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Agriculture in Nepal's NDC 3.0: Economy-wide Impacts on Nepal's Economy

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Abstract

Nepal's agriculture sector, central to food security, and rural employment and livelihoods faces mounting pressures from climate change, land degradation, and declining productivity. The Third Nationally Determined Contribution (NDC 3.0) introduces a set of targeted agricultural interventions designed to enhance climate resilience while improving productivity and reducing greenhouse gas emissions. This policy brief assesses the economy-wide implications of achieving these agricultural targets using IFPRI's dynamic Computable General Equilibrium (CGE) model calibrated to 2022 Nepal's Social Accounting Matrix. Two scenarios are evaluated: a Business-as-Usual (BAU) scenario and an NDC 3.0 scenario reflecting successful implementation of interventions such as climate-smart agriculture, improved cattle shed management, soil organic matter enhancement, irrigation expansion, and post-harvest loss reduction. Model results indicate substantial economic and welfare gains: agricultural GDP increases by 2.85 percent annually through 2035, national GDP growth rises by 0.94 percentage points per year, and approximately 317,400 individuals are lifted above the $2.15/day poverty line. Among all interventions, post-harvest loss reduction contributes the most, followed by improved livestock management. While NDC-aligned agricultural interventions offer substantial economic potential, their success depends on addressing significant fiscal, institutional, and implementation challenges. Without strengthened coordination, adequate financing, and improved extension capacity, Nepal risks falling short of the productivity and resilience gains envisioned under NDC 3.0.

Key Messages

- **NDC 3.0 agricultural interventions substantially accelerate economic growth**: Model simulation shows that achieving agricultural targets under NDC 3.0 raises the agricultural GDP by 2.85 percent per year and lift overall GDP growth by 0.94 percentage points annually through 2035.
- **Post-harvest loss reduction delivers the largest economic and food security gains**: Reducing current post-harvest losses from as high as 50 percent to the NDC 3.0 target of 15 percent contributes the most to the national GDP gains and lifts an estimated 193,500 people above the $2.15/day poverty line.
- **Implementation constraints limit realization of NDC 3.0 benefits**: Severe financing gaps such as the NPR 104.12 billion required for improved cattle sheds alone and major capacity shortages (up to 52% vacancies in research and extension institutions) underscore the need for urgent institutional strengthening and financial support.

1. Introduction

Agriculture remains the backbone of Nepal's economy, engaging about 62 percent of the population and accounting for 21.5 percent of employment (Central Bureau of Statistics, 2019, p. 20), while playing a central role in rural livelihoods, food security, and nutrition (National Statistics Office, 2023). However, the sector's contribution to Gross Domestic Product is steadily declining from 30.30 percent in 2013/14 to 24.12 percent in 2022/23

reflecting slow productivity growth relative to more rapidly expanding industry and services sectors (Nepal Rastra Bank, 2025a). Crop production dominates agricultural outputs, accounting for nearly two-thirds of sectoral outputs, with staple and high-value crops such as paddy, maize, vegetables, wheat, and potato comprising the largest shares.

Despite its importance, agricultural performance is constrained by stagnant yields, increasing fallow land, land fragmentation, labor shortages driven by youth out-migration, weak post-harvest systems, and growing reliance on food imports. Climate change further exacerbates these challenges through erratic rainfall, floods, droughts, and temperature variability, intensifying production risks and affecting smallholder farmers. Although Nepal contributes negligibly to global greenhouse gas emissions, it is among the countries most vulnerable to climate shocks, which have already imposed significant economic losses on agriculture, undermined production stability, and heightened food insecurity. Simultaneously, low productivity of staple cereals, especially rice and maize, have widened the agricultural trade deficit and increased exposure to international price and supply shocks. Nepal's average cereal yield remains low at 3.34 mt/ha, below the global average (4.15 mt/ha) and regional peers such as Bangladesh (5.16 mt/ha), Sri Lanka (3.80 mt/ha), and India (3.63 mt/ha). As a result, Nepal imported NPR 47.36 billion of rice in 2022/23, highlighting vulnerabilities in food security and consumer price stability (Nepal Rastra Bank, 2025b).

Against this backdrop, this policy brief examines the economic implications of the agricultural interventions outlined in Nepal's Nationally Determined Contribution 3.0 (NDC 3.0). These interventions, including climate-smart agriculture (CSA), irrigation expansion, improved livestock and manure management, post-harvest loss reduction, and soil organic matter (SOM) enhancement offer a direct pathway to address climate vulnerability and GHG emissions while improving productivity and overall welfare. Using a computable general equilibrium (CGE) model, our analysis evaluates the economy-wide impacts of these interventions, examining how this transition could reshape Nepal's economy.

2. Policy Landscape : Agriculture and Nationally Determined Contribution 3.0 in Nepal

Nepal's agriculture policy framework is guided by medium-term and long-term strategies, including the Agricultural Development Strategy (2015-2035), the Sixteenth Plan (2024/25 – 2028/29), the National Agriculture Policy (2004), and the National Adaptational Plan (2021-2050). These frameworks emphasize productivity growth, commercialization, and climate resilience but give limited explicit attention to agricultural GHG mitigation.

NDC 3.0 complements existing policies by integrating mitigation objectives alongside food security and adaptation goals. In addition to reductions in agricultural GHG emissions, NDC 3.0 promotes efficiency through post-harvest loss reduction, agro-meteorological advisory services, index-based agricultural insurance, irrigation through renewable energy, improve soil organic matter, and improved livestock management practices.

Key NDC 3.0 Targets in Agriculture Sector (2030–2035)

- ***Improved Cattle Sheds*:** Livestock contributes 11.3 percent of Nepal's total GHG emission (Poudel et al., 2024). NDC 3.0 targets the installation of 500,000 improved cattle sheds by 2035 to promote efficient manure management and GHG emission reduction (Government of Nepal [GoN], 2025).
- ***Expansion of Permanent Crops and Orchard:*** NDC 3.0 aims to establish 5,000 hectares of new orchards by 2030 and 10,000 hectares by 2035 to strengthen climate-resilient and carbon sequestration. It also aims to increase the area under permanent crops to improve productivity, and support sustainable land management practices (GoN, 2025).
- ***Soil Organic Matter:*** Targets include increasing soil organic matter to at least 4% by 2030 through promoting the use of organic fertilizers, establishing organic fertilizer plants, strengthening the organic certification system, and improving agricultural and household waste management for compost or organic fertilizer production.
- ***Post-Harvest Loss Reduction**:* NDC 3.0 aims to reduce post-harvest crop losses to 15 percent, addressing losses that currently range from 3–20% in cereals and up to 50% in fruits and vegetables, especially during handling, storage, and marketing (GoN, 2025).
- ***Climate Resilient Farming System:*** NDC 3.0 targets to establish 200 climate-resilient farms by 2030 and 500 by 2035, while supporting the transitioning of 45,000 households in 80 municipalities towards resilient agro-ecological production systems (GoN, 2025).
- ***Solar Irrigation*:** NDC 3.0 focuses on expanding the irrigation coverage by 463,000 hectares, including 173,000 hectares of year-round irrigation and 111,500 hectares through lift irrigation systems powered by renewable energy. Solar-powered irrigation is a central component of this transition (GoN, 2025).

Despite clear NDC 3.0 targets, achieving them will require overcoming substantial constraints, including limited financing, declining land under permanent crops, low soil organic matter levels, and weak post-harvest systems. Effective coordination among agencies and coherent financing mechanisms will be critical to meeting these targets.

3. Nepal's Agriculture Sector's Future: Economy-wide Effects-Methodology and Results

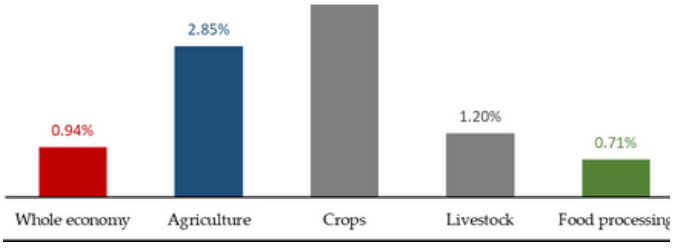
We employ an economywide model for Nepal to assess the impact of the successful completion of NDC 3.0 agricultural targets. IFPRI's dynamic computable general equilibrium model (Thurlow, (2008)), which is calibrated to a recent Social Accounting Matrix (SAM) of Nepal has been used to measure the impact on Nepal's economy (IFPRI, 2024). Using this model, we run two scenarios with the following description:

- *Business-as-Usual (BAU) Scenario*: This scenario assumes the continuation of historical trends in agricultural productivity, population growth, and investment. It also assumes that there will be no major new policy changes or interventions related to NDCs. It projects Nepal's economic trajectory to the year 2035.

- *NDC 3.0 Scenario*: This scenario simulates the successful implementation of NDC 3.0 agricultural interventions—including climate-smart agriculture, improved livestock and manure management, soil organic matter enhancement, irrigation expansion (including solar irrigation), expansion of land area under fruits orchard and post-harvest loss reduction.

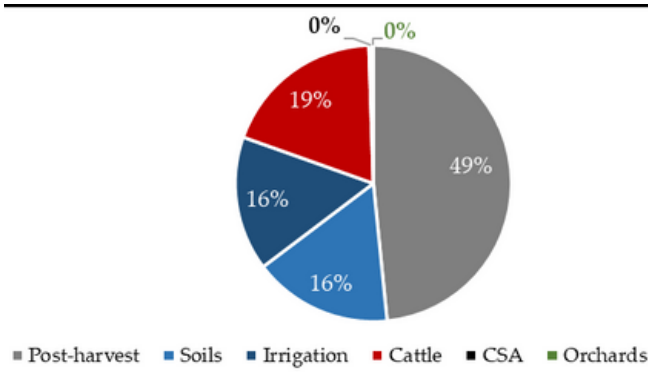
The simulation outcomes are reported in Figures 1-3. Figure 1 shows that successful implementation of agricultural interventions delivers a stronger economic performance than the BAU scenario. Agricultural GDP increases by an average of 2.85 percent per year through 2035, driven primarily by productivity gains in the crops and livestock sector. These gains have broader spillover effects on the economy, raising overall GDP growth by 0.94 percentage points per year relative to the BAU path. Further, the intervention aimed at reducing the post-harvest losses contributes the most to the gains in national GDP, followed by improved cattle shed management (Figure 2). Together with irrigation expansion and SOM improvement, these interventions reflect the importance of efficiency-enhancing and resilience-building measures.

Figure 1: GDP growth accelerates (% point increase over 2025 - 2035)



Source: Results based on model simulations.

Figure 2: Contribution of Agriculture Targets to Total Gain in National GDP (%)

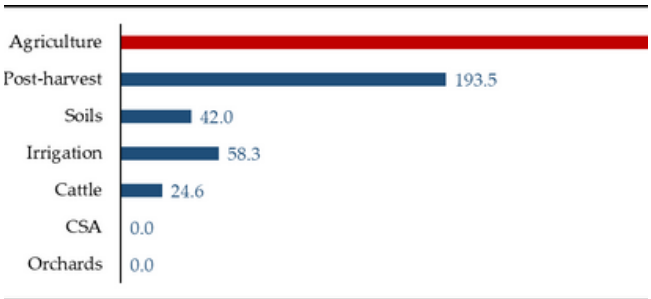


Source: Results based on model simulations.

Note: Cattle = improved livestock and manure management, CSA = Climate-smart agriculture, Irrigation = irrigation expansion (including solar irrigation), Orchards = expansion of land area under fruits orchard, Post-harvest = post-harvest loss reduction, and Soils = soil organic matter enhancement.

The agricultural interventions also generate significant welfare improvements (Figure 3). By 2035, the overall real consumption increases by 10 percent as compared to the business-as-usual scenario, which is driven by rising farm incomes and declining domestic food prices. Welfare gains are broadly shared among the poorest income decile, experiencing a 10.1 percent increase in income and the richest decile experiencing a 10.4 percent increase. Furthermore, the implementation of agricultural interventions, particularly the reduction in post-harvest losses, is estimated to lift approximately 3,17,400 individuals above the international poverty line ($2.15 per day), highlighting the potential of agricultural interventions to drive inclusive economic transformation.

Figure 3: People lifted out of poverty (1000 people) with $2.14 a day poverty line



Source: Results based on model simulations.

Note: Cattle = improved livestock and manure management, CSA = Climate-smart agriculture, Irrigation = irrigation expansion (including solar irrigation), Orchards = expansion of land area under fruits orchard, Post-harvest = post-harvest loss reduction, and Soils = soil organic matter enhancement

5. Caveat

This note is based on the ongoing collaborative research work, and the model assumptions are made based on the series of expert consultation meetings held in Kathmandu in February and May 2025. The analysis represents a first order assessment of the economy-wide impact of agriculture interventions outlined in Nepal's NDC 3.0. As the research progresses, the analysis will include various policy trade-offs to accomplish NDC 3.0 targets for agriculture sector.

6. Challenges

Despite the robust economic potential, several barriers inhibit the interventions from realizing their full potential.

1. ***Fiscal constraints:*** The high initial capital requirement for implementing the agricultural interventions, especially solar irrigation and improved cattle shed management, exceed current national budget allocation in agriculture. The estimated cost of NPR 104.12 billion is required to improve cattle shed by 2035. The required finance is significantly high when compared to the allocated budget of NPR 57.48 billion for the fiscal year 2025/26 to the Ministry of Agriculture and Livestock Development of Nepal.
2. ***Infrastructure and market limitations*:** Weak rural infrastructure, limited cold storage facilities, and poorly integrated value chains are constraints to productivity gains and contribute to the post-harvest losses.
3. ***Adoption and scalability with current institutional capacity:*** Extension support, financial access and motivation among farmers are crucial for the adoption of climate smart technologies and the management of cattle shed and soil health. However, the staffing shortages pose a significant challenge and could impede adoption efforts. For example, the federal, provincial, and local extension systems have 12 percent, 37 percent and 29 percent vacant positions, respectively (Timsina et al., 2023). Also, the Nepal Agriculture Research Council is understaffed by 52 percent and the Department of Agriculture by 47 percent, hindering the extension process.
4. ***Knowledge gaps and climate risks*:** Limited access to real-time agro-meteorological data prevents farmers from effectively mitigating climate risks despite available technologies. Further, increasing climate variability and exposure to international price shocks introduce uncertainty around productivity gains and welfare outcomes.

7. Conclusion and Policy Recommendations

Agriculture-related interventions under Nepal's NDC 3.0 have the potential to generate significant productivity gains, economy-wide growth, and poverty reduction while strengthening climate resilience. Model-based evidence suggests that post-harvest loss reduction, livestock improvements, climate-smart technologies, and soil health enhancement can produce sizable economic and welfare benefits relative to a business-as-usual trajectory. However, to realize the full potential of these interventions, sustained investment, coordinated implementation, and stronger institutional systems are required.

8. Policy Recommendations

- ***Prioritize high-return interventions***: Allocate public resources and climate finance to post-harvest loss reduction, livestock management, and productivity-enhancing technologies that generate the largest economy-wide gains.
- ***Strengthen institutional coordination***: Improve alignment among agriculture, water, energy, and climate institutions to ensure coherent implementation of NDC 3.0 targets.
- ***Scale up climate finance and private investment***: Leverage concessional finance, results-based financing, and public–private partnerships to address fiscal constraints.
- ***Enhance extension and adoption support*:** Invest in extension systems, digital advisory services, and farmer's capacity building to accelerate the uptake of climate-smart practices.
- ***Integrate monitoring and learning***: Strengthen data systems to track progress, evaluate impacts, and adjust policies based on evidence.

9. Acknowledgement

The IIDS-IFPRI project focuses on integrating agrifood systems into climate and development policies ahead of COP30 in Brazil (2025). Furthermore, the study aims to provide model-based analysis to support Nepal's government in areas such as low-carbon agricultural technologies, sustainable energy transition, andransport sector mitigation strategies. It will also assess the macroeconomic impact of climate policies, financing options for low-carbon development, and socioeconomic risks of transition. Key activities include workshops with policymakers, sectorial diagnostics, economy-wide modeling, and a final report to be completed by March 2026. Finally, the study seeks to enhance Nepal's food security, resilience, and environmental sustainability.

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