IJESD • International Scientific Journal
ISSN: 2955-0386
IF: 12.31

ASSESSING CLUSTER EFFICIENCY ACROSS FIRMS, VALUE CHAINS AND REGIONS AN APPLICATION TO UZBEKISTAN'S COTTON–TEXTILE SECTOR

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Abstract

Cluster performance is often assessed through production, employment or export growth, although these outcomes reveal little about how gains arise or how they are distributed. This paper develops a framework for evaluating the economic performance of clusters that combine regional concentration with contractual coordination along a value chain. A narrative synthesis of research on agglomeration economies, collective efficiency and cluster policy identifies four mechanisms: shared access to specialised resources, lower transaction costs, knowledge and technology diffusion, and coordination across production stages. For each mechanism, the framework specifies observable indicators at the firm, value-chain and regional levels. Uzbekistan's cotton–textile sector illustrates why the spatial reach of shared services and the contractual relationship between growers and processors should be measured separately. Export growth can accompany changes in processing activity without revealing whether growers receive higher real net income or are paid on time. The proposed evaluation therefore pairs regional value added and employment with measures of farm returns, payment performance and buyer choice. The application identifies data requirements and comparison strategies for future evaluation.

Keywords Agglomeration economies · Cluster policy · Value chains · Regional development · Uzbekistan

JEL classification L14 · O18 · Q13 · R12

1 Introduction

The economic case for industrial clusters rests in part on activities that firms can organise more efficiently together. A shared testing laboratory can spread fixed certification costs across more orders, while a local market for specialised labour or machinery maintenance can reduce recruitment and repair delays. Whether these advantages materialise depends on demand for the service, its accessibility and the costs of coordinating its use (Marshall 1920; Schmitz 1995; Porter 1998, 2000; Duranton and Puga 2004).

The term cluster can refer to several distinct economic arrangements. Geographic concentration describes where firms locate. Functional links describe how firms trade, share providers and exchange knowledge. Formal cluster designation describes an administrative or contractual arrangement. These features can overlap, but each implies a different unit of analysis and a different comparison. A district can specialise in growing cotton while relying on processors located elsewhere. A grower may contract with a designated cluster without gaining practical access to a local pool of buyers or suppliers. Treating location and contractual membership as separate variables makes these cases observable (Martin and Sunley 2003; Delgado et al. 2016).

This paper asks under what conditions collaboration between cluster participants produces measurable economic gains and what evidence would distinguish those gains from firm selection or wider economic change. It links each proposed mechanism to observable behaviour and assigns performance indicators

to three scales: the firm or farm, the production chain and the region. Its contribution is to connect evaluation across these scales for an agricultural value chain where the geography of production and the geography of contracting may diverge. Uzbekistan's cotton–textile sector illustrates how to use the framework.

2 Literature and analytical approach

2.1 Agglomeration, collective efficiency and regional competition

Marshall (1920) links industrial concentration to specialised labour pools, supporting industries and the circulation of production knowledge. Krugman (1991) shows how scale economies, transport costs and market size can reinforce geographic concentration. Duranton and Puga (2004) distinguish sharing, matching and learning as microeconomic mechanisms. In a textile region, for example, a concentration of producers can sustain specialised machine maintenance, while a larger number of employers can improve matches between workers' skills and job requirements. Ellison et al. (2010) use industry coagglomeration patterns to assess the role of input–output links, common labour needs and technological connections.

Schmitz (1995) adds deliberate joint action to the analysis of local external economies. The emergence of a specialised supplier and the creation of a jointly financed testing laboratory may both benefit local firms. Evaluating the laboratory requires information on contributions, operating costs and access rules. Porter (1998, 2000) relates these forms of cooperation to productivity, innovation and new business formation. Firms may cooperate on training and standards while competing for buyers. The scope for such competition matters when access to a common service or market is controlled by a dominant participant.

Delgado et al. (2010, 2014) link the strength of related industries in US regions to entrepreneurial activity and regional economic performance. Their approach distinguishes the presence of related industries from the initial scale of an individual local industry. Employment concentration alone can therefore miss economically important connections with maintenance, packaging, logistics, design and certification providers. Greenstone et al. (2010) compare locations that won large plant openings with runner-up locations and find larger productivity spillovers among incumbent plants with closer labour and technology links to the entrant. Combes et al. (2012) show why productivity comparisons across places must also allow for differences in firm selection.

2.2 Evidence on policy effects

Evidence on local production linkages addresses a different question from evaluations of an intervention designed to promote them. Martin et al. (2011), for example, find that a French cluster-support programme did not reverse the relative productivity decline of participating firms. OECD (2007) documents differences in programme objectives and governance across countries. Wilson et al. (2022) develop a framework for tracing effects from cluster initiatives to broader outcomes, drawing attention to the variety of effects that an evaluation may need to capture. These studies motivate a distinction between the performance of existing industrial relationships and the additional effects attributable to public support or formal designation.

2.3 Review design

The paper uses a narrative synthesis of selected conceptual studies, empirical research and policy documents. Four features organise the comparison: unit and geographic scale of analysis, definition of cluster exposure, economic outcome and comparison strategy. The studies differ in context, period, exposure and outcome, so their findings are interpreted in relation to their designs and are synthesised qualitatively.

The Uzbekistan application draws on public policy documents and a World Bank sector account. These sources establish institutional context. The framework specifies indicators and a

prospective empirical design. The synthesis uses a selected body of literature and does not assess coverage through a systematic search protocol.

During manuscript preparation, ChatGPT assisted with English translation, structural editing and development of explanatory material for the evaluation framework.

3 A framework for measuring cluster efficiency

3.1 Mechanisms and observable outcomes

Table 1 connects each mechanism to conditions that make it plausible and to measures that could show whether the mechanism operates. An efficiency assessment compares the expected gains with the additional costs of providing shared services, administering agreements and coordinating production.

Table 1 Mechanisms, enabling conditions and indicators of cluster efficiency

Mechanism	Conditions and observable links	Performance indicators
Shared specialised resources	Enough demand for laboratories, storage, logistics or training. Access rules and fees permit use by intended firms.	Real cost per service, capacity utilisation and participation by firm size.
Lower transaction costs	Clear grading, delivery and settlement terms. Credible enforcement and accessible alternatives for transacting.	Time to find a supplier and fulfil an order, days to settlement and share of amounts overdue.
Knowledge and technology diffusion	Joint training, exchange of production experience and capacity to adopt new practices.	Adoption of practices, real value added per hour worked and defect rate.
Value-chain coordination	Production, processing and sales capacity align with demand and quality standards.	On-time deliveries, share processed downstream, chain gross value added and real net farm income.

The indicators operate at different levels. At the firm or farm level, real value added per hour worked, unit production cost and operating margins capture changes in production performance. Service uptake and cost per use can show whether shared capacity is being used sufficiently to spread its fixed costs. At the value-chain level, payment performance, farm income and the share of output undergoing further processing reveal consequences that sales or exports alone cannot describe. At the regional level, real gross value added, employment and local supplier participation show how much activity takes place within the defined boundary. Monitoring job quality alongside employment can distinguish an increase in job counts from changes in the terms of employment.

Chain value added is the sum of output less intermediate consumption at each stage within the specified boundary. Simply adding turnover would count the value of yarn in both the spinner's sales and the value of the fabric sold by a downstream producer. A district-level assessment should assign value added to the location where it is produced and recognise cross-district intermediate purchases. Deflating monetary outcomes consistently is particularly important when input and output prices change over time.

3.2 Geographic scope and distribution of benefits

A single administrative boundary may poorly represent the economic reach of a cluster. Access to a testing laboratory may depend on travel time, the market for skilled employees on commuting patterns, and the market for seed cotton on where growers can deliver under prevailing contractual and transport conditions. An evaluation can therefore record both operating locations and actual commercial or service relationships. Reporting results at district and regional scales helps reveal whether gains accrue where cotton is grown or where processing takes place.

An increase in chain value added can coexist with a fall in the grower's share. Contract pricing, quality deductions, payment delays and financing terms affect farm returns. Reduced coordination costs may improve overall performance while limited buyer options weaken growers' bargaining position.

Track the effective price received after deductions, days from delivery to settlement, overdue amounts relative to amounts due, and real net farm income per hectare. The feasible number of buyers is best assessed using actual purchasing activity, transport costs and the grower's contractual options. These measures help determine who benefits from better coordination.

4 Application to Uzbekistan's cotton–textile sector

4.1 Institutional context and performance measures

Uzbekistan's cotton–textile model links cultivation and ginning with downstream activities such as spinning, weaving, finishing and garment production. Cabinet of Ministers Resolution No. 733 of 2021 established procedures for organising cotton–textile clusters. Presidential Decree No. PF-205 of 2023 addressed market relations in agriculture, including arrangements involving cotton growers and clusters (Cabinet of Ministers of the Republic of Uzbekistan 2021; President of the Republic of Uzbekistan 2023). The World Bank (2025) describes the broader reform context and the shift towards domestic processing. Evaluators should record which rules applied in each observed harvest season because the legal instruments have been amended.

For a grower, the contract determines how quality is assessed, how the purchase price is established and when payment is due. For a processor, reliable deliveries of suitable cotton can improve capacity utilisation and reduce unit costs. For a district, the economic implications depend on the processing stages located there, demand for local services and the job opportunities created. An increase in national textile exports would accordingly be assessed alongside district-level value added, plant utilisation, real farm income and settlement records.

4.2 Prospective empirical design

An empirical evaluation would link annual farm and processor records to contracts, deliveries, payment dates and operating locations. The panel should distinguish formal designation from actual procurement relationships and record the first season of each form of exposure. Baseline measures should include farm size, land quality, irrigation access and proximity to processors. Weather shocks, changes in prices and financing conditions, and concurrent reforms should be documented. Where untreated neighbouring farms sell into the same market or use the same shared facilities, their indirect exposure should also be measured.

If farms enter cluster contracts at different times and a credible comparison group is available, the evaluation could use a group-time difference-in-differences design (Callaway and Sant'Anna 2021). Under plausible conditional parallel trends and limited anticipation, farms entering in the same season could be compared with eligible never-treated or not-yet-treated farms. Pre-treatment outcome trajectories, the sensitivity of estimates to the comparison group and geographic exposure, and uncertainty at the level of assignment should be reported. If sector-wide reforms leave no credible comparison group, farm, processor and district trends can still be reported as descriptive evidence. Mechanisms should be examined through intermediate outcomes as well as final outcomes. For instance, testing whether more regular deliveries precede improved utilisation can help assess the proposed coordination mechanism.

5 Discussion and conclusion

The framework provides a common basis for evaluating clusters where firms share a regional labour or services market and where contractual arrangements organise transactions across locations. Its main implication is that gains from concentration, joint action and formal policy should each be tied to the mechanism and comparison that can support the inference. A local training programme can be assessed through participation, adoption of practices and changes in labour productivity. A contracting reform requires outcomes such as buyer access, settlement and farm returns alongside processor performance.

For regional policy, the results suggest defining the service or market failure before choosing what to support. A shared facility can be monitored through utilisation, access and operating cost per test. A procurement arrangement can be monitored through supply reliability, buyer options and payment records. Monitoring commercially relevant links across district borders makes it possible to determine where gains occur, while collecting data at successive chain stages makes it possible to assess their distribution.

The selected literature spans different sectors and institutions, and the Uzbekistan application uses public documents to illustrate the framework. The study does not estimate the size of a cluster effect or identify which mechanism contributes most in Uzbekistan. Linked farm, processor and district data would allow the proposed measures to be tested against the experience of comparable participants over time.

Data availability

No original dataset was generated or analysed. The synthesis is based on the publications and public documents cited in the reference list.

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