxt programme itself provided the necessary funding to allow the University to engage with SMEs.

Obstacles encountered and responses

One of the obstacles to the development of the regional cluster was a lack of critical mass of collaborations in particular fields aggregating the needs of individual SMEs. This made it difficult for Lund University to respond to SME individual demands. One of the responses was to focus more strongly on one specific area of food and health – namely functional food – compared with the early focuses of the network on four areas; functional food; international consumer marketing; large-scale food and eating (for hospitals, schools, et.); and food innovation in theory and practice.

In order to reinforce the research and support to SMEs in functional food (i.e. to focus on creating foods with specific health giving properties) one of the key outputs of the funding was to create the Functional Food Science Centre at Lund University. This was a new wave university research centre involving 70 senior researchers from 40 departments and five faculties at Lund University. Funding from the programme helped establish a PhD curriculum within the Centre, delivered in close collaboration with the food industry and representatives of the commercial and industrial development and the health and medical care system in Scania.

In addition, there was no easy recipe to provide technology transfer to many small businesses directly without the requirement for individual researchers or research departments to create their own connections with SMEs and whilst ensuring that the university retained a strategic focus on core scientific activities.

In response, the university pursued a two-pronged approach:

- Intermediary organisations were enrolled in the network to relieve the necessity for Lund University to work directly with many small firms simultaneously. In addition, a new intermediary organisation was created called IDEON Agro Food, based at IDEON, a science park at the university. This applied the IDEON business support model, originally developed for exploiting ICT and biotech companies (using mainly analytical knowledge in high-technology fields) in the functional food area. IDEON Agro Food encouraged the formation of larger networks and better relationships between food companies and knowledge producers, using predominantly synthetic knowledge in low-technology fields.

- Lund University's success in winning strategic research projects focused academic leaders on thinking how to best engage with regional communities and businesses, to deliver the core university missions by providing access to core research funding, increasing their world-class status and visibility. Many of the activities of the Food Innovation at Interfaces programme had a dual basis, firstly in university research but also in wider university-centred – but nevertheless boundary-spanning – activities, which emerged as Lund University became regionally engaged.

Relevance for Chiang Mai and Chiang Rai regions

This initiative demonstrates a method to transform food production in a region from a mass-producing sector of low quality and low cost products to high quality products with a large value creation potential. It achieved this by creating networks of SMEs connected to a regional university with relevant knowledge, with the support of the science park as an intermediary.

The initiative had a particular emphasis on creating linkages between the different types of knowledge that SMEs need to develop functional foods, combining science, engineering and marketing inputs from

the University. The emphasis on combining different types of knowledge is shared with the Clusterland Upper Austria case (Box 5.5). However, whereas Clusterland Upper Austria focuses on cross-fertilisation between clusters, in Scania the aim was to combine these different types of knowledge for SMEs within the same cluster. This is closer to the requirements of advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai, where the university and science park can bring packages of knowledge to networks of regional SMEs to support their innovation.

The case also demonstrates how to develop a network of stakeholders including SMEs, science parks and the university over the long term and the benefits this can have. The aim in Scania was to develop the Scania Food Innovation Network to become the best network globally for co-operation between the different knowledge areas and competences that will develop the food sector in the future. The work resulted in network co-operation and relations regionally, nationally and internationally between university, industry and research institutes.

The Network has had a strong focus on food and hospitality. During the years more than 120 firms have become members of the network, including large firms such as Tetra Pak and Findus. The initiative has resulted in more than 35 different products and services. Among the new or improved products developed are sport beverages, infection-reducing food (functional food), and various forms of nutrition additives. These represent to a large extent the same range of advanced agricultural products that are being promoted in Chiang Mai and Chiang Rai.

Source: Benneworth, P., L. Coenen, J. Moodysson, and B. T. Asheim, (2009), "Exploring the Multiple Roles of Lund University in Strengthening the Scania Regional Innovation System: Towards Institutional Learning?" *European Planning Studies*, 17(11), 1645-1664.

A national platform for clusters

It would also be useful in Thailand to create a platform for different regional clusters to exchange information and ideas and to network together. This platform can provide operational support for different clusters, as well as capacity-building support for professionals working in CMOs. It can also provide a platform to strengthen diversification projects involving firms and research institutions in different clusters. Box 5.5 sets out a model from Austria.

Box 5.5. The national Austrian Cluster Platform and the Upper Austria Clusterland Platform, Austria

Description of the approach

Austria was an early mover in policy to support regional cluster management organisations. The Automotive Cluster Styria was founded in the Syria region in 1995, the Automotive Cluster in Upper Austria was founded in 1998 and from 2000 onwards other regions followed. There are now more than 60 regional cluster management organisations in Austria with more than 7 100 cluster members (73% of them SMEs), accounting for some 815 000 employees. The cluster networks are linked up with research and educational institutions and co-operate with other clusters.

Cluster Platforms have been created at national and regional level to support information exchange, collaboration, cross-fertilisation and professional capacity building among the different regional cluster organisations. This case study covers the national platform for all the regional cluster management organisations nationally, and an example of a regional platform in the Upper Austria region, to help co-ordinate the different clusters within the region.

The national cluster platform

In 2008, the Federal Ministry of Science, Research and Economy launched the Austrian Cluster Platform as a structured strategic and working environment for cluster management organisations and networks in Austria. The goals are to increase co-operation between national and regional levels on support policies for clusters, especially for R&D and skills, to reinforce co-operation between clusters and research institutions, and to support information exchange and co-operation among the regional clusters and with foreign clusters.

The Platform plays an important role in supporting early and intensive information exchange across the country's cluster networks on best practices for improving cluster management. The Austrian Cluster Platform is responsible for the organisation of the annual Austrian Cluster Conference and maintains five working groups – on clusters in the national innovation system; cluster good practices related to research, innovation and skills; cluster-relevant developments in technology and innovation at European level, including regional policy; internationalisation of clusters; and future production technologies Industry 4.0 and Knowledge Intensive Services. The Platform provides regular information to the cluster network members. It also aims to participate in the development of European Union strategy and programme development to make the EU-wide initiatives relevant to the support of the regional clusters.

The regional cluster platform

A regional-level cluster platform called "Clusterland" has also been created in Upper Austria region to co-ordinate the different cluster programmes in the region. The Clusterland platform is funded and supported by the Upper Austria Business Agency, and has a Director and staff to support networking, information exchange and capacity building across the clusters. It co-ordinates nine clusters, each of which is represented on the governing board of the platform. The clusters are the Automotive Cluster; Plastics Cluster; Furniture and Timber Construction Cluster; Health Technology Cluster; Information Technology Cluster; Clean Tech Cluster; Food Cluster; Mechatronics Cluster; and Medical Technology Cluster.

This organisational set-up coordinates the various clusters in the region to facilitate cross-cluster co-operation and innovation through co-operation in the cross-roads of the clusters. This supports breaking out of the value chains of the individual clusters by looking out of the (cluster) box. This cross-fertilisation between different clusters facilitates and strengthens the innovative capacity and competitive

advantage of regional innovation system and promotes growth in value added through cluster diversification.

Factors for success

These cluster platforms are very well organised and create strong horizontal links between clusters and vertical links between the national and regional innovation systems. The strong focus on cluster policy has been very important in strengthening the innovativeness, competitiveness and internationalisation of SMEs.

Obstacles encountered and responses

The problem of the absorptive capacity of SMEs is an issue in all advanced cluster programmes with a strong focus on SMEs, especially with respect to the aim of the cluster management organisations to improve connections between SMEs and R&D organisations. This problem has been addressed by the programmes in two ways. First, the national working groups enable learning and information exchange among the clusters on best practices for improving cluster management. Second, Austria has strong arrangements for supporting SME skills development through vocational training (competence building by training apprentices through the dual education/apprenticeship programmes) and placements of graduates from the universities and especially the applied universities in SMEs.

Relevance for Chiang Mai and Chiang Rai regions

The Austria cluster policies demonstrate an effective approach to co-ordinating activities across clusters and to sharing operational and capacity building support. They highlight how cluster platforms at the national and regional level can support both learning by cluster management organisations on best practice cluster support activities and cross-fertilisation between clusters for unrelated diversification and the integration of KETs. This type of platform can play an important role in linking together activities for the regional advanced agriculture and biotechnology and food-for-the-future cluster in Chiang Mai and Chiang Rai with the activities of other major strategic clusters in Thailand.

Sources for further information: www.biz-up.at

Conclusions and policy recommendations

There is strong potential to develop advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai using biotech as a KET. This is based on a successful national strategy to develop research in relevant areas with potential for commercialisation, including through BIOTEC and national and regional universities and research organisations. However, there is a missing link in terms of the exploitation of the research by SMEs in their products in international markets. One of the major responses to this should be the creation of a cluster management organisation and cluster development agents to create networks between SMEs and universities, research organisations and science parks and to provide support to entrepreneurs and firms with start-up and scale-up potential to integrate new technologies and improve their marketing and business organisation.

The existing cluster policy is not sufficient for this task. The policy focuses particularly on tax incentives for R&D and innovation projects with individual firms. This approach should be expanded to include the long-term funding of an overarching cluster management organisation for advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai. This organisation would support the creation of a vision for cluster development in consultation with cluster stakeholders, increase the visibility and marketing of the cluster, and undertake networking and brokering of connections between groups of SMEs and the universities, science parks and research organisations for technology transfer. It should also fund direct cluster support measures including direct financing of training programmes and collaborative R&D projects.

There are many international examples of cluster policies adopting this approach, some of them illustrated in the chapter, including within European Union regional smart specialisation strategies. Overall, a change in Thailand's cluster policy is required to support the absorption of knowledge generated through public research by start-up and scale-up SMEs. The key policy recommendations are presented below:

Box 5.6. Recommendations on clusters and new industry path development

- Continue the advanced national research on biotechnology as a key enabling technology (KET) and strengthen the focus of this research on potential areas of application of the technology in advanced agriculture products and food-for-the-future.

- Strengthen applied research in universities and development work in science parks in Chiang Mai and Chiang Rai in areas of applications of biotechnology in advanced agriculture products and food-for-the-future.

- Create a cluster management organisation (CMO) with cluster management agents for the cluster. The CMO should be a public-private partnership involving collaboration between national and regional governmental agencies and knowledge generation institutions (national and regional universities and regional science parks) and national and regional industry organisations. It should have links to national and regional organisations and clusters.

- The CMO should analyse and advise on the potential for new path development in advanced agriculture and biotechnology and food-for-the-future in Chiang Mai and Chiang Rai and help agree relevant support actions with government, research and business. This should include development of a shared strategy document for the cluster.

- Introduce direct cluster development projects for advanced agriculture and biotechnology and food-for-the-future based on long-term funding. The CMO should identify and recruit potential start-up and scale-up firms to participate in these projects. The funded projects should include:
  - R&D collaborations involving groups of potential and existing start-ups and scale-ups working with universities, science parks and research organisations.
  - Workforce training projects for potential and existing start-ups and scale-ups.
  - Intensive business development services to potential and existing start-ups and scale-ups.

- In addition, the CMO should undertake activities to attract FDI and promote FDI-SME linkages (as discussed in chapter 4).

- The Chiang Mai and Chiang Rai cluster initiative should be a pilot. Further regional CMOs and cluster development projects should be created in other sectors and regions building on the experience of Chiang Mai and Chiang Rai.

- A national network of CMOs should be established to promote information exchange and capacity building on cluster development approaches as well as to create relevant linkages for SMEs and research organisations across sectors and regions. The national network should include an educational programme on cluster governance run by the regional science parks as well as a mobility scheme for CMO staff to move between CMOs.
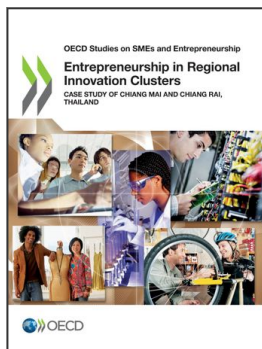

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Notes

[1] A 'functional food' is defined as food with added ingredients for which scientific evidence of positive health effects can be demonstrated. In other words, it is a hybrid form between nutrition and a pharmaceutical.

[2] Although Food Innopolis belongs to the Super Cluster category, the tax and non- tax incentives are the same as for firms in Thailand Food Valley, as agriculture and biotechnology is only defined as a 'first S-curve' sector. For industries defined as 'future industries' and belonging to the 'new S-curve' industries, a 10-15 years corporate income tax exemption as well as a personal income tax exemption for international specialists to work in the specified areas are under consideration by the Ministry of Finance.

[3] Research from Norway shows that three times as many firms with deficit apply for a similar tax exemption as firms with a surplus. Thus, in Norway a cash reimbursement scheme is applied to make this incentive interesting for start-ups and scale-ups that have not yet generated a surplus.