

Key Catalysts of Agricultural Advancement in the state of Gujarat

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ABSTRACT

Purpose: The purpose of this paper is to explore the role of key indicators of agriculture advancement in the state of Gujarat.

Design/ Methodology/ Approach: The present study is an analytical as well as descriptive study.

Research limitations/ implications: The study has explored contribution of technological advancement, impact of sustainability, and agriculture marketing as the important indicators of agriculture development in Gujarat.

Originality/ Value: The paper has explored a positive relationship between Agri. GSDP of Gujarat state and factors affecting such as agriculture credit, gross irrigated area, use of NPK fertilizers and cropping intensity, whereas the relationship between dependent variable (Agri, GSDP) and one of the independent variable (rainfall) are less correlated.

INTRODUCTION

Historically, India has been an agricultural economy, and a large portion of its rural population, around 66.6% according to the 2011 census, relies on agriculture for their livelihoods. One of the challenges faced by the agricultural sector is the significantly lower income it generates compared to the non-agricultural (industrial and service) sectors (G Chauhan 2022). Despite of several reformative actions it is a need of an hour to bring further modernization to boost farmers' earnings. Since India's Independence, while agriculture has remained important, its contribution to the country's GDP has diminished due to the rapid growth of the industrial and services sectors and vis a vis slow growth of agriculture sector. Despite the decline in its GDP contribution, agriculture remains a critical supplier of raw materials to both the industrial sector (e.g., textiles, food processing) and non-agricultural industries. Agriculture plays a significant role in India's economy through its contributions to exports. Around 18% of the country's total exports are directly from the agriculture and allied sectors, and its indirect role in supporting other export-driven industries makes its contribution

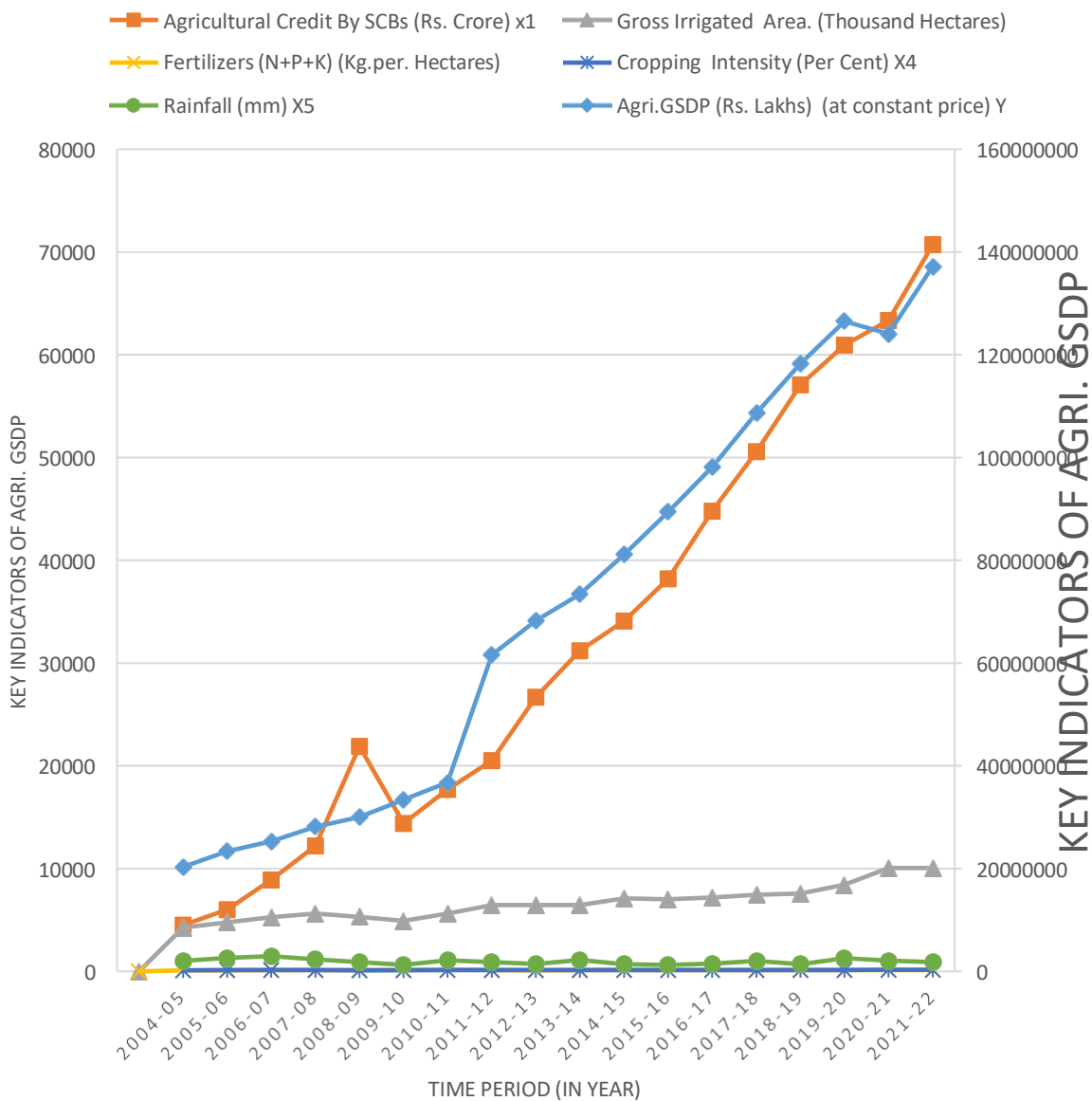
even higher. In the overall growth story of Indian economy Gujarat economy plays a significant role. And within Gujarat agriculture plays an important role in the gross state domestic product. This research paper focus on contribution of agriculture sector in the overall Gross State Domestic Product.

Gujarat is the leading state where agriculture advancement plays a major role. The current research focuses on basic key indicators which reflect both the infrastructure supporting agriculture and the outcomes in terms of productivity and economic growth. This researcher paper attempts to establish the cause and effect relationship between value of Agri. GSDP of Gujarat and key indicators of agriculture. Agri. GSDP measures the total value of agricultural products produced in Gujarat. It indicates the overall economic contribution of agriculture to the state's economy. A rising Agri. GSDP suggests increased productivity, better management of resources, and more robust agricultural infrastructure.

Key Indicators of Agriculture Advancement in the State of Gujarat:

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GUJARAT AGRICULTURE STATE DOMESTIC PRODUCT:



(i) **Agricultural Credit (SCBs - Scheduled Commercial Banks)**

This refers to the credit and loans extended to the agriculture sector by commercial banks. Increased credit availability helps farmers invest in better equipment, irrigation, seeds, and other inputs. Higher credit uptake reflects the financial support needed for technological adoption and capital investment in farming practices. In the Regression model it is indicated by x1. Over two decades agriculture credit has increased exponentially, it was 4500 crore in the year 2004 which has increased to 70,723 Crore by the year 2021-21 (RBI Report 2023).

(ii) **Gross Irrigated Area:** The total area under irrigation (in hectares). Irrigation ensures reliable water supply and allows multiple cropping cycles within a year. An increase in irrigated land signifies improved infrastructure (like canals, drip irrigation systems, etc.), reducing dependence on monsoons

and boosting crop productivity. In the regression model it is presented by x2. It is measured in terms of thousand hectares. The gross irrigated area was 4280 thousand hectares during 2004-05, which has increased to 10,060 thousand hectares during 2021-22 (RBI Report 2023).

(iii) **Fertilizer Consumption (NPK - Nitrogen, Phosphorus, Potassium):** The use of fertilizers to enhance soil fertility and boost crop yield. Proper and increased use of fertilizers is crucial for higher crop productivity. It reflects the use of modern agricultural inputs to improve yields. In this paper it is indicated by x3 in the regression model. Over two decades of observation period the use NPK has increased from 99.5 kg per hectares in 2004-05 to 144.3 kg per hectares during 2021-22 (RBI Report 2023)..

- (iv) Cropping Intensity: This is the ratio of the gross cropped area to the net sown area, expressed as a percentage. It reflects the extent of land being used for multiple cropping during a year. Higher cropping intensity means land is being used more efficiently for multiple crop cycles annually, indicating better agricultural practices and resource utilization. In this research paper it is indicated by x4 in the regression model. It has also increased over two decades of time period.
- (v) Rainfall: The total amount of rainfall the state receives during the year. While Gujarat has been enhancing irrigation infrastructure, rainfall is still a crucial factor for agriculture, especially in rain-fed regions. Its variation influences water availability and the cropping pattern. Due to various reasons the average rain fall changes every year in the state of Gujarat. In the research this variable is indicated by x5. The average rain fall was recorded 1005.8 mm in the year 2004-05, which

has decreased to 911.1 mm in the year 2008-09, it further fall to 641.6 mm in the year 2009-10. During 2019-20 it has increased to 1278.7 mm and then fall to 909.5 mm in the year 2021-22(Agri. Statistics at a Glance 2023).

Research Methodology: The data collected on different economic variables from the various secondary source from RBI website and Agriculture Statistics at a Glance to analyze them with the help of simple linear regression technique.

A linear model of the equation (1) is specified below in the study;
 $Y = B_1 + B_2X_1 + B_2X_2 + B_2X_3 + B_2X_4 + B_2X_5 + u$

Where,

- Y = Agricultural GSDP (Gross State Domestic Product)
 X1 = Agricultural Credit by Commercial Banks in Gujarat
 X2 = Gross Irrigated Area
 X3 = Fertilizers (N+P+K)
 X4 = Cropping Intensity
 X5 = Rain fall

Descriptive Statistics			
	Mean	Std. Deviation	N
Agri. GSDP	71343486.83	40761651.438	18
Agriculture Credit SCBs	32434.22	21191.552	18
Gross Irrigated Area	6668.00	1656.797	18
Fertilizer (NPK)	131.66	17.088	18
Cropping Intensity	127.39	11.474	18
Rainfall	965.13	249.727	18

The total number of observations are 18, the Mean value of Agri. GSDP (Agriculture Gross State Domestic Product) ₹71,343,486.83 (approximately ₹71.34 million). This is the average agricultural output value across the 18 data points. And Standard Deviation: ₹40,761,651.44. This indicates significant variation in Agri. GSDP values, with the typical value deviating from the mean by ₹40.76 million. A high standard deviation reflects that agricultural output varies widely across different observations.

The Mean value of agriculture credit from SCBs is ₹32,434.22 crore. The average amount of credit disbursed to agriculture through SCBs is ₹32,434.22 crore across the 18 observations. And the value of Standard Deviation: ₹21,191.55 crore. This shows a large spread in the amount of credit disbursed, indicating that the credit flow to agriculture varies substantially across different years or regions.

The Mean value of gross irrigated are is 6,668 hectares, On average, 6,668 hectares of land are irrigated across the observations. The value of Standard Deviation is 1,656.80 hectares, The irrigated area data show moderate variability, with

the area irrigated differing from the mean by about 1,656.80 hectares on average.

The Mean value of Fertilizer uses is 131.66 kg per hectare, The average usage of NPK fertilizers per hectare is 131.66 kg across the 18 data points. Standard Deviation: 17.09 kg per hectare, Fertilizer usage is relatively stable, as shown by a lower standard deviation. The variation around the mean usage is 17.09 kg per hectare.

The Mean value of cropping intensity is 127.39%. This is the average cropping intensity, meaning on average, 127.39% of the available land is cropped multiple times in a year (indicating crop rotations or multiple growing cycles). Standard Deviation: 11.47%. This suggests that cropping intensity does not vary greatly across observations but does show some fluctuation.

The Mean value of Rainfall is 965.13 mm. On average, the regions included in the study received about 965 mm of rainfall during the observation periods. Standard Deviation: 249.73 mm. This indicates a substantial variation in rainfall across different years or regions, reflecting the erratic nature of monsoons in India, which is a key factor affecting agriculture.

Correlations							
		Agri. GSDP	Agriculture Credit SCBs	Gross Irrigated Area	Fertilizer (NPK)	Cropping Intensity	Rainfall
Pearson Correlation	Agri. GSDP	1.000	.982	.941	.193	.898	-.273
	Agriculture Credit SCBs	.982	1.000	.951	.285	.884	-.242
	Gross Irrigated Area	.941	.951	1.000	.293	.965	-.156
	Fertilizer (NPK)	.193	.285	.293	1.000	.138	-.051
	Cropping Intensity	.898	.884	.965	.138	1.000	-.007
	Rainfall	-.273	-.242	-.156	-.051	-.007	1.000
Sig. (1-tailed)	Agri. GSDP	.	.000	.000	.222	.000	.136
	Agriculture Credit SCBs	.000	.	.000	.126	.000	.167
	Gross Irrigated Area	.000	.000	.	.119	.000	.268
	Fertilizer (NPK)	.222	.126	.119	.	.293	.421
	Cropping Intensity	.000	.000	.000	.293	.	.489
	Rainfall	.136	.167	.268	.421	.489	.
N	Agri. GSDP	18	18	18	18	18	18
	Agriculture Credit SCBs	18	18	18	18	18	18
	Gross Irrigated Area	18	18	18	18	18	18
	Fertilizer (NPK)	18	18	18	18	18	18
	Cropping Intensity	18	18	18	18	18	18
	Rainfall	18	18	18	18	18	18

SOURCE: RBI AND ECONOMIC SURVEY 2021-22

- a. Agri. GSDP (Agriculture Gross State Domestic Product)
 - Agriculture Credit SCBs (0.982): Strong positive correlation. As agriculture credit increases, Agri. GSDP tends to increase. The correlation coefficient of 0.982 suggests that nearly 98% of changes in Agri. GSDP are associated with changes in agricultural credit.
 - Gross Irrigated Area (0.941): Strong positive correlation. Increased irrigation area is linked with higher Agri. GSDP, meaning irrigation has a significant role in enhancing agricultural production.
 - Fertilizer (NPK) (0.193): Weak positive correlation. Fertilizer use shows a minimal relationship with Agri. GSDP, suggesting it may not be a major driver of agricultural output in this case.
 - Cropping Intensity (0.898): Strong positive correlation. Higher cropping intensity, meaning multiple crops per year, is strongly linked to increased agricultural output.
 - Rainfall (-0.273): Weak negative correlation. A slight inverse relationship indicates that higher rainfall may not always lead to higher agricultural output, possibly due to excess rainfall or droughts.
- b. Agriculture Credit SCBs
 - Gross Irrigated Area (0.951): Very strong positive correlation. An increase in credit is closely associated with an increase in irrigated area, suggesting that credit is often used for irrigation-related investments.
 - Fertilizer (NPK) (0.285): Weak positive correlation. There is some connection between agricultural credit and fertilizer usage, though not very strong.
 - Cropping Intensity (0.884): Strong positive correlation. Higher access to credit is linked with higher cropping intensity, allowing farmers to grow more crops within a year.
 - Rainfall (-0.242): Weak negative correlation. As with Agri. GSDP, rainfall seems to negatively affect credit flow, possibly because credit demand reduces during periods of excessive or unpredictable rainfall.
- c. Gross Irrigated Area
 - Fertilizer (NPK) (0.293): Weak positive correlation. More irrigated land tends to slightly increase fertilizer usage, but the relationship isn't very strong.
 - Cropping Intensity (0.965): Very strong positive correlation. This suggests that as the area under irrigation increases, cropping intensity also increases, leading to multiple cropping cycles on the same land.
 - Rainfall (-0.156): Weak negative correlation. More rainfall is slightly associated with less irrigated land, likely because irrigation is less necessary in regions with heavy rainfall.
- d. Fertilizer (NPK)
 - Cropping Intensity (0.138): Very weak positive correlation. Fertilizer use does not significantly influence cropping intensity.
 - Rainfall (-0.051): Very weak negative correlation. Fertilizer use has a minimal relationship with rainfall, indicating that rainfall doesn't strongly influence fertilizer application.
- e. Cropping Intensity

- Rainfall (-0.007): No significant correlation. Rainfall does not have a noticeable effect on cropping intensity, possibly because irrigation is more important in driving cropping intensity in the dataset.

Significance Levels (Sig. 1-tailed): A significance value (p-value) less than 0.05 suggests that the relationship is statistically significant. For Agri. GSDP, the relationships with Agriculture Credit SCBs, Gross Irrigated Area, and Cropping Intensity are significant ($p < 0.001$). Relationships with Fertilizer (NPK) and Rainfall are not significant ($p > 0.05$), meaning these factors might not have a meaningful influence on Agri. GSDP. Agriculture Credit, Irrigation, and Cropping Intensity are the most significant drivers of agricultural growth (Agri. GSDP) in this data. Rainfall shows a weak or negative relationship with most variables, indicating that other factors like irrigation and credit may play a bigger role in agricultural success than natural rainfall.

CONCLUSION

Agriculture Credit, Irrigation, and Cropping Intensity are the most significant drivers of agricultural growth (Agri. GSDP) in this data. Whereas Rainfall shows a weak or negative relationship with most variables, indicating that other factors like irrigation and credit may play a bigger role in agricultural success than natural rainfall. Agriculture Credit, Irrigation, and Cropping Intensity are the most significant drivers of agricultural growth (Agri. GSDP) in this data. Rainfall shows a weak or negative relationship with most variables, indicating that other factors like irrigation and credit may play a bigger role in agricultural success than natural rainfall. These indicators together help gauge the advancement of agriculture in Gujarat, showing how various elements contribute to its agricultural sector's resilience and growth.

Suggestion: If Government policy will be focused on sustainable agriculture practices, such as organic farming, use of renewable energy, and water conservation methods then Gujarat state will be able to attend sustained agriculture growth. Adoption of sustainable farming ensures long-term agricultural growth without depleting natural resources. Gujarat has been promoting organic farming and water-saving techniques like micro-irrigation. This includes subsidies, minimum support prices (MSP), and development schemes by the state and central governments. Supportive policies encourage investment in agriculture, adoption of modern practices, and provide financial security to farmers.

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