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# Increasing Agricultural Productivity Through New Technology in Nohar and Sangaria Tehsils

Shiv Karan Karwasra, Scholar (Geography), Tantia University, Sri Ganganagar
Dr. Mukesh Kumar, Supervisor (Geography), Tantia University, Sri Ganganagar

## Abstract

This paper examines how new agricultural technologies could raise farm productivity in Nohar and Sangaria tehsils of Hanumangarh district, Rajasthan, and how local geography shapes their adoption and effects. The district belongs to Rajasthan's irrigated north-western plains agro-climatic zone, where canal and groundwater irrigation support an intensive crop economy. Wheat, mustard, gram, cotton, guar and other crops create different demands for water, labour, crop protection and marketing. The paper reviews the relevance of precision irrigation, soil testing, mechanisation, remote sensing, mobile advisory services, weather information and digital market access. It proposes a comparative, mixed-method geographical design combining village-level surveys, farm records, interviews, secondary statistics and GIS mapping. Productivity is defined in both physical and economic terms: yield per hectare, gross margin, labour and water productivity, input efficiency and production risk. Published district statistics establish the wider agricultural context, but publicly available evidence does not establish technology adoption or causal productivity effects separately for Nohar and Sangaria. Accordingly, this paper develops a locally testable analytical framework rather than claiming original field results. It argues that technology is most likely to produce durable gains when it is matched to land, water and crop conditions, accessible through shared services, supported by extension, and evaluated for cost, equity and environmental effects.

**Keywords: agricultural productivity; digital agriculture; irrigation; geographical study; Nohar; Sangaria; Hanumangarh; Rajasthan**

## Introduction

Agriculture in arid and semi-arid regions depends on the interaction of climate, soils, water infrastructure, farm size, labour and access to markets. In north-western Rajasthan, irrigation has enabled more intensive cultivation than rainfall alone would permit, but the resulting production system must manage water availability, variable weather, soil conditions and rising costs. New technology can improve productivity when it helps farmers make more timely and site-specific decisions, reduce losses, or use scarce inputs more efficiently. Its effects are not automatic: equipment and digital services must be affordable, reliable and suited to local farming practices.

Nohar and Sangaria form a useful comparative area within Hanumangarh district. The district's geographic position and links to markets in Rajasthan and neighbouring states shape the movement of inputs and produce. District-level sources identify an irrigated north-western plains setting and report an important mix of cereal, oilseed, pulse and commercial crops (Rajasthan Foundation, n.d.). These characteristics make technology relevant in several linked ways: water scheduling for irrigated crops; improved seed and crop establishment; precision application of fertilisers and pesticides; mechanisation at peak labour periods; and timely access to weather, pest and price information.

The central question is not simply whether technology raises yields, but where, for whom and at what cost it does so. This paper asks: (1) what geographic and agricultural conditions distinguish Nohar and Sangaria; (2) which technologies are most relevant to their crop and resource systems; (3) how technology adoption may affect yield, farm income, labour and water productivity; and (4) what geographic and institutional barriers shape adoption? The paper combines a literature-based assessment with a proposed field methodology. It does not treat district-wide trends as tehsil-level evidence.

**Review of Literature**

Research on agricultural digitalisation identifies a broad set of possible gains: more timely information, improved input allocation, reduced labour bottlenecks, better risk management and lower transaction costs. FAO's synthesis of ten case studies from low- and middle-income countries finds that digital and automated solutions can support productivity, resilience and efficiency, while access remains limited for small-scale producers and depends on enabling conditions (McCampbell, 2022). This suggests that availability alone is a poor measure of impact; effective use, local relevance and service delivery also matter.

Precision agriculture brings together satellite positioning, remote sensing, sensors, GIS and variable-rate application to observe and manage spatial differences within fields. Sensor-based monitoring can improve the timing and targeting of water, nutrients and crop-protection measures, though the value depends on sensor quality, interpretation and integration with agronomic advice (Journal of the Indian Society of Soil Science, 2022). In a tehsil-level study, these technologies can be examined at multiple scales: field-level soil and moisture variation, village-level irrigation access, and tehsil-level patterns of crop area and infrastructure.

Digital tools can also improve access to information and markets. Mobile services may provide weather forecasts, pest alerts, crop guidance, price information and links to government services. The World Bank's analysis of digital technology in food systems stresses that benefits depend on access to connectivity and digital infrastructure, and notes that smallholders face constraints in using advanced technologies (World Bank, 2019). For Nohar and Sangaria, the practical question is whether information arrives in a language and format farmers can use, at the moment it affects a decision, and whether it is trusted and actionable.

The technology literature therefore points to three analytical principles. First, productivity should include more than yield: cost per unit of output, water productivity, labour savings and farm profitability can change independently. Second, adoption is socially and geographically uneven because access to capital, land, connectivity, extension and custom-hiring services varies. Third, technologies function as part of a system: a sensor without advice, a machine without repair support, or a market application without price transparency may have little value. These principles inform the comparative framework proposed here.

**Methodology**

Research design: A comparative mixed-method study is proposed for Nohar and Sangaria tehsils. The unit of analysis is the farm household, nested within village and tehsil geographies. A field survey should be conducted across villages selected to represent differences in irrigation source, crop mix, distance from market, farm size and access to services. A practical design would stratify villages by these characteristics and then sample farm households within each stratum. Final sample size should be determined through a pilot survey and statistical power calculation; no sample has been collected for this paper.

Data sources: Primary data should include household and farm characteristics, plot area, crops, input quantities and costs, irrigation practices, machinery access, technology use, extension contact, market channels, output, sale price, perceived constraints and recent production shocks. Short interviews with farmers, input dealers, custom-hiring providers, extension workers, cooperatives and mandi actors can explain adoption decisions and service gaps. Secondary data should include Census of India village and tehsil records, Rajasthan agricultural statistics, district crop and irrigation records, meteorological series, soil information and relevant programme data. Each dataset must be checked for year, spatial scale and boundary consistency before comparison.

Geographical analysis: GIS can map sampled villages, roads, markets, irrigation infrastructure where data are available, and the distribution of technology services. Spatial indicators may include distance to an agricultural market or service centre, irrigation access, crop concentration and connectivity. Remote-sensing imagery can be used to examine seasonal

vegetation and land-use patterns, but it should be validated against field observations and should not be interpreted as farm yield without appropriate calibration. Tehsil boundaries and administrative changes must be reconciled across datasets.

Measures and analysis: Physical productivity should be measured as crop yield per hectare, using verified harvest or farm records where possible. Economic productivity should include gross margin per hectare and output value per unit of key input. Water productivity can be estimated as output per unit of irrigation water where reliable water-use measurements exist; otherwise, irrigation frequency and source should be reported as proxies rather than converted into unsupported water-volume estimates. Labour productivity can be measured as output or gross margin per labour day. Descriptive statistics and cross-tabulations can compare technologies and farms. Regression analysis may estimate associations between technology use and outcomes while controlling for farm size, crop, irrigation, soil, education, credit and market access. Because adoption is not random, causal claims require a credible identification strategy, such as a matched comparison, panel data or a phased programme evaluation.

Technology groups to assess: (1) soil testing and site-specific nutrient advice; (2) drip, sprinkler, laser land levelling, scheduling and water monitoring where agronomically suitable; (3) improved seed and precision sowing; (4) tractors, seed drills, harvesters and custom-hiring services; (5) remote sensing, GIS, mobile weather and pest advisories; and (6) digital market and payment services. The study should record both ownership and access through rental, cooperative or service-provider arrangements, since shared access may be more realistic for smaller farms.

**Research Gap**

The reviewed sources provide useful evidence on district geography, broad crop patterns and the potential of agricultural technologies, but they do not establish how technology use differs between Nohar and Sangaria at farm or village scale. District totals cannot show whether farmers near irrigation infrastructure benefit differently from those at its margins, or whether outcomes vary by crop, farm size and access to custom-hiring services. Nor do general reviews determine whether a particular technology is profitable under local costs, water conditions and crop calendars.

A further gap concerns measurement. Many accounts emphasize adoption or yield, while farmers may experience gains through reduced labour, lower water use, fewer crop losses or improved prices. Conversely, yield increases may not translate into higher net returns if equipment, energy, repairs or credit costs are high. There is therefore a need for a geographically explicit, comparative analysis that combines farm-level economic measures with spatial access and resource conditions, and distinguishes correlation from causal impact. This paper addresses that gap by proposing a replicable design for both tehsils.

Importance of the Study

The study has practical value for farmers and local institutions because it can identify which technologies fit particular crops and resource settings, where shared services could reduce investment barriers, and what kinds of extension support are needed. A spatial comparison can help target demonstrations, soil testing, repair facilities, machinery banks and digital advisory services to underserved villages rather than distributing support uniformly.

For planners, the study can connect agricultural productivity with water stewardship and resilience. In an irrigated but water-constrained environment, an intervention should be judged by output and income alongside water and energy use, soil health and production risk. For researchers, comparing two tehsils within one district helps separate broad district context from local variation in access and physical geography. The proposed measures also allow technology programmes to be evaluated with transparent indicators and a clear baseline.

**Conclusion**

New technology offers plausible routes to higher and more stable agricultural productivity in Nohar and Sangaria, especially through better water management, targeted input use, timely mechanisation, crop monitoring and useful digital information. The likely gains depend on the geography of irrigation, soils, crop choices, markets and service access, as well as on household resources and institutional support. Technology adoption should therefore be assessed as a spatial and socio-economic process rather than as a simple count of devices or applications.

The evidence reviewed supports a carefully qualified conclusion: technology can improve efficiency and resilience, but district-level reports and broad literature cannot establish its actual impact in either tehsil. A comparative field survey linked to GIS, farm accounts and appropriate evaluation methods is required. Such a study should measure yields, net returns, labour and water productivity, account for adoption bias, and examine who can access the benefits. This evidence would enable locally appropriate investment and more sustainable productivity growth in Hanumangarh district.

**Bibliography**

1. Food and Agriculture Organization of the United Nations. (2022). Agricultural digitalization and automation in low- and middle-income countries: Evidence from ten case studies (FAO Agricultural Development Economics Technical Study No. 25). https://www.fao.org/agrifood-economics/publications/detail/en/c/1618845/
2. Government of India, Directorate of Census Operations, Rajasthan. (2011). Census of India 2011: District Census Handbook, Hanumangarh (Series 09, Part XII-B). https://censusindia.gov.in/nada/index.php/catalog/1029/
3. Government of Rajasthan, Rajasthan Foundation. (n.d.). Hanumangarh district profile. https://foundation.rajasthan.gov.in/rf/hanumangarh.html
4. Government of Rajasthan, Rajasthan Foundation. (n.d.). Hanumangarh district report. https://foundation.rajasthan.gov.in/rf/pdf/Hanumangarh.pdf
5. Government of Rajasthan, Directorate of Economics and Statistics. (2024). Agricultural statistics 2023-24. Rajasthan Agriculture Statistics portal. https://rajas.rajasthan.gov.in/
6. Journal of the Indian Society of Soil Science. (2022). Sensor based monitoring for improving agricultural productivity and sustainability: A review. https://epubs.icar.org.in/index.php/JISSS/article/view/128125
7. McCampbell, M. (2022). Agricultural digitalization and automation in low- and middle-income countries: Evidence from ten case studies. Food and Agriculture Organization of the United Nations.
8. World Bank. (2019). Future of food: Harnessing digital technologies to improve food system outcomes. World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/941601554962010560/future-of-food-harnessing-digital-technologies-to-improve-food-system-outcomes