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Cluster-based agricultural development: a comparison between China and Africa

RESEARCH ARTICLE

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Abstract

Clusters for high-value crops are ubiquitous in China and in African countries. Drawing from three case studies (potato cluster in China, medicinal and aromatic cluster in Egypt, and dates cluster in Tunisia), this chapter discusses the major challenges facing cluster development and the roles of different agents (e.g. entrepreneurs, business associations, and local governments). Cluster development involves supply-side or demand-side bottlenecks along the way, which are beyond the capacity of individual enterprises. Whether a cluster can develop to the next stage depends crucially upon whether the bottlenecks can be resolved. Because the bottlenecks are context- and temporal-specific, it would be impossible for a planner or outsider donor to prescribe a one-size-fits-all intervention to overcome all the binding constraints. Instead, local elites, such as business leaders and local officials, can play a greater role in identifying the emerging bottlenecks and figuring out indigenous solutions. In China, because local governments have an embedded interest in promoting local economic development, they are keen to provide local public goods or initiate joint actions to address the successive binding constraints and facilitate cluster development. By comparison, the role of the local government is more muted in Africa, limiting the growth potentials of agricultural clusters.

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1. Introduction

Clusters, where similar economic activities are concentrated in a limited geographic area, are popular production modes in many sectors in developed and developing countries (Porter, 1990; Sonobe and Otsuka, 2006, 2010). Marshall (1920) pointed out that enterprises in clusters enjoy many competitive advantages, such as access to markets, labor pooling, and easy learning. In addition, the fine division of labor embedded in clusters helps lower the capital requirement to new entrants enabling more potential entrepreneurs with limited resources to get a head start on their aspirations, thereby generating employment (Long and Zhang, 2011; Ruan and Zhang, 2009). This point is particularly important for developing countries where labor is abundant and jobs are badly needed. Promoting cluster-based development has been identified as a key development strategy in many countries and regions, such as Egypt (Abdelaziz *et al.*, 2021a). There is a strong interest in learning the know-how of cluster-based development in both the academic and policy arenas.

Despite the keen interest, the literature on cluster formation is rather thin. The limited literature largely focuses on developed countries and high-tech sectors (Braunerhjelm and Feldman, 2006). By comparison, the studies on cluster formation in developing countries in the agricultural sector, in particular, are scanter. It is unclear whether the lessons from developed countries are relevant for agricultural clusters in developing countries. What is the respective role of different agents, such as local government, entrepreneurs, business associations, in agricultural cluster development in developing countries?

Drawing from three in-depth case studies on agricultural clusters in China and Africa, this chapter tries to answer this question. Our analytical framework stems from the seminal work by Sonobe and Otsuka (2006), who classified cluster growth into two stages: quantity expansion and quality upgrade. The previous literature has also paid attention to the emergence of clusters (i.e. the incipient stage from zero to one) (Braunerhjelm and Feldman, 2006). This chapter divides the cluster formation process into three stages, 0→1, 1→N, and N→Q, where N and Q stand for quantity and quality, respectively. This chapter refers to 0→1 as the incipient stage, 1→N as the growth stage, and N→Q as the quality upgrading stage.

In the initial stage of cluster formation, pioneering entrepreneurs face large uncertainties in the viability of the new product or business model. Therefore, it is hard for a central planner to come up with a sound development strategy. In this stage, entrepreneurs often play a more important role. Once the success is observed, others follow the suit.

However, as the cluster size grows, there is often an increasing demand for public goods, such as marketplaces and product safety standard. It would be difficult for individual entrepreneurs to provide the necessary public goods. Instead, joint actions are called for.

In the empirical analyses, we first identify the stage of cluster formation and the corresponding major challenges. Then we documented the major measures taken or potential solutions to address the binding constraints, paying particular attention to the roles of different agents.

The case studies show that the bottlenecks vary greatly across different stages of cluster development and are context specific. The binding constraints can be on the demand side or the supply side at other times. After one bottleneck is addressed, another one emerges. Thereby, continuous tinkering is required. It is hard for an outsider (or planner) to design an ex ante universal strategy applying to clusters in different stages of development worldwide. Thereby, more 'searchers' (Easterly, 2006) are needed to look for local solutions to the emerging binding constraints. The key searchers are entrepreneurs and local community leaders. They have an informational advantage in diagnosing the major challenges facing cluster development.

The role of searchers and planners in the cluster growth process has been discussed in the literature (Braunerhjelm and Feldman, 2006; Easterly, 2006; Porter, 1990). However, the literature rarely distinguishes

their roles in different stages of cluster development, particularly in developing countries. We pay particular attention to this point in this chapter.

This comparative study sheds some light on the design of industry policies in the context of cluster development. While the donor community and national governments strive to find a panacea for economic development, the three case studies show that it is too idealistic to prescribe one-size-fits-all policy interventions to promote cluster development. Putting the local elites in the driver's seat and aligning their interest with local economic development is a more viable option to navigating the bumpy road of cluster development.

2. Comparison of three clusters in China and Africa

2.1 Potato cluster in China[1]

The potato was not introduced to Anding County of Gansu Province until the 1960s as a crop to fight hunger. In several decades, Anding has become one of China's four major potato clusters. The cluster formation was not smooth, with various binding constraints constantly evolving. Table 1 lists the major challenges in the incipient stage, growth stage, and quality upgrading stage, as well as corresponding solutions.

Although potato was suitable for production in Anding, farmers were initially reluctant to plant potato because it was not part of the traditional diet. To promote the potato as a major crop, local governments asked village cadres to first adopt potato production, demonstrating that it was suitable for the local environment. Because of the embedded trust in village cadres, the demonstration eased other villagers' reservations about adopting potato farming in Anding.

It would be almost impossible for individual farmers to develop suitable local potato varieties, so local agricultural research organizations played a key role in filling the gap. The Gansu Academy of Agricultural Science bred a high-yield variety for starch processing (high starch and low sugar content). The county agricultural extension station and a farmer accidentally bred Xiadaping, which became the most popular vegetable potato. These two varieties have been widely used in Anding. The potato seed is vulnerable to diseases, and to address this problem, the county set up a breeding center to produce disease-free potato seeds. These measures largely addressed the binding constraints on the supply side.

After the supply-side constraints were removed, the demand-side challenges emerged. Since outsider traders controlled the market channels, they had a larger say in prices when purchasing potatoes from farmers. Thereby, farmers' profit was squeezed despite the expanded cropping area. Seeing the problem, a former schoolteacher proposed to the local government to set up a producer association, which would lead joint actions in place of outsider traders. The county government provided seed money to establish the association. The association then hired informants to gather market information in several major wholesale markets nationwide and set up collection points across the county. In addition, the association and local government broadcast the information in local media (radio, TV, and newspapers) and on large monitors in major gathering places (e.g. central squares, railway and bus stations). Thanks to the more transparent and timely market information, farmers could get a better farmgate price.

Potato production is seasonal. After the harvest, one key challenge was transporting the potato to the outside market. Road transportation was much more costly than the railway. However, the freight train quota assigned to Anding by the Ministry of Railways was too low to meet the demand. To tackle the challenge, the local government asked a provincial leader, who was originally from Anding and who used to work in the Ministry of Railways, to help lobby the ministry to increase the quotas of direct freight trains. Thanks to the lobbying effort, the quotas increased, easing the transportation glut for a few years.

[1] This section mainly draws from Zhang and Hu (2014).

Table 1. Anding potato cluster in China by development stage: challenges and the role of different agents in figuring out solutions.[1]

Development stage	Key bottlenecks	Role of individuals and private sector	Role of public organizations or governments
0→1 (incipient)	Developing and promoting local varieties.	Village cadres were asked to set up demonstration fields on their own land.	Gansu Academy of Agricultural Science bred a high-yield variety for starch processing (high starch and low sugar content).
			County agricultural extension station and a farmer accidentally bred Xiadaping, which became the most popular vegetable potato.
			The county set up a breeding center to produce disease-free potato seeds.
1→N (quantitative expansion)	Selling potatoes to outside markets.	A former teacher initiated the establishment of trader and producer associations, sending informants to collect price data in major wholesale markets.	The county government gave seed money to set up the association.
	Transporting potatoes during the peak season.		The county broadcasts the information in local media (radio, TV, and newspapers) and on large monitors in major gathering places (central squares, railway and bus stations).
			Marketplaces were set up across the county.
			Because of lobbying, the Ministry of Railways increased the quotas of direct freight trains, which lowered the transportation cost.
			Subsidies were provided to producers to build indigenous storage areas.
N→Q (qualitative upgrading)	Absorbing surplus production and extending the value chain.	Outside private firms set up plants to process potatoes for industrial starch, flour, and chips.	To the first movers, the county government provided free land, helped secure subsidized bank loans, and guaranteed stable potato supply.

[1] The information is based on Zhang and Hu (2014).

The potato price tends to drop after harvest and goes up right before the Chinese New Year. If farms can store their potatoes for a few months, they could sell them at a higher price. The local government decided to subsidize farmers to build indigenous storage in response to the need. The increased storage facilities enabled farmers to better buffer price fluctuations.

The profit margin for raw potatoes is limited. One way to increase value-added is to expand the value chain. The county government made a great effort to attract starch processing firms by offering preferential treatments, such as tax breaks and bank loans. As Hausmann and Rodrik (2003) point out, there is a discovery cost to pay for first movers. However, once the pioneering investment is proved to be successful, others can easily imitate and quickly dilute the profit margin of first movers. The negative externality can deter potential entrepreneurs from investing in the new processing industry. Government support, to some extent, offsets the negative impact, inducing investors to set up processing plants in Anding. Within a few years, a burgeoning potato processing industry had emerged. To ensure sound quality, a few leading processing enterprises signed contract farming agreements with farmers through producer associations, under which farmers are obligated to plant the designated potato varieties and comply with quality standards. All these measures facilitated the cluster's transition toward the quality upgrading phase.

Table 2. Medicinal and aromatic plants (MAPs) cluster in Egypt: challenges and potential solutions.[1]

Development stage	Key bottlenecks	Role of individuals and the private sector	Role of public organizations or governments
0→1 & 1→N	Organically formed with a long history.	Production and export are mainly organized by farmers, traders, and exporters.	Subsidy for lab testing used to be provided but was later on removed.
N→Q	Water scarcity and contamination prevent farmers from producing enough organic MAPs for the booming export market.	Need to provide farmers with incentives to reduce pesticides and residues from other crops, which have been contaminated by drainage water.	The Ministry of Water Resources and Irrigation and the Ministry of Agriculture and Land Reclamation need to work together to solve the water scarcity and contamination problem.
		Joint actions between the private and public sectors to develop or adopt low-cost test instruments to ensure produce comply with international standards.	

[1] The information is based on Abdelaziz *et al.* (2021a).

2.2 Medicinal and aromatic plants clusters in Egypt[2]

Medicinal and aromatic plants (MAPs) have been farmed along the Nile River for thousands of years. Organic MAPs production clusters have formed in Fayoum and Beni Suef. The external demand for Egyptian organic MAPs is strong; and Egypt has become one of the largest exporters of organic MAPs globally. However, the growth of this sector is limited by a few binding constraints (Table 2).

For farmers, the most limiting factor is water contamination. Water from canals linking to the Nile is provided every 35 days. In the period between, farmers rely on the agriculture drainage water remaining in the canal, often contaminated by household waste. While agricultural drainage water is suitable for watering some agricultural crops, it is not suitable for organic farming as it would contain chemical fertilizers and pesticides from neighboring non-organic farms. Consequently, when MAPs farmers irrigate their crops using contaminated water, the MAPs harvest may not pass the safety test required for export to the OECD countries. Even though many farmers attempt to cultivate their lands organically (relying on organic fertilizers and zero pesticide use), the produce likely ends up being affected by the drainage water and consequently downgraded. As a result, the produce is sold at a much lower price. The water contamination problem presents a clear binding constraint to the MAPs cluster that is impossible to solve by individual farmers, making local government intervention and joint action necessary.

Another major problem is the sharp increase in the costs of agricultural and postharvest lab tests to ensure produce quality and safety. The cost for each test, which was previously subsidized by the government, has increased from EGP 35 to EGP 1,700 over the past several years as the government waived the subsidy. This is a big blow to small farmers with less than 5 feddans (a unit of area used in Egypt, equal to 4,200 m^2). They can no longer afford to test the quality of their produce, losing bargaining power with traders on their harvest's grade or quality. To save on testing costs, instead of conducting separate lab tests for each farmers' harvest, traders pool different farmers' harvests to do fewer lab tests, making it impossible to trace problems to individual farmers once the test reveals positive results. Thus, the problem of one farmer will lead to a downgrade for a large group of farmers, even if their produce is compliant. If the government can encourage the entry of private companies specializing in lab testing, the cost may come down dramatically. Providing subsidies to offset the cost of lab testing is another option.

[2] This section draws heavily from Abdelaziz *et al.* (2021a).

During the field visits, many processing enterprises complain about the problem of business licensing. The government only grants licenses to processing companies located in the industrial zones not in the desert fringe. However, the industrial zones are often far away from the MAPs production and residential areas. The cost of transporting workers and products to the industrial zones is double that of transportation costs to local processing plants within the cluster. This ends up forcing numerous local processing hubs to conduct operations without a license (or illegally) because they are not allowed to register. In fact, a few owners of the processing plants we interviewed displayed interest, ability, and willingness to expand their processing capacity and upgrade their equipment quality if they were granted a business license. They were reluctant to make large investments without a license because the government could shut down their operation anytime. This binding constraint calls for the government to relax the business license requirement.

In summary, despite the growth potentials of organic MAPs in Egypt, the production clusters are subject to some binding constraints, which can only be addressed by joint actions or policy reforms. Although the challenges facing the clusters can be easily diagnosed, local governments have kept a blind eye. Non-government organizations, such as business associations, are largely absent. There is a lack of searchers at the local level.

2.3 Dates clusters in Tunisia[3]

Oases in the south of Tunisia are well known for dates production. There is a strong external demand for Tunisian dates, and its export value accounted for about 20% of the total value of Tunisia's agricultural exports in 2018, having more than doubled since 2000. The rapid growth lies in the active collaborations between the public and private sectors.

Various government agencies and cluster- (or sector-) organizations are involved in the dates cluster development (see Appendix 5.1 in Abdelaziz *et al.* (2021b)). The government agencies and research organizations include the Office of the Commissioner for Agricultural Development (CRDA), Investment Promotion Agency (APIA), Industry and Innovation Promotion Agency (APII), Date Technical Centre (CTD), ISET (Higher Institute of Technological Studies) training centers, Institute of the Arid Regions of Medenine (IRA), and Regional Research Centre for Oasian Agriculture (CRRAO). The cluster/sector-specific organizations include the Interprofessional Date Group (GID), Pole Djerid, and the Date Palm Cluster.

Yet, a few supply-side factors limit the growth potential of date clusters in southern Tunisia. External environmental and ecological threats are high on the list. One big problem associated with monocropping relates to insects and disease. Farmers must cover fruit bunches with mosquito nets to protect dates from insects, incurring extra labor and material costs. Climate change has made it harder to predict the exact timing of harvest. Higher temperatures during the harvesting season harm date quality.

Date productions also encounter challenges with inputs and technologies. There is a lack of new varieties, and the labor shortage is a problem, especially during harvest time. The cost of electricity and water has also been rising, and water salinity has become an increasingly serious problem.

Consequently, supply-side policy interventions are called for. The major policy options include more government investment in new and disease-resistant varieties, promoting mechanization, and introducing water-saving irrigation technologies. As shown in Table 3, numerous government agencies and associations are working on the dates cluster. Compared with the medicinal and aromatic clusters in Egypt, there are more searchers on the ground in the Tunisian date cluster who are actively looking for solutions to the emerging bottlenecks. With such a strong local capacity in the dates cluster in Tunisia, we believe that the bottlenecks can be eventually overcome, and the cluster can move up to the next stage.

[3] This section draws heavily from Abdelaziz *et al.* (2021b).

Table 3. Date cluster in Tunisia: challenges and potential solutions.[1]

Development stage	Key bottlenecks	Role of individuals and the private sector	Role of public organizations or governments
0→1 & 1→N	Organically formed	Production and export are mainly organized by farmers, traders, and exporters.	Various government agencies and cluster- (or sector-) organizations are involved: • Office of the Commissioner for Agricultural Development (CRDA) • Investment Promotion Agency (APIA) • Industry and Innovation Promotion Agency (APII) • Date Technical Centre (CTD) • Interprofessional Date Group (GID) • Pole Djerid and the Date Palm Cluster • ISET (Higher Institute of Technological Studies) training centers • Institute of the Arid Regions of Medenine (IRA) • Regional Research Centre for Oasian Agriculture (CRRAO)
N→Q	External environmental and ecological threats (climate change, inadequate water, insects, and diseases).	Increase mechanization at all stages of the value chain through hiring labor-cum-machine services.	Urgent need for research organizations to develop new date varieties with higher water efficiency, are resilient to climate change, and are less prone to disease.
	Labor shortages.	Adopt water-saving irrigation technologies.	
	Lack of new varieties and limited value addition.	Explore investment opportunities in new date derivatives and palm waste products.	The government should promote more investment in the final processing and higher value-added products, and cooperation between research organizations and firms to commercialize dates derivative products.
		Improve coordination along the value chain to increase value-added through business associations.	

[1] The information is based on Abdelaziz *et al.* (2021b).

3. Conclusions

Sonobe and Otsuka (2006, 2010) document two important regularities related to cluster development. First, clusters are widespread in developing countries and important for generating employment. Second, cluster development goes through different stages. Despite the ubiquities of clusters, cluster development has generally been more rapid in East Asian economies than in African countries. We compared the major challenges facing three agricultural clusters in China, Egypt, and Tunisia. Over the course of cluster development, many challenges emerge. They are context-specific and largely beyond the capacity of individual enterprises to resolve, thus, calling for joint actions. However, it is hard for an outsider or planner to use one-size-fits-all strategies to overcome all the challenges, although donors prefer to mainstream a particular intervention

strategy across countries. Entrepreneurs, civil society, and local governments are better positioned to figure out local indigenous solutions to the bottlenecks discussed. In particular, in the incipient stage of cluster development, entrepreneurs and their social networks can play an important role in discovering the right seeds suitable for the local environment. Later, as clusters grow, more joint actions are often needed to overcome emerging bottlenecks. At this stage, local governments and organizations can play a great role in providing necessary public goods and leading joint actions.

As shown in the three case studies, the key difference between China and the two African countries lies in local state capacity and incentives. In China, local officials have a keen interest in promoting local economic development because of career concerns and fiscal decentralization. Thereby, they tended to pay more attention to local businesses' needs and helped initiate joint actions to solve cluster development's common bottlenecks. In Tunisia, there are strong public-private partnerships. Moreover, the cluster/sector-level organizations work together with government agencies and research organizations to tackle emerging problems.

The international demand for Egyptian MAPs and Tunisian dates has been very strong. However, the clusters in the two countries face a strong headwind on the supply side. In the case of the Egyptian MAPs cluster, water contamination, high cost of lab tests, and rigid business license requirements on processing plants are major impediments to cluster growth. However, local governments and organizations are largely absent in leading joint actions.

The key challenges facing dates clusters in Tunisia include lack of value chain coordination, inadequate water supply, labor shortages, diseases, lack of new varieties, and limited value addition. More joint actions between the private and public sectors are needed to address these binding constraints.

The literature on industry policy has called for a shift from why to how (Lin, 2010; Rodrik, 2009). However, the discussions on industry policy still largely focus on policies at the national level. The three case studies demonstrate that local industrial policies matter more to cluster development. However, more research is needed to study the role of local industrial policy in cluster formation. Since cluster formation is a continuous process, encountering various binding constraints along the way, it is crucial for people on the ground to identify the bottlenecks and figure out indigenous solutions by using existing local strengths. To do that, the incentives of local leaders need to be aligned with local economic development. However, it would be a daunting task to reform the incentive system of local officials in the short run. A more viable option is to encourage non-government organizations, such as business organizations, to play a more active role in initiating joint actions in countries lacking incentives for local officials. This is particularly relevant for the medicinal and aromatic clusters in Egypt.

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