Farmer welfare and gendered time use implications of a large-scale transition to cocoa agroforestry in Ghana: A local economy-wide general equilibrium assessment

29th Annual Conference on Global Economic Analysis

Introduction and motivation

In West Africa, cocoa is widely recognised as a forest-risk commodity. In Ghana, the second largest producer of cocoa, recent evidence shows that between 2000 and 2019, cocoa was a direct driver of about 57% of forest loss, with additional land-use pressures occurring through displacement dynamics affecting food-crop production (Renier et al., 2025). Further evidence suggests that cocoa-related deforestation in the tropics would continue to be a risk (Schneider et al., 2023). As global scrutiny of deforestation intensifies, particularly under the European Union's Deforestation Regulation, Ghana's cocoa sector, among other producing countries, faces increasing pressure to demonstrate sustainable land-use transitions (Boysen & Jacobs-Crisioni, 2025).

Cocoa agroforestry (CAF), the integration of shade and diverse tree species into cocoa systems, is widely promoted as a strategy for ecological intensification and climate adaptation, potentially reducing pressure on forests while supporting farm productivity and resilience. Evidence from Ghana demonstrates that CAF potentially improves farmer income and, at moderate shade levels, can sustain or increase cocoa yields and make it resilient to weather changes relative to full-sun systems (Asitoakor et al., 2022; Wätzold et al., 2026).

Despite potential benefits, adoption remains limited, and synthesis work suggests current sustainability interventions may be insufficient to scale CAF in West Africa (Kouakou et al., 2025). The dominant economic assessment remains focused on private profitability and plot-level yield effects (e.g., Asare et al., 2017; Boadi et al., 2024; Obiri et al., 2007), often abstracting from general equilibrium feedbacks that arise when many farms transition simultaneously. A large-scale transition could shift local demand for hired labour – given increased competition from activities such as artisanal and small-scale gold mining (Donkor et al., 2024) – with effects on wages, land rents, crop choice, and local prices. Another gap is the seasonality of production and labour. Methodological work using a seasonal national computable general equilibrium (CGE) model demonstrates that omitting seasonal labour markets can understate wage effects and overstate output responses (Feuerbacher et al., 2020), which is important because Ghana's cocoa sector has distinct main and light crop seasons. A further gap concerns gender and time use (Filipski et al., 2017): interventions can raise women's time burdens unless unpaid work constraints and task substitution are recognised (Armbruster et al., 2019; Torvikey et al., 2024), and studies in Ghana document women's substantial participation in cocoa alongside disproportionate domestic workloads that can constrain adoption and welfare outcomes (Dery & Dongzagla, 2020).

This study aims to assess the economy-wide welfare and gendered time use implications of a large-scale transition to CAF in Ghana, explicitly capturing spillovers through land and labour markets under seasonal constraints. The proposed contribution is twofold. First, it provides local economy-wide evidence on trade-offs and synergies between forest conservation objectives and rural welfare in Ghana's cocoa sector. Second, it provides gender-disaggregated insights into how alternative policy mixes shape labour burdens and time allocation.

Methods and data

CGE models have been applied to assess cocoa-sector policies at national scales, including deforestation trade regulations in Ghana (Boysen & Jacobs-Crisioni, 2025) and pollinator loss affecting cocoa and economy-wide outcomes (Krumbe et al., 2023). This study employs a Local Economy-Wide Impact Evaluation (LEWIE) model, a CGE framework that captures direct and indirect policy impacts through production, consumption, and price linkages within a defined local economy (Taylor & Filipski,

2014). The LEWIE model is calibrated from microdata using “elemental” household Social Accounting Matrices (SAMs) that are nested into a meta-SAM, so activity, commodity, and factor accounts are household-specific rather than shared. The model has been applied to the context of global price shocks in a regional economy to evaluate the impact on gendered time use and seasonal production (Filipski et al., 2017). This analysis builds on applications of LEWIE to gendered seasonal outcomes (Filipski et al., 2017) and incorporates insights from seasonal labour-market modelling (Feuerbacher et al., 2020).

The local economy is defined as Ghana’s Western North Region, a major cocoa-producing area. The model will be calibrated to a regional SAM derived from household survey modules covering production, sales/purchases, factor use, wages, and gender-disaggregated seasonal labour and time use. Given the early stage of the study, the calibration strategy is staged: an initial model will be benchmarked using the Ghana Living Standards Survey (Ghana Statistical Service, 2019), among others and updated with a purpose-designed regional data collection module planned for 2026 to strengthen parameterisation of seasonal labour allocation and time use accounting.

The model is designed conceptually by differentiating between conventional full-sun monoculture and CAF cocoa activities. A multi-nested production function is used. In the upper nest, output is produced using a Leontief aggregation of intermediates and value added. In the second nest, value added is a constant elasticity of substitution (CES) composite of land and a labour–capital composite; labour is further nested by season (main and light cocoa seasons) to reflect peak labour demand and potential segmentation. Within each seasonal labour nest, labour is disaggregated by gender and type (family-immobile and hired-mobile) (Feuerbacher et al., 2020). Land is allocated across activities using a constant elasticity of transformation (CET) structure. Within agricultural land, land can shift between cocoa and other crops; within cocoa land, it can shift between full-sun monoculture and CAF.

The analysis involves a comparison of the base scenario with three counterfactual scenarios. Large-scale transition (S1): a binding adoption constraint is imposed such that the CAF activity uses 90% of cocoa land, with the total cocoa land endowment fixed in the benchmark scenario. Transition and gender-responsive package (S2): complementary interventions that reduce women’s time burdens (modelled as labour-saving technical change in specified tasks/seasons and/or reduced non-market time requirements). Transition under land-conversion constraints (S3): binding limits or higher costs on land expansion/conversion to test rebound risks under profitability increases and compliance constraints.

Expected results

The analysis expects welfare outcomes to depend strongly on seasonal labour dynamics. Increased labour demand during peak seasons may raise local wages, benefiting labour-reliant households but raising production costs for cocoa farmers. Distributional effects may therefore offset aggregate welfare gains. Without gender-responsive measures, CAF adoption could heighten women’s time poverty if additional tasks fall disproportionately on them. Conversely, combining CAF incentives with labour-saving interventions may enable joint gains in income, gender equity, and forest protection. Results could inform the design of equitable and sustainable CAF policies under Ghana’s national deforestation-free cocoa agenda and EU-oriented supply-chain initiatives.

References

Armbruster, S., Solomon, J., Blare, T., & Donovan, J. (2019). Women’s time use and implications for participation in cacao value chains: evidence from VRAEM, Peru. *Development in Practice*, *29*(7), 827–843. https://doi.org/10.1080/09614524.2019.1604630

Asare, R., Asare, R. A., Asante, W. A., Markussen, B. O., & Ræbild, A. (2017). Influences of Shading and Fertilization on On-farm Yields of Cocoa in Ghana. *Experimental Agriculture*, *53*(3), 416–431. https://doi.org/10.1017/S0014479716000466

Asitoakor, B. K., Vaast, P., Ræbild, A., Ravn, H. P., Eziah, V. Y., Owusu, K., Mensah, E. O., & Asare, R. (2022). Selected shade tree species improved cocoa yields in low-input agroforestry systems in Ghana. *Agricultural Systems*, *202*, 103476. https://doi.org/10.1016/j.agsy.2022.103476

Boadi, S. A., Bosselmann, A. S., Owusu, K., Asare, R., & Olwig, M. F. (2024). Household Economics of Cocoa Agroforestry: Costs and Benefits. In M. F. Olwig, A. Skovmand Bosselmann, & K. Owusu (Eds.), *Agroforestry as Climate Change Adaptation* (pp. 121–145). Springer International Publishing. https://doi.org/10.1007/978-3-031-45635-0_5

Boysen, O., & Jacobs-Crisioni, C. (2025). *The EU Deforestation regulation for cocoa: Impacts on Ghana's economy and deforestation* (GTAP Resource #7554). GTAP Conference Paper.

Dery, I., & Dongzagla, A. (2020). *Gender analysis within the cocoa supply chain in Ghana.* Oxfam. https://www.cocoainitiative.org/sites/default/files/resources/Oxfam%20Gender%20analysis%20Ghana%20Nov20%20%281%29.pdf?

Donkor, P., Siabi, E. K., Frimpong, K., Frimpong, P. T., Mensah, S. K., Vuu, C., Siabi, E. S., Nyantakyi, E. K., Agariga, F., Atta-Darkwa, T., & Mensah, J. K. (2024). Impacts of illegal Artisanal and small-scale gold mining on livelihoods in cocoa farming communities: A case of Amansie West District, Ghana. *Resources Policy*, *91*, 104879. https://doi.org/10.1016/j.resourpol.2024.104879

Feuerbacher, A., McDonald, S., Dukpa, C., & Grethe, H. (2020). Seasonal rural labor markets and their relevance to policy analyses in developing countries. *Food Policy*, *93*, 101875. https://doi.org/10.1016/j.foodpol.2020.101875

Filipski, M., Aboudrare, A., Lybbert, T. J., & Taylor, J. E. (2017). Spice Price Spikes: Simulating Impacts of Saffron Price Volatility in a Gendered Local Economy-Wide Model. *World Development*, *91*, 84–99. https://doi.org/10.1016/j.worlddev.2016.10.018

Ghana Statistical Service. (June 2019). *Ghana Living Standards Survey Round 7*. https://www.statsghana.gov.gh/gssmain/fileUpload/pressrelease/GLSS7%20MAIN%20REPORT_FINAL.pdf

Kouakou, K. M.-P., Lyons-White, J., Thompson, W. J., Addoah, T., Cammelli, F., Blaser-Hart, W. J., Maguire-Rajpaul, V., Dawoe, E., & Garrett, R. D. (2025). Existing Sustainability Interventions are Insufficient to Scale Up Cocoa Agroforestry in West Africa. *Sustainable Development*, Article sd.70266. Advance online publication. https://doi.org/10.1002/sd.70266

Krumbe, F., Wongnaa, C. A., & Feuerbacher, A. (2023). *The economic dependency of Ghana's cocoa sector on pollination services* (GTAP Resource #6941). GTAP Conference Paper.

Obiri, B. D., Bright, G. A., McDonald, M. A., Anglaaere, L. C. N., & Cobbina, J. (2007). Financial analysis of shaded cocoa in Ghana. *Agroforestry Systems*, *71*(2), 139–149. https://doi.org/10.1007/s10457-007-9058-5

Renier, C., Addoah, T., Guye, V., Garrett, R., van den Broeck, G., Ermgassen, E. K. H. J. zu, & Meyfroidt, P. (2025). Direct and indirect deforestation for cocoa in the tropical moist forests of Ghana. *Environmental Research: Food Systems*, *2*(2), 25006. https://doi.org/10.1088/2976-601X/add01b

Schneider, M., Winchester, C., Goldman, E., & Shao, Y. (2023). Mapping Cocoa and Assessing Deforestation Risk for the Cocoa Sector in Côte d'Ivoire and Ghana. *World Resources Institute.* Advance online publication. https://doi.org/10.46830/writn.21.00011

Taylor, J. E., & Filipski, M. J. (2014). *Beyond Experiments in Development Economics*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198707875.001.0001

Torvikey, G. D., Dalaa, M. A., Adomaa, F. O., Abdul-Razak, S., Amoah, I. A., Kofituo, R. K., Tettey, A., & Asare, R. (2024). Making Climate-Smart Cocoa Inclusive: Towards a Framework for Gender Transformation. *South African Review of Sociology*, *54*(1), 42–57. https://doi.org/10.1080/21528586.2024.2321909

Wätzold, M. Y. L., Krumbiegel, K., Tillie, P., & Wollni, M. (2026). Agroforestry as a climate change adaptation strategy: Evidence from Ghana's cocoa sector. *Agricultural Systems*, *231*, 104519. https://doi.org/10.1016/j.agsy.2025.104519