MECHANIZATION AND LABOR DEMAND IN UZBEKISTAN'S AGRICULTURE

Maftuna Utkirova Murodovna

Lecturer, International Agriculture University (IAU), Tashkent, Uzbekistan

Lecturer, Management and Development Institute of Singapore (MDIS), Tashkent Branch, Uzbekistan

mmmurodovna888@gmail.com

ORCID ID : 0009-0007-2687-2789

Abstract

Uzbekistan's government has committed substantial public credit to accelerating the mechanization of agriculture, with machine-assisted cotton picking targeted to reach 70 percent of the harvest in 2026 and 85 percent under the reconfigured "76th scheme" field layout, up from roughly 20 percent as recently as early 2025. Because the cotton harvest alone mobilizes an estimated two million seasonal workers each year, this shift carries direct implications for rural labor demand in a sector that, despite three decades of decline, still accounts for about a quarter of national employment. This paper situates Uzbekistan's mechanization drive within the induced-innovation framework of Hayami and Ruttan and the dual-economy tradition of Lewis, arguing that mechanization in Uzbekistan is being induced primarily by policy and financing rather than by an organic rise in rural wages, which complicates the standard assumption that displaced labor will be smoothly absorbed elsewhere. Drawing on official and secondary sources on the 2025-2026 mechanization program, the paper examines the scale of expected labor displacement, the sectors positioned to absorb displaced seasonal workers, and the risk that mechanization proceeds faster than complementary reallocation mechanisms - non-farm rural employment, labor migration, and social protection - can adjust. The paper concludes with a policy

agenda centered on sequencing mechanization with rural non-farm job creation and strengthening seasonal-worker transition support.

Keywords: agricultural mechanization; labor demand; cotton harvesting; induced innovation; rural employment; Uzbekistan; structural transformation

JEL Classification: J23, J43, O13, O33, Q10

1. INTRODUCTION

Agriculture remains a structurally important part of Uzbekistan's economy. It contributed close to a fifth of gross domestic product in 2025 and continued to employ approximately a quarter of the national labor force, a share that has fallen steadily from close to 40 percent in the mid-1990s but remains far above the shares typical of upper-middle-income economies. Within this sector, cotton retains an outsized labor footprint: the annual harvest is widely described as the largest seasonal labor mobilization in the country, drawing in on the order of two million workers, roughly half of whom depend on the harvest for their entire annual cash income.

Since 2017, and with renewed intensity in 2025 and 2026, the government has pursued mechanization as the principal solution to the labor-intensity of cotton production. In March 2026 the state approved a $400 million external credit line to finance cotton and grain harvesters and other machinery on preferential terms, explicitly to raise the machine-assisted share of the cotton harvest. Official targets call for 70 percent machine picking in 2026, and for the harvesting of cotton across all 891,000 hectares organized under the mechanization-compatible "76th scheme" field layout, with an associated 85 percent machine-harvesting target. This represents a rapid acceleration from a machine-harvesting share estimated at only about 20 percent in early 2025.

A shift of this magnitude raises a question that has received comparatively little systematic attention in the Uzbekistan literature: what happens to the labor that mechanization displaces? This paper addresses that question by combining the

classical theoretical literature on agricultural mechanization and labor transition with the most recent (2025-2026) data on Uzbekistan's mechanization program. Section 2 reviews the relevant theory. Section 3 documents the scale and pace of mechanization in Uzbekistan's cotton sector and the associated labor market context. Section 4 analyzes the labor demand implications and adjustment risks. Section 5 sets out policy implications, and Section 6 concludes.

2. THEORETICAL FRAMEWORK

2.1 Mechanization as induced innovation

Hayami and Ruttan's induced-innovation model treats the choice between labor-intensive and capital-intensive agricultural technology as a response to the relative scarcity, and therefore relative price, of land, labor, and capital. Where rural wages rise relative to the cost of machinery - typically because labor is drawn out of agriculture by urbanization, industrialization, or migration - farmers and agricultural research systems are induced to adopt and develop labor-saving technology. The model implies that mechanization is, in the first instance, an economically efficient response to a tightening rural labor market rather than an exogenous shock imposed on it.

Uzbekistan's experience only partially fits this pattern. While labor migration and urban wage growth have drawn workers away from rural areas, the scale and pace of cotton mechanization documented in Section 3 substantially exceeds what wage-induced adoption alone would typically produce over so short a period. The 2025-2026 push is better described as policy-induced mechanization: state-guaranteed credit lines, preferential loan terms of up to ten years with a two-year grace period, and explicit numerical targets are substituting for the market-price signals that, in the Hayami-Ruttan model, ordinarily govern the pace of technology adoption. This distinction matters because policy-induced mechanization can outrun the labor market's capacity to reallocate displaced workers, whereas wage-induced mechanization is, by construction, paced by the availability of alternative employment.

2.2 Dual-economy transition and labor absorption

Lewis's dual-economy model describes economic development as the transfer of labor from a low-productivity traditional (typically agricultural) sector to a higher-productivity modern sector, a transfer that is sustainable so long as the modern sector generates sufficient labor demand to absorb workers released from agriculture. The model's central caution, echoed in the subsequent development literature, is that premature or excessively rapid labor release from agriculture - whether driven by mechanization, land consolidation, or policy - can outpace the modern sector's absorptive capacity, producing underemployment, informal-sector expansion, or accelerated out-migration rather than a smooth productivity-enhancing transition.

2.3 Synthesis

Read together, the two frameworks suggest that the labor market consequences of Uzbekistan's mechanization drive depend less on the technology itself than on whether it is paced to, and coordinated with, complementary growth in non-farm rural employment, labor migration channels, and social protection for displaced seasonal workers. Section 4 applies this lens to the 2025-2026 Uzbekistan case.

3. MECHANIZATION AND THE LABOR MARKET CONTEXT, 2025-2026

Table 1 summarizes the principal indicators of Uzbekistan's mechanization program and the labor market context in which it is unfolding.

Indicator	**Period**	**Value**
Agriculture, forestry, and fishing share of GDP	2025	≈19%
Agriculture share of total employment	2025	25.2%
Agriculture employment share	1994 (peak)	39.5%
Estimated seasonal cotton-harvest workforce	Annual	≈2 million workers

Indicator	Period	Value
Share of harvest workers reliant on cotton income for full annual earnings	Recent years	≈50%
Machine-assisted cotton-picking share	Early 2025	≈20%
Machine-assisted cotton-picking target	2026	70%
Machine-harvesting target under "76th scheme" field layout	2026	85%
Area to be cultivated under the "76th scheme" layout	2026	891,000 hectares
External credit approved for harvester and machinery financing	March 2026	USD 400 million
2025 cotton harvest volume (quota fulfilled)	2025	≈3.8 million tons

Table 1. Mechanization targets and agricultural labor market indicators, Uzbekistan, 2025-2026.

The productivity contrast underlying the push toward mechanization is stark: a single cotton combine harvester can cover roughly 15 hectares per day, compared with about 150 manual pickers needed to harvest 10 hectares over three days. At this ratio, raising the machine-harvested share from 20 percent to 70-85 percent of a roughly 900,000-hectare crop implies a very large reduction in the number of manual picker-days required nationally, concentrated in the October-November harvest window on which the seasonal cotton workforce depends.

This mechanization drive is occurring alongside, and is explicitly framed by the government as a response to, a structural problem in the cotton sector: a persistent shortage of workers willing to pick cotton voluntarily at prevailing rates, which has kept alive residual and administratively organized forms of labor mobilization even after Uzbekistan's landmark 2021 elimination of systemic state-imposed forced labor

in the harvest. Framed this way, mechanization is being pursued not only as a productivity measure but as a labor-supply solution - reducing the sector's dependence on a large seasonal workforce that has become increasingly costly and difficult to mobilize through either market or administrative means.

4. LABOR DEMAND IMPLICATIONS AND ADJUSTMENT RISKS

Applying the framework of Section 2 to the facts in Section 3 yields three observations.

First, the pace of change is unusually rapid by the standards of the induced-innovation literature. A rise from roughly one-fifth to seven- or eight-tenths of harvest mechanization within a single agricultural cycle is not the gradual, wage-paced adjustment the Hayami-Ruttan model describes; it is a policy-financed discontinuity. This matters because the dual-economy model's absorption condition - that released labor finds productive alternative employment - is much harder to satisfy when labor release is compressed into one or two harvest seasons rather than spread across a decade of rising rural wages.

Second, the workers most exposed are precisely the seasonal cotton pickers who, per the figures in Table 1, number in the millions and for roughly half of whom the harvest constitutes their principal annual income. Unlike permanent farm employees, this workforce is drawn from the broader rural population - including school and university students, public-sector employees, and residents mobilized informally in past years - rather than being a fixed cohort of specialized agricultural laborers. This composition means that mechanization's labor market effect is likely to be diffuse, reducing supplementary and seasonal income across a wide swath of rural households rather than eliminating a concentrated set of full-time farm jobs.

Third, the sectors positioned to absorb this displaced seasonal labor are not obviously ready to do so at the same pace as mechanization is proceeding. As documented in related analysis of Uzbekistan's 2025-2026 labor market, private-sector

employment growth has been concentrated in financial and insurance services, professional and technical services, and administrative and support services - urban, comparatively skill-intensive segments poorly matched to the profile of rural seasonal cotton pickers. Rural non-farm employment, agro-processing, and the equipment-servicing trades that mechanization itself creates (machine operation, maintenance, and logistics) represent more plausible absorption channels, but they employ a small fraction of the workforce that manual picking currently occupies, and require different skills and, in the case of machine operation, capital and training that many displaced seasonal workers do not currently possess.

Taken together, these three observations suggest that Uzbekistan's mechanization program, while likely to raise cotton-sector productivity and reduce the administrative burden of harvest labor mobilization, carries a material risk of outpacing the economy's capacity to absorb displaced seasonal labor productively - the precise risk the dual-economy model identifies as a driver of underemployment and accelerated out-migration rather than orderly structural transformation.

5. POLICY IMPLICATIONS

Sequence mechanization financing with rural non-farm job creation. Because the $400 million mechanization credit line is a discrete, government-directed financing decision, it can in principle be paired with parallel, deliberately sequenced investment in rural agro-processing, machinery service industries, and other non-farm rural employment, so that labor demand in absorbing sectors grows in step with labor release from manual picking rather than lagging behind it.

Build transition pathways into machine-operation and maintenance roles. Mechanization itself creates a smaller but more skilled set of jobs - combine operators, technicians, and logistics staff. Targeted, subsidized training programs that prioritize experienced seasonal cotton-harvest workers and their household members for these

roles would convert a share of displaced labor demand into new labor supply within the same sector, partially closing the absorption gap identified in Section 4.

Monitor seasonal household income effects directly. Because roughly half of the harvest workforce relies on cotton-picking income for its full annual earnings, national labor market monitoring - of the kind the Central Bank of Uzbekistan already conducts on a quarterly basis - should be extended to track rural seasonal income and underemployment specifically through the harvest transition period, rather than relying solely on aggregate employment and wage indicators that can mask concentrated rural income loss.

Preserve voluntary and adequately compensated participation where manual picking persists. Because full mechanization will not be reached immediately even under the 2026 targets, continued attention to voluntary participation and fair compensation in the remaining manually harvested share remains necessary to consolidate the gains made since the 2021 elimination of systemic forced labor.

Track machine-harvesting quality and cost alongside labor displacement. Reported concerns about machine-harvested cotton quality and the cost of harvester services to farmers suggest that displacement estimates should be paired with monitoring of whether mechanization is delivering the productivity gains that justify it, so that policy can adjust the pace of the transition if returns fall short of the underlying labor-displacement cost.

6. CONCLUSION

Uzbekistan's 2025-2026 mechanization program represents one of the more rapid technology-driven labor transitions in the country's recent agricultural history, with the machine-harvested share of the cotton crop targeted to rise from roughly one-fifth to seven- or eight-tenths of the harvest within a single agricultural cycle, backed by a $400 million state-guaranteed credit line. Read through the induced-innovation and dual-economy frameworks, this transition is better characterized as policy-induced

than wage-induced, which means the labor market's usual pacing mechanism - rural wages rising in step with reduced labor demand in agriculture - is largely absent. The paper has argued that this raises a material risk that mechanization will outpace the rural non-farm economy's capacity to absorb the seasonal cotton-harvest workforce, particularly given that roughly half of an estimated two million seasonal workers depend on the harvest for their full annual income. Because the pace of mechanization is itself a policy choice, sequencing it deliberately with rural non-farm job creation, machine-operation training pathways, and close monitoring of seasonal household income offers the clearest route to capturing mechanization's productivity benefits without reproducing, in a new form, the labor market strains the policy is intended to resolve.

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