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Article

Formalising Agricultural Employment in a Green Transition: Lessons from the European Union's Social Conditionality for Uzbekistan

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Abstract: Green policies in agriculture change how land and water are used, and therefore who works on farms and on what terms. This article examines how Uzbekistan can use the green transition in agriculture to reduce informal employment, drawing on the experience of the European Union, where the 2023–2027 Common Agricultural Policy made farm subsidies conditional on compliance with basic labour standards ("social conditionality"). Using a balanced panel of 205 districts and cities for 2022–2024 (615 observations) built from the labour resources balance, the study estimates pooled and fixed-effects models of the informal-sector share of domestic employment. Informality fell from 45.8% to 42.0% of domestic employment over the period, while formal employment grew by 1.03 million people. A one-percentage-point rise in unemployment is associated with a 6.1-point higher informality rate across districts and a 1.5-point rise within a district over time; cities have informality rates 17.6 points lower than rural districts with similar characteristics, and districts with higher initial informality reduced it faster. In 2024, household plots and seasonal work accounted for 57% of the informal sector, and plot employment explains much of the rural–urban gap. Uzbekistan's water-saving subsidies, which covered about 60% of irrigated land in 2025, are conditioned on environmental results but not on labour formality. The article proposes a phased "green-social conditionality" linking these subsidies to the registration of farm workers.

Keywords: green economy, informal employment, agriculture, social conditionality, Common Agricultural Policy, panel data, fixed effects, convergence, Uzbekistan, European Union.

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1. Introduction

The green transition is usually discussed in terms of emissions, energy and water. Its effect on jobs receives less attention, yet in agriculture the two cannot be separated. A farm that switches to drip irrigation needs fewer workers for flooding fields and more for installing and maintaining equipment. A cluster that receives a green subsidy also decides how many seasonal workers it hires and whether it registers them. The European Union recognised this link when it presented the European Green Deal as a transition that must leave no one behind [1] and created the Just Transition Fund to support regions and workers affected by it [2].

For Uzbekistan the question is pressing. Agriculture uses about 90% of the country's water, and most of that water originates outside its borders. The government has responded with an ambitious programme of water-saving technologies: by the end of 2025 they covered 2.6 million hectares, or about 60% of irrigated land [3], up from about 4% in

2020 [4]. At the same time, agriculture remains the main home of informal work. More than 77% of agricultural jobs are informal [5], and the unobserved economy accounted for 75.1% of value added in agriculture in the first half of 2025 [6].

These two facts are usually treated by different ministries and in different strategies. Water-saving policy belongs to the green economy agenda, while informal employment belongs to labour and poverty-reduction policy. Yet both meet on the same farms and clusters, and both are influenced by the same public subsidies. Designing one set of instruments for both goals requires knowing what drives informality in rural districts and how fast it is changing.

The aim of this article is to show how the instruments of the green transition in Uzbek agriculture could also be used to formalise employment. The tasks are: to analyse the EU's legal and policy instruments that link farm support to labour standards; to estimate the determinants and dynamics of informal employment across Uzbekistan's districts with econometric models; and to propose a phased mechanism adapted to Uzbek conditions.

2. Methodology

The object of the study is agricultural and rural employment in the context of the green transition; the subject is the set of policy instruments that link public support for farms to the formality of employment. The study combines a comparative analysis of policy documents with econometric modelling.

Document analysis. For the EU, the analysis covers Regulation (EU) 2021/2115 on CAP Strategic Plans, in particular Article 14 on social conditionality [7], the Seasonal Workers Directive 2014/36/EU [8] and Regulation (EU) 2019/1149 establishing the European Labour Authority [9]. For Uzbekistan, it covers the Strategy for the Transition to a Green Economy for 2019–2030 [10], the water-sector programme for 2025–2028 [4] and Resolution PQ-366 of 2022 on reducing informal employment [11].

Data. The econometric analysis uses the labour resources balance for January–December 2022, 2023 and 2024 for all districts and cities, and for 2025 for Samarkand region [12]. District records from different years were matched by region and name, which produced a balanced panel of 205 districts and cities observed in all three years (615 observations). The dependent variable *INF* is the share of the informal sector in domestic employment, that is, in the sum of the formal and informal sectors. Persons working abroad are excluded from the denominator; otherwise changes in labour migration would move the informality rate mechanically.

The explanatory variables are: the unemployment rate *UR*; the share of persons working abroad in the economically active population *ABR*; the labour-force participation rate *LFP*, defined as the economically active population as a share of labour resources; a dummy *CITY* equal to one for the 31 cities; and the logarithm of the average resident population *lnPOP*. For 2024, the balance also reports the components of the informal sector, which allows the share of household-plot workers in domestic employment *PLOT* to be computed.

Models. The first model pools all observations and includes year and region fixed effects, so that it explains differences between districts within the same region:

$$INF_{it} = \beta_0 + \beta_1 UR_{it} + \beta_2 ABR_{it} + \beta_3 LFP_{it} + \beta_4 CITY_i + \beta_5 lnPOP_{it} + \mu_r + \tau_t + \varepsilon_{it} \qquad (1)$$

where i indexes districts, t years, μ the region effects and τ the year effects. The second model replaces region effects with district fixed effects α, so that the coefficients are identified only from changes within each district over time; time-invariant *CITY* drops out:

$$INF_{it} = \alpha_i + \gamma_1 UR_{it} + \gamma_2 ABR_{it} + \gamma_3 LFP_{it} + \tau_t + u_{it} \qquad (2)$$

In both models standard errors are clustered by district to allow for correlation of errors within a district over time [13]. The third model is a 2024 cross-section that adds the household-plot share, with heteroskedasticity-robust standard errors [14]:

$$INF_i = \delta_0 + \delta_1 PLOT_i + \delta_2 UR_i + \delta_3 CITY_i + e_i \qquad (3)$$

Because plot workers are part of the informal sector, δ_1 describes the composition of informality rather than a causal effect. Finally, the speed at which district informality converges is tested with a β-convergence regression of the change in informality between 2022 and 2024 on its 2022 level, with region effects [15]:

$$\Delta INF_i = \theta_0 + \theta_1 INF_{i,2022} + \mu_r + v_i \qquad (4)$$

As a robustness check, a random forest model [16] with the same explanatory variables is trained on 2022–2023 and used to predict 2024, and its out-of-sample error is compared with that of model (1).

3. Results and Discussion

The EU experience. Informal work is concentrated in agriculture in the EU as well. Data compiled for the European Platform tackling undeclared work show that informal employment accounted for 61.2% of employment in EU agriculture, compared with 16.3% in the economy as a whole [17]. Seasonal work is a major channel: a study for the European Economic and Social Committee estimates almost 2 million EU and more than 0.4 million non-EU seasonal workers in EU agriculture [18].

The EU has built its response in three layers. The Seasonal Workers Directive set common conditions of entry, stay and equal treatment for third-country seasonal workers [8]. The European Platform tackling undeclared work, launched in 2016 and later integrated into the European Labour Authority [9], allows labour inspectorates to share methods and run joint actions, including seminars on agriculture and seasonal work [17]. The most innovative step is social conditionality in the 2023–2027 Common Agricultural Policy: farmers who breach rules on transparent working conditions or occupational health and safety face a reduction in their CAP payments. Member States could apply it voluntarily from 2023 and must apply it from 2025 at the latest [7].

Social conditionality extends the logic of environmental cross-compliance, which has long made CAP payments depend on respect for environmental rules, to the treatment of workers. Its design is attractive where public subsidies form a large part of farm income: the state uses an incentive it already pays instead of relying only on fines. The early experience also shows its limits. The mechanism relies on existing labour inspections, and inspectorates in most Member States lack staff and resources, which slows enforcement and leaves coverage uneven [19].

Uzbekistan: green conditionality without social conditionality. Uzbekistan's green agricultural policy already uses conditionality, but only of the environmental kind. The green economy strategy set the general direction [10]. The water-sector programme for 2025–2028 adds water-saving technologies on a further 1.4 million hectares, including 293,000 hectares of drip irrigation [4]. A resolution of February 2026 raised the target to 3.5 million hectares, about 80% of irrigated land, by 2028, introduced a doubled tax rate where water-saving technologies are not adopted despite a stable water supply, and classified traditional irrigation on subsidised land as unauthorised water use from 1 April 2026 [20]. The state therefore already makes subsidies and taxes depend on how farms use water. It does not make them depend on how farms employ people.

Trends and structure of informal employment. Between 2022 and 2024 the formal sector grew from 6.44 million to 7.47 million people, while the informal sector declined slightly from 5.45 million to 5.41 million. The informal-sector share of domestic employment therefore fell from 45.8% to 42.0%, and the unemployment rate from 8.9% to 5.5% (Table 1).

Table 1. Main indicators of the labour resources balance of Uzbekistan, thousand persons

Indicator	2022	2023	2024
Employed, total	13,737.4	14,017.9	14,262.9
formal sector	6,437.6	6,503.9	7,472.5
informal sector	5,445.0	5,466.1	5,412.7
working abroad	1,854.7	2,047.9	1,377.7
Unemployment rate, %	8.9	6.8	5.5
Informal sector, % of total employment	39.6	39.0	38.0
Informal sector, % of domestic employment	45.8	45.7	42.0

Source: author's calculations based on [12].

The structure of the informal sector in 2024 is dominated by agriculture-related forms of work. Of the 5.41 million people in the informal sector, 1.50 million (27.8%) worked on dehqon and household plots without legal-entity status and 1.60 million (29.5%) were temporary and seasonal workers, many of them on farms. Only 0.45 million people were formally employed in dehqon farms with legal-entity status (Table 2).

Table 2. Structure of the informal sector and related formal employment, 2024

Category	Persons, thousand	Share of informal sector, %
Informal sector, total	5,412.7	100.0
Dehqon and household plots (no legal entity)	1,504.0	27.8
Temporary and seasonal workers	1,597.9	29.5
Unregistered entrepreneurs	1,441.9	26.6
Unregistered work in family firms	868.8	16.1
For comparison (formal sector): dehqon farms with legal-entity status	452.5	—
For comparison (formal sector): registered self-employed	1,122.5	—

Source: author's calculations based on [12].

Differences between districts are large. In 2024 the informality rate averaged 46.2% in rural districts and 24.1% in cities and ranged from 2.0% in Navoi city to 71.1% in Yangikurgan district of Namangan region. By region, it was highest in Namangan (55.7%), Surkhandarya (53.4%) and Fergana (50.5%) and lowest in Tashkent city (6.4%) and Navoi region (20.7%). The largest reductions between 2022 and 2024 occurred in Kashkadarya (12.1 points) and Jizzakh (9.1 points).

Descriptive statistics. Table 3 summarises the panel. The informality rate varies from 2% to 74% across district-years, with a mean of 45.4%. The explanatory variables are only weakly correlated with each other: all pairwise correlations are below 0.31 in absolute value, and variance inflation factors in model (1) are between 1.09 and 1.20, so multicollinearity is not a concern. The strongest simple correlations with informality are with urban status (−0.49) and unemployment (0.37).

Table 3. Descriptive statistics of the district panel, 2022–2024 (N = 615)

Variable	Mean	Std. dev.	Min	Max
INF, % of domestic employment	45.43	17.05	1.97	74.02
UR, %	7.18	1.52	3.84	9.77
ABR, % of active population	11.27	4.91	0.00	26.54

Variable	Mean	Std. dev.	Min	Max
LFP, %	77.28	4.94	53.32	91.04
CITY (share of observations)	0.15	0.36	0	1
lnPOP	11.90	0.67	9.11	13.47

Source: author's calculations based on [12].

Econometric estimates. Table 4 reports the estimates of models (1)–(3).

Table 4. Determinants of the informal-sector share of domestic employment

Variable	Model (1): year and region FE	Model (2): district FE	Model (3): 2024 cross-section
UR	6.135*** (1.534)	1.485** (0.726)	11.081*** (1.683)
ABR	0.090 (0.205)	−0.393*** (0.116)	—
LFP	0.432*** (0.163)	0.422* (0.221)	—
CITY	−17.636*** (2.808)	—	−0.962 (2.799)
lnPOP	3.702* (1.935)	—	—
PLOT	—	—	1.374*** (0.167)
Year effects	yes	yes	—
R^2 (within R^2 for model 2)	0.754	0.358	0.671
Observations / districts	615 / 205	615 / 205	206 / 206

*Note: standard errors in parentheses, clustered by district in models (1) and (2) and heteroskedasticity-robust in model (3); ***, **, * denote significance at the 1%, 5% and 10% levels. Source: author's calculations based on [12].*

Four results stand out. First, unemployment is the strongest driver of informality. Across districts of the same region, a one-percentage-point higher unemployment rate is associated with a 6.1-point higher informality rate. Within a district over time the effect is smaller, 1.5 points, but still significant at the 5% level. Applied to the 12.9 million people in domestic employment in 2024, a one-point fall in unemployment within districts corresponds to roughly 190,000 workers moving out of the informal sector. This supports the view that much rural informality reflects exclusion from formal jobs rather than a free choice.

Second, urban status matters a great deal in model (1): cities have informality rates 17.6 points lower than rural districts with similar unemployment, migration, participation and population. In model (3), however, once the household-plot share is added, urban status loses its significance, while each additional percentage point of plot employment is associated with an informality rate 1.37 points higher. The rural–urban gap is therefore largely a gap in the structure of agricultural employment.

Third, labour migration does not explain differences between districts, but within a district a one-point rise in the share of residents working abroad is associated with a 0.39-point fall in informality. Migration relieves pressure on local labour markets, so a fall in migration, as recorded in 2024, may push some workers back into informal rural jobs. Fourth, higher labour-force participation is associated with slightly higher informality: new entrants, many of them young people and women in rural areas, often begin in the informal sector.

Convergence and robustness. The estimate of model (4) is $\theta_1 = -0.086$ (standard error 0.030, significant at 1%, $R^2 = 0.35$): districts with an informality rate 10 points higher in 2022 reduced it by a further 0.86 points by 2024. At the same time, the coefficient of variation of district informality rose from 0.36 to 0.40, because cities reduced informality faster in relative terms than rural districts. Rural districts are catching up slowly, but the gap is not closing on its own.

The random forest model trained on 2022–2023 predicted 2024 informality with a root mean squared error of 27.2 points, compared with 10.2 points for model (1). The sharp changes in unemployment and in recorded labour migration in 2024, which may partly reflect changes in statistical methodology, moved the data outside the range seen in training. With a short panel, flexible machine-learning models should therefore be used alongside, not instead of, econometric models.

Evidence from Samarkand region, 2025. The 2025 balance for Samarkand region shows how fast change can be when formal job creation accelerates (Table 5). The regional informality rate fell from 48.6% to 41.6% in one year, and formal employment grew by 18.4%. Progress was uneven: in Urgut district informality remained close to 60%, and in Narpay and Pakhtachi districts it rose.

Table 5. Informal-sector share of domestic employment in Samarkand region, %

District	2024	2025	Change, p.p.
Samarkand region	48.6	41.6	−6.9
Samarkand city	11.9	2.9	−8.9
Kattakurgan city	49.8	28.7	−21.1
Pastdargom	50.9	34.3	−16.6
Kattakurgan district	60.5	47.7	−12.8
Jambay	54.5	43.4	−11.1
Urgut	63.8	59.6	−4.2
Nurabad	61.4	56.7	−4.7
Narpay	55.6	56.2	+0.6
Pakhtachi	43.7	51.1	+7.4

Source: author's calculations based on [12].

Implications for policy: phased green-social conditionality. The econometric results point to where the policy must act: rural districts with high unemployment and a large share of plot and seasonal employment. These are exactly the districts where water-saving subsidies are being spread most widely. Water-saving technologies are adopted mainly by clusters and larger farms, which also hire most seasonal workers; their hiring practices determine whether seasonal work is registered, yet the subsidy rules ignore this question. Table 6 compares the EU and Uzbek approaches and outlines the proposal.

Table 6. Agricultural conditionality in the EU and Uzbekistan

Instrument	European Union	Uzbekistan today	Proposal
Environmental conditions on subsidies	Cross-compliance; enhanced conditionality under CAP 2023–2027	Subsidies and tax rates tied to water-saving technologies	Keep
Labour conditions on subsidies	Social conditionality, Art. 14 of Reg. (EU) 2021/2115, mandatory from 2025	None	Link water-saving subsidies and land-lease preferences to registered labour contracts
Registration of seasonal work	Directive 2014/36/EU; national simplified schemes	Electronic contracts in the Unified National Labour System; Face-ID contracts for firms with up to 50 workers since 2025	A simplified seasonal e-contract for farm work

Instrument	European Union	Uzbekistan today	Proposal
Household plots	Small farmers largely outside penalties	Voluntary social tax (one base amount a year) counts plot workers as formally employed	Offer the voluntary social tax through subsidy and credit programmes
Enforcement	Labour inspectorates; cooperation through the European Labour Authority	AI-based "Shadow Economy Map" piloted by the Prosecutor General's Office	Risk-based inspections of subsidised farms

Source: compiled by the author from [7], [8], [9], [11], [20], [21], [22].

Four steps would make the mechanism workable. First, the condition should be phased in, as in the EU: a voluntary period in which subsidised clusters that register their seasonal workers receive a higher subsidy rate, followed by a binding condition for new subsidies after two or three seasons. Second, registration must be cheap. Electronic labour contracts with Face-ID identification, available to firms with up to 50 workers since 2025 [21], can be adapted into a short seasonal contract with the social tax paid per day worked. Third, household plots should not lose support; the voluntary social tax introduced in 2022 [11] can instead be offered alongside green subsidies and microcredit. Fourth, inspections should focus on subsidised farms in high-risk districts, building on the AI-based risk platform already piloted by the Prosecutor General's Office [22], and the effect of the condition on formal employment should be evaluated with the panel models used here before the scheme is scaled up.

Because unemployment is the strongest driver of informality, conditionality alone is not enough. It should be combined with measures that create formal rural jobs, such as processing, storage and the installation and maintenance of water-saving equipment, so that registration is accompanied by real employment. The main risk is the one observed in the EU: a condition that is not inspected changes little. A further risk is that stricter conditions slow the adoption of water-saving technologies. Both argue for a gradual design in which the labour condition first appears as a bonus rather than a penalty.

4. Conclusion

Uzbekistan's green transition in agriculture is already reshaping farm practices through subsidies and tax incentives tied to water use. The same instruments reach the farms that employ most seasonal workers, yet they say nothing about the conditions of that employment.

The econometric analysis of 205 districts for 2022–2024 shows that informality fell from 45.8% to 42.0% of domestic employment, that unemployment is its strongest driver, and that the rural–urban gap is largely explained by the weight of household-plot employment. Districts with higher informality are reducing it faster, but too slowly to close the gap without targeted policy. The Samarkand data for 2025 show that rapid progress is possible where formal jobs are created.

The EU's social conditionality shows that farm subsidies can promote formal and safe work, and its first years show that the approach depends on simple registration and adequate inspection. A phased green-social conditionality, combined with formal job creation in rural areas, would allow Uzbekistan to pursue its 2030 targets for water saving and formal employment through a single set of policy instruments. The next stage of research is to add data on subsidised areas and water-saving technologies by district to the panel and to estimate their effect on formal employment directly.

REFERENCES

[1] European Commission, *The European Green Deal*, COM(2019) 640 final. Brussels, Belgium: European Commission, 2019.

[2] European Parliament and Council of the European Union, "Regulation (EU) 2021/1056 of 24 June 2021 establishing the Just Transition Fund," *Official Journal of the European Union*, L 231, 2021.

[3] Kun.uz, "Uzbekistan's water reserves fall by 6.5 billion cubic meters year on year," Dec. 19, 2025. [Online]. Available: https://kun.uz/en/news/2025/12/19/uzbekistans-water-reserves-fall-by-65-billion-cubic-meters-year-on-year

[4] Government of the Republic of Uzbekistan, "Water resources management and irrigation sector development program adopted," Aug. 13, 2025. [Online]. Available: https://gov.uz/en/news/view/77473

[5] Central Bank of Uzbekistan, CERR and UNDP, *Informal Employment in Uzbekistan*. Tashkent, Uzbekistan: UNDP, 2025. [Online]. Available: https://www.undp.org/uzbekistan/publications/informal-employment-uzbekistan

[6] Kun.uz, "Uzbekistan's shadow economy drops to 8% of GDP in H1 2025," Jul. 30, 2025. [Online]. Available: https://kun.uz/en/news/2025/07/30/uzbekistans-shadow-economy-drops-to-8-of-gdp-in-h1-2025

[7] European Parliament and Council of the European Union, "Regulation (EU) 2021/2115 of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans)," *Official Journal of the European Union*, L 435, pp. 1–186, 2021.

[8] European Parliament and Council of the European Union, "Directive 2014/36/EU of 26 February 2014 on the conditions of entry and stay of third-country nationals for the purpose of employment as seasonal workers," *Official Journal of the European Union*, L 94, pp. 375–390, 2014.

[9] European Parliament and Council of the European Union, "Regulation (EU) 2019/1149 of 20 June 2019 establishing a European Labour Authority," *Official Journal of the European Union*, L 186, 2019.

[10] President of the Republic of Uzbekistan, "On approval of the Strategy for the transition of the Republic of Uzbekistan to a green economy for the period 2019–2030," Resolution No. PQ-4477, Oct. 4, 2019. [Online]. Available: https://lex.uz/docs/4539502

[11] President of the Republic of Uzbekistan, "On measures to reduce the share of informal employment and to form the balance of labour resources on the basis of modern approaches," Resolution No. PQ-366, Aug. 30, 2022. [Online]. Available: https://lex.uz/docs/-6179326

[12] *Labour Resources Balance of the Republic of Uzbekistan by Districts and Cities, January–December 2022, 2023, 2024 and 2025 (Samarkand region)* [Data set]. [Source organisation to be specified].

[13] A. C. Cameron and D. L. Miller, "A practitioner's guide to cluster-robust inference," *Journal of Human Resources*, vol. 50, no. 2, pp. 317–372, 2015.

[14] H. White, "A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity," *Econometrica*, vol. 48, no. 4, pp. 817–838, 1980.

[15] R. J. Barro and X. Sala-i-Martin, "Convergence," *Journal of Political Economy*, vol. 100, no. 2, pp. 223–251, 1992.

[16] L. Breiman, "Random forests," *Machine Learning*, vol. 45, no. 1, pp. 5–32, 2001.

[17] European Platform tackling undeclared work, *Tackling Undeclared Work in the Agricultural Sector, with a Focus upon Seasonal Workers and Horticulture: Learning Resource Paper*. Brussels, Belgium: European Commission, 2019.

[18] European Economic and Social Committee, *Collecting Data on the Situation of Social Protection of Seasonal Workers in the Agriculture and Food Sectors in EU Member States after COVID-19*. Brussels, Belgium: EESC, 2023.

[19] The Parliament Magazine, "CAP social conditionality clause: farm workers' rights," 2021. [Online]. Available: https://theparliamentmagazine.eu/news/article/cap-social-conditionality-clause-farm-workers-rights

[20] Ministry of Foreign Affairs of the Republic of Uzbekistan, "Water conservation must become one of our core values," 2026. [Online]. Available: https://pakistan.mfa.uz/en/news/water-conservation-must-become-one-of-our-core-values

[21] President of the Republic of Uzbekistan, "On additional measures to improve the system of labour relations and vocational training and to encourage employers," Decree No. PF-126, Aug. 4, 2025. [Online]. Available: https://lex.uz/uz/acts/-7675184

[22] President of the Republic of Uzbekistan, "Measures to reduce the share of the shadow economy and increase the effectiveness of prosecutorial oversight were considered," Jun. 26, 2026. [Online]. Available: https://president.uz/oz/lists/view/9358