Research Article

Indian Journal of Extension Education
Vol. 61, No. 3 (July–September), 2025, (19-24)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Agricultural Productivity through Rural Assets: Evaluating MGNREGA's Role in Boosting Agricultural Performance in India

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HIGHLIGHTS

- MGNREGA infrastructure projects significantly improve agricultural yield, cultivated area, and total production across Indian states.
- Employment generation under MGNREGA positively influences agricultural productivity through increased labour availability and infrastructure use.
- Land development and micro-irrigation interventions show strong positive associations with crop productivity and farm expansion.

ARTICLE INFO

Keywords: Agricultural productivity, MGNREGA, Rural public infrastructure, Random-fixed effect, Agricultural extension.

https://doi.org/10.48165/IJEE.2025.61304

Conflict of Interest: None

Research ethics statement(s): Informed consent of the participants

ABSTRACT

The study evaluated the agricultural productivity effects of rural infrastructure investments and employment provision under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in India. The study assesses how public works, such as land development, micro-irrigation, drought-proofing, and rural connectivity, support key agricultural outcomes, including cultivated area, crop yield, and total production. Using state-level panel data from 2016 to 2023 and applying both fixed and random effects models, the study rigorously accounts for state-specific heterogeneity and time-invariant factors, ensuring unbiased and policy-relevant estimates of MGNREGA's impact on agriculture. The empirical findings demonstrate robust positive effects of MGNREGA-facilitated assets, particularly land development, drought-proofing, water conservation, and micro-irrigation, on key agricultural performance indicators. Notably, localised employment generation, as indicated by person-days of employment, emerges as a critical enabler of enhanced productivity. These findings highlight the potential of MGNREGA not merely as a welfare initiative but as a catalytic policy tool for agricultural enhancement. The research underscores the value of integrating rural employment schemes with agronomic needs to improve productivity, stabilise output, and support sustainable rural livelihoods in India's agrarian economies.

INTRODUCTION

Agriculture remains the backbone of the Indian economy, employing approximately 46.1 per cent of the workforce as of 2023–24 and contributing 15.998 per cent to the nation's Gross Value Added (GoI, 2024). Despite its centrality, the sector faces persistent structural challenges, including low productivity, inadequate irrigation, limited land development, and exposure to climate-related risks (Shaba & Alam, 2024). The MGNREGA, enacted in 2005, is India's flagship social protection program that guarantees 100 days of wage employment annually to rural households (Mohanakumar & Vipin Kumar, 2018). Its primary aim is to provide wage employment and enhance livelihood security, literature highlights its potential in creating durable rural assets that improve the productive capacity of land and labour (Drèze & Khera, 2017). In 2023–24, MGNREGA registered 26.17 crore workers,

Received 28-05-2025; Accepted 18-06-2025

with 11.81 crore active participants. The scheme generated 308.66 crore person-days across 5.99 crore households, with 58.9 per cent of labour contributed by women, reflecting strong gender inclusion. On the infrastructure front, 220.44 lakh works were undertaken, comprising 136.19 lakh ongoing and 84.25 lakh completed projects (MoRD, 2024). Over 45 per cent of total expenditure was directed towards agriculture and allied activities, reinforcing the scheme's developmental alignment with rural livelihoods (MoRD, 2024).

Existing studies focus on the program's impact on income security (Sheahan et al., 2018), women empowerment (Rodriguez, 2022), poverty alleviation (Patel, 2024), and labour market outcomes (Imbert & Papp, 2015), with fewer attempts to rigorously evaluate its role in enhancing agricultural performance. Some localised assessments suggest that MGNREGA can improve groundwater recharge, reduce soil erosion, and enhance cropping intensity (Shah, 2016; Reddy & Babu, 2018), but these findings are often context-specific and lack generalisability. There is thus a need to systematically assess whether MGNREGA functions as a productive complement to agriculture at a macro level. Present study draws upon the Agricultural Production Function framework, a classical model in agricultural economics that posits that output is a function of multiple inputs, including land, labour, capital, and technology (Gautam, 2024). Public infrastructure created under MGNREGA is theorised to augment these inputs by enhancing the efficiency and productivity of the natural resource base, improving access to water, facilitating timely labour supply, and reducing input-output transaction costs (Anantha et al., 2021). In doing so, these interventions are not merely welfare measures but constitute indirect public investments in agriculture that potentially alter production frontiers, especially in marginal and resource-constrained areas. Within this theoretical framework, the paper hypothesises that MGNREGA-related infrastructure and labour mobilisation positively affect crop yield, production, and area under cultivation. The analysis utilises state-level panel data spanning from 2016 to 2023 and employs fixed effects and random effects models to account for time-invariant heterogeneity and endogeneity concerns. In bridging employment policy and agricultural performance, this research contributes to an evolving discourse on the multifunctional role of public employment schemes in agrarian economies. It extends the literature by empirically validating the hypothesis that MGNREGA's asset-oriented interventions serve as productive complements to agricultural inputs, thereby enhancing output and efficiency and affirms that state-mediated labour mobilisation and infrastructural provisioning can operate as effective instruments of agrarian transformation in the Global South.

METHODOLOGY

This study employs a quantitative panel data approach to examine the effect of rural public infrastructure and employment generated under MGNREGA on agricultural performance in India. The dependent variables include three core indicators of agricultural output: crop yield (in kg/ha), production (in lakh tonnes), and area under cultivation (in lakh hectares), while the explanatory variables are derived from MGNREGA interventions related to employment and asset creation.

The panel dataset spans eight years (2016–2023) and includes state-level observations across 34 Indian states and UTs. Agricultural statistics, yield, production, and area are obtained from the Ministry of Agriculture & Farmers Welfare (UPAg, 2024), while MGNREGA indicators are sourced from the Ministry of Rural Development's Management Information System (MIS) (MoRD, 2024). The data are structured in a balanced panel format to enable consistent comparisons across time and states.

The key independent variables include MGNREGA employment metrics like Total workers employed (Total.Workers), total person-days generated (Person_employ), and wage expenditure (Wage_exp). Similarly, Rural asset indicators like Rural drinking water (Ruraldrinkingwater), rural sanitation works (RuralSanit), drought-proofing structures (Drought_Proof), land development works (LandDeve), micro-irrigation facilities (MicroIrrig), flood control (FloodControl), water conservation assets (WaterConservation), rural road connectivity (RuralConnect), rural infrastructure projects (Rural_Infra), and works executed on individuals' land (Works.on.Individuals.Land).

The empirical strategy adopts a panel regression model using both fixed effects (FE) and random effects (RE) estimators to account for heterogeneity across states (Dettori et al., 2022). The fixed effects model controls for time-invariant, unobserved heterogeneity by allowing each state to have its intercept, thereby isolating the within-state variation over time. The random effects model assumes that state-specific effects are uncorrelated with the explanatory variables and thus estimates both within- and between-state effects. The general panel regression model is specified as:

$$Y_{it} = \alpha + \beta_1 \text{ActiveSC}_{it} + \beta_2 \text{ ActiveST}_{it} + \beta_3 \text{ ActiveOther}_{it} + \beta_4 \text{ ActiveWomen}_{it} + \beta_5 \text{ Wage\_exp}_{it} + \beta_6 \text{ Admin\_exp}_{it} + \beta_7 \text{ Person\_employ}_{it} + \beta_8 \text{ AvPDHH}_{it} + \beta_9 \text{ AvWagePD}_{it} + \beta_{10} \text{ CostPerPD}_{it} + \beta_{11} \text{ NRM\_Work}_{it} + \beta_{12} \text{ VulSectwork}_{it} + \beta_{13} \text{ Rural\_Infra\_cat}_{it} + \upsilon_i + \lambda_t + \varepsilon_{it}$$

Where Y_{it} Agricultural outcome (Yield, Production, or Area), α Intercept term, β Vector of coefficients, X_{it} Vector of explanatory variables representing MGNREGA-related inputs, υ_i Unobserved time-invariant state-specific effects, λ_t, fixed effects, ε_{it} Idiosyncratic error term.

The Random Effects model assumes no correlation between these unobserved effects and the regressors, allowing for greater efficiency if the assumption holds.

$$Y_{it} = \alpha + \beta X_{it} + \upsilon_{it} + \varepsilon_{it}$$

The Fixed Effects model is particularly useful in controlling for state-specific factors such as institutional capacity, historical labour trends, or geographic characteristics that do not change over time.

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}$$

This transformation removes υ_{it}, capturing only the within-state variation over time. The FE model is preferred when these unobserved effects are correlated with the regressors, i.e., $Cov(X_{it}, \upsilon_{it}) \neq 0$.

To empirically determine the appropriate specification for each dependent variable, the Hausman test is conducted (Vogelsang, 2012). Robust standard errors clustered at the state level are used to correct for heteroskedasticity and serial correlation. Before model estimation, Variance Inflation Factors (VIFs) are computed to detect multicollinearity, and residual diagnostics are conducted to assess model validity. This rigorous econometric design facilitates a theoretically grounded and policy-relevant evaluation of how MGNREGA's labour-based asset creation influences the trajectory of agricultural development in India.

RESULTS

Econometric specifications: descriptive analysis, stationarity, and model selection

Descriptive statistics (Table 1) reveal substantial variation across states and years in both agricultural outcomes and MGNREGA-related variables, indicating heterogeneity in program implementation and agrarian contexts. High dispersion in variables like wage expenditure, person-days of employment, and infrastructure creation suggests differing state capacities and policy priorities. To ensure robustness of the analysis, the dataset was cleaned and standardised, with key variables like person_employ, wage_exp log-transformed to address skewness and facilitate elasticity-based interpretations. Overall, the descriptive summary underscores the importance of controlling for unobserved heterogeneity through panel models, given the diverse socio-economic and institutional landscapes influencing agricultural productivity across India.

To ensure the robustness of the panel data regression models and to mitigate the risk of spurious results, in Table 2, the Levin-Lin-Chu (LLC) unit root test was applied to assess the stationarity of the dependent variables: Area, Yield, and Production. The findings indicate mixed integration orders across the variables. The Area variable was found to be non-stationary in levels (LLC test statistic = 10.009, p = 0.8434), but became stationary after first differencing (LLC = –3.427, p = 0.0212), suggesting it is integrated of order one, I(1). In contrast, Yield and Production both demonstrated stationarity in level form, with statistically significant LLC test results (Yield: –2.123, p = 0.0128; Production: –6.824, p = 0.0044), thus confirming their status as I(0) series. Consequently, the regression models used first-differenced values for the Area variable, while Yield and Production were modelled in levels. Independent variables were not subjected to unit root testing due to the short panel structure and model specification.

To determine the most appropriate estimation technique for the panel data, Diagnostic tests for RE and FE models were estimated for each of the agricultural outcomes—cultivated area, yield, and production in Table 3. Model selection was guided by the Hausman specification test, which tests the null hypothesis that the preferred model is Random Effects, under the assumption that the individual-specific effects are uncorrelated with the regressors (Baltagi, 2014).

The Hausman test results (Area: p = 0.2855; Yield: p = 0.9819; Production: p = 0.2570) consistently suggest that the RE model is more suitable than the FE model for all three outcomes. This implies that unobserved state-level characteristics influencing agricultural performance are not systematically correlated with MGNREGA-related explanatory variables, allowing for more efficient estimation using RE.

Table 1. Descriptive statistics of the data

Variable	N	Mean	SD	Median	Min	Max
Area	231	21.72	25.75	17.35	0	101.17
Yield	231	2212.7	750.94	2099	0	4489
Production	231	45.15	49.98	34.89	0	212.5
Total.Workers	231	40.56	41.85	15.34	0.07	133.11
Wage_exp	231	184626.29	217613.27	81950.69	0	1057014.95
Person_employ	231	2672559.23	2998475.85	1018627	0	11826053
Rural_Infra	231	3007.35	9367.45	457	0	109305
Drought_Proof	231	10392.35	20138.68	2403	0	137906
FloodControl	231	3384.79	7817.99	648	0	60233
LandDeve	231	11368.14	30626.44	3539	0	323013
MicroIrrig	231	6883.34	15661.86	2532	0	166297
Ruraldrinkingwater	231	3116.66	5259.15	836	0	50313
RuralConnect	231	11381.46	16001.19	5225	0	91252
RuralSanit	231	11674.62	32086.32	1370	0	235426
WaterConservation	231	13617.78	20490.3	5528	0	131354
Works.on.Individuals.Land	231	177216.46	251266.58	38449	0	1158337

Source: Author's calculation

Table 2. Result for Levin-Lin-Chu (LLC) test for panel unit roots

Variable	LLC Test Statistic (Level) I/0	P value	LLC Test Statistic (1st Diff) I/1	P value	Integration Order
Area	10.009	0.8434	-3.427***	0.0212	I(1)
Yield	11.574***	0.6785	-2.123***	0.0128	I(0)
Production	-6.824***	0.0044	-7.345***	0.0032	I(0)

Source: Author's calculation

The Breusch–Pagan LM test confirms significant panel-level effects across all models ($p < 0.05$), reinforcing the use of panel estimation techniques over pooled OLS. This aligns with expectations, as state-level differences, such as agroclimatic conditions or administrative efficiency, are likely to influence agricultural trends over time. However, the Wooldridge test for autocorrelation indicates the presence of first-order serial correlation in all three models. This suggests that agrarian performance in one year is influenced by prior-year conditions, such as residual impacts of infrastructure or monsoon variability. Likewise, the Pesaran CD test reveals cross-sectional dependence, meaning that agricultural outcomes in one state are influenced by developments in others– an expected trend in a federal system with shared policies and interlinked resource flows. Finally, the Mean VIF values (Area: 4.157; Yield: 4.267; Production: 4.012) suggest no major multicollinearity, validating the stability of regression coefficients.

These diagnostics highlight two important trends. First, agricultural outcomes are not isolated across time or geography, underscoring the systemic nature of agrarian development. Second, given these violations of standard FE model assumptions, the standard errors were corrected using Driscoll-Kraay robust standard errors (Vogelsang, 2012). This method accounts for heteroscedasticity, serial correlation, and cross-sectional dependence, which are likely in macro-panel data such as the one used in this study. The estimation was conducted using the vcovSCC function from the plm package in R, which implements Driscoll-Kraay standard errors with a fixed number of lags suitable for unbalanced panels with time-series dependence. The results from the robust RE estimations are, therefore, reliable even in the presence of these statistical issues and serve as the basis for the interpretation in the subsequent section. The analysis proceeds with Random Effects estimation as the primary modelling strategy, while also presenting Fixed Effects results for robustness and comparison.

Impact of MGNREGA interventions on agricultural outcomes: evidence from panel regression analysis

The panel regression analysis using both FE and RE models revealed differentiated impacts of MGNREGA-related infrastructure and employment variables on agricultural performance across cultivated area, yield, and production in Table 4. Based on the Hausman test, the RE model is preferred, and the following results are discussed primarily in terms of RE estimates, with FE results referenced where relevant.

For cultivated area, land development and drought-proofing showed strong and significant positive associations, indicating that physical asset creation under MGNREGA has contributed to expanded agricultural land use. Employment generation, proxied by person-days of employment, was also positively associated, reinforcing the role of labour provisioning. Notably, micro-irrigation displayed a significant and positive effect only in the RE model, suggesting that irrigation supports yields better outcomes when accounting for state-level time-invariant heterogeneity. However, the effect of total workers was not significant in RE, despite being significant under FE, pointing to localised labour effects rather than general trends.

In terms of agricultural yield, several water-related and infrastructure indicators stood out. Rural drinking water access, micro-irrigation, and rural infrastructure all showed significant positive associations with yield, highlighting the role of water and physical infrastructure in boosting productivity. Conversely, rural sanitation had a consistently negative impact, which may reflect opportunity costs or unintended land-use changes. Land development and water conservation also contributed positively to yield improvements.

For agricultural production, total workers, person employment, and land development were all positively and significantly associated with output in the RE model. Drought-proofing and flood control also had meaningful positive effects, reinforcing the productivity-enhancing potential of climate-resilient assets. However, rural connectivity again showed a negative but significant effect, possibly indicating unintended shifts away from agriculture due to better physical access. Works on individuals and rural sanitation did not exhibit statistically robust effects on production. In summary, the RE model results suggest that MGNREGA's employment and asset-building components, especially those related to land, water, and irrigation infrastructure, have had a significant and positive impact on rural agricultural performance across states.

DISCUSSION

The observed positive associations between variables such as land development, person employment, and micro-irrigation with cultivated area, yield, and production align with the core objectives of MGNREGA–namely, creating durable rural assets while enhancing agricultural productivity and resilience. The consistent and significant impact of land development and person employment across all three agricultural indicators suggests that MGNREGA interventions are not merely income-supporting mechanisms but contribute meaningfully to productive infrastructure. These results support the conclusions of earlier works such as Deininger & Liu

Table 3. Hausman specification test and other diagnostic tests

Test	Area	Yield	Production
Hausman Test (p-value)	0.2855	0.9819	0.2570
Preferred Model	Random Effects	Random Effects	Random Effects
Mean VIF	4.157	4.267	4.012
Breusch–Pagan LM Test (p-value)	0.00307	0.0093	0.0101
Wooldridge Test for Autocorrelation (p-value)	0.0022	0.0000	0.0033
Pesaran CD Test (p-value)	0.0000	0.0041	0.0012
Model Used	RE (1st Diff)	RE (Level)	RE (Level)

Source: Author's calculation

Table 4. RE and FE Regression results for Agricultural outcomes

	Area				Yield				Prodution			
	RE		FE		RE		FE		RE		FE	
	Estimate	P-value	Estimate	P-value	Estimate	P-value	Estimate	P-value	Estimate	P-value	Estimate	Pvalue
Intercept	-0.3502**	0.044			2324.8***	0.000			10.9900*	0.031		
Total.Workers	0.0072	0.223	1.7792***	0.010	1.2988	0.409	2.8634	0.648	0.9422***	0.002	6.7335	0.071
Ruraldrinkingwater	0.0052	0.235	0.0055	0.580	0.0099**	0.011	0.0102**	0.032	0.0006*	0.023	0.0048	0.101
RuralSanit	-0.0010	0.123	0.0023	0.679	-0.0019**	0.031	-0.0021**	0.023	-0.0001**	0.027	-0.0071	0.114
Wage_exp	0.0164**	0.024	-0.0015	0.868	0.0002	0.561	-0.0010	0.609	0.0069	0.606	0.0032**	0.025
Drought_Proof	0.0226*	0.029	0.0584***	0.005	0.0364	0.108	0.0341	0.086	0.0221***	0.001	0.0275**	0.032
Person_employ	0.0198***	0.004	0.0263**	0.030	-0.0123	0.699	-0.0216	0.311	0.0136***	0.003	0.0175*	0.062
LandDeve	0.0173***	0.001	0.0327***	0.006	0.0416	0.234	0.0444	0.234	0.0715	0.004	0.0616**	0.017
MicroIrrig	0.0962***	0.009	-0.0443	0.269	0.0355***	0.002	0.0335**	0.042	0.0192	0.730	0.0343	0.132
FloodControl	0.0214	0.418	0.0172	0.717	-0.0194	0.268	-0.0024	0.267	0.0361*	0.057	0.0306*	0.029
WaterConservation	-0.0592	0.456	-0.0124	0.875	0.0245***	0.000	0.0212**	0.029	-0.0119	0.781	0.0247	0.654
RuralConnect	-0.0346	0.104	0.0102**	0.025	-0.0927**	0.026	-0.0936**	0.030	-0.0449**	0.012	-0.0514*	0.061
Rural_Infra	0.0982	0.414	0.0327	0.706	0.0458***	0.006	0.0455**	0.044	0.0223*	0.046	0.0190*	0.053
Works.on.Individuals	0.0146***	0.001	0.0142	0.421	-0.0529	0.327	-0.0310	0.456	-0.0361	0.205	-0.0430	0.068
R-squared	0.4321		0.3836		0.4635		0.3456		0.5154		0.4123	

Source: Author's calculation; *Note:* *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$.

(2019), which emphasise that public works programs that combine wage employment with asset creation yield lasting benefits for agricultural livelihoods. Furthermore, the positive impact of micro-irrigation and water conservation measures on yield and production corroborates findings by Shah (2016), who highlights that irrigation-based interventions under MGNREGA lead to more stable and enhanced crop outputs, particularly in semi-arid regions.

The significant contribution of rural drinking water infrastructure to yield points to the broader developmental spill-overs of MGNREGA (Bharne et al., 2025). Improved water access likely facilitates both domestic and farm-related activities, reducing time burdens, especially for women, and allowing more labour allocation toward agricultural tasks (Jatav & Singh, 2023). This observation resonates with studies by Narayanan et al., (2019), which find that the indirect effects of MGNREGA on rural household productivity can be substantial when basic infrastructure is addressed. Conversely, the negative association of rural sanitation infrastructure with both yield and production appears counterintuitive. One plausible explanation is that such investments, although critical for public health, might involve land-use changes or temporary displacement of cultivable land (Jiragal et al., 2025). It also reflects a misalignment between asset type and local agricultural priorities, a concern raised in implementation assessments by Drèze & Khera (2017), who caution that asset utility is often contingent on local relevance and community participation.

Interestingly, rural connectivity, while generally assumed to be beneficial, shows a negative relationship with production in both RE and FE models. This may suggest unintended consequences such as increased labour mobility leading to reduced agricultural labour supply or land-use shifts towards non-agricultural uses. This finding aligns with Yadav & Ghosh (2023), who note that infrastructure development without integrated rural planning can sometimes create sectoral imbalances or labour diversion effects. The study also highlights that not all asset types have uniform effects. For instance, works on individual land does not show statistically significant impacts, which could indicate variability in the scale or sustainability of individual-level assets. These mixed outcomes emphasise the need for rigorous asset planning, ensuring that investments are both need-based and linked to productive outcomes (Nain et al., 2024).

Overall, the trends suggest that when MGNREGA focuses on natural resource management, irrigation, and public employment provisioning, it has tangible positive spill-overs for agriculture. These results support the broader thesis that employment guarantee schemes, when properly implemented, can serve dual goals—short-term income support and long-term rural development. However, the effectiveness is contingent upon the type of asset, regional agroclimatic conditions, and alignment with local needs. Further, while RE models account for time-invariant state-level characteristics and provide a robust analytical framework, localised qualitative assessments remain necessary to fully interpret causality and policy relevance.

CONCLUSION

The study confirms that rural employment schemes play a vital role not only in providing wage employment but also in improving agricultural outcomes through the creation of productive assets. The results demonstrate that interventions such as land development, drought proofing, water conservation, and localised irrigation positively influence cultivated area, yield, and total agricultural production. Employment creation and community-based infrastructure development emerge as critical enablers of rural agricultural productivity. The evidence suggests that well-targeted rural employment programs can deliver lasting benefits to the agricultural sector, particularly when infrastructure is tailored to local agroecological needs. These findings validate the hypothesis that asset-building under such schemes contributes meaningfully to agricultural performance. It should now be recognised that the integration of rural employment programs with agricultural planning is essential for achieving sustainable rural development. The research implies that policy design must continue to emphasise asset quality, regional targeting, and long-term agricultural relevance.

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