

**INTRODUCTION TO DATA ANALYTICS WITH POWER BI
PROJECT REPORT**

(Project Semester August – January 2025)

***Data Driven Insights into Rural Farming Ecosystem
of Andhra Pradesh***

Submitted by

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CERTIFICATE

This is to certify that P. GIRISH SAI TEJA Registration no. 12305666 has completed INT374 project titled, “**Data Driven Insights into Rural Farming Ecosystem of Andhra Pradesh - 2020**” under my guidance and supervision. To the best of my knowledge, the present work is the result of his/her original development, effort and study.

Signature and Name of the Supervisor

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DECLARATION

I, P. GIRISH SAI TEJA, student of B. Tech under CSE/IT Discipline at, Lovely Professional University, Punjab, hereby declare that all the information furnished in this project report is based on my own intensive work and is genuine.

Date: 17-12-2025

Signature

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ACKNOWLEDGEMENT

I would like to express my sincere gratitude to everyone who supported and guided me throughout the successful completion of this project titled “Data Driven Insights into Rural Farming Ecosystem of Andhra Pradesh - 2020”

I am extremely thankful to my mentor and faculty Mrs. Tanima Thakur for her continuous guidance, encouragement, and valuable insights, which played a crucial role in shaping this project. Her support and constructive feedback helped me understand analytical concepts and apply them effectively.

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1.INTRODUCTION

Agriculture forms the backbone of rural livelihoods in India, supporting a large share of the population through farming, allied activities, and agriculture-based employment. In states like Andhra Pradesh, rural development is linked to factors such as irrigation availability, access to basic household amenities, adoption of modern agricultural practices, and the effectiveness of government welfare schemes. Evaluating these dimensions in an integrated manner is essential for understanding regional disparities, identifying development gaps, and supporting informed decision-making for sustainable agricultural growth.

In recent years, the Government of India has promoted transparency and data accessibility through platforms such as data.gov.in, which provide comprehensive datasets related to agriculture, rural infrastructure, housing, and social welfare. While these datasets contain valuable information, their large scale and multi-dimensional nature make it challenging to extract meaningful insights without appropriate analytical tools. Business Intelligence (BI) platforms such as Power BI enable the transformation of raw government data into interactive visual dashboards, allowing users to analyze trends, compare regions, and identify performance gaps effectively.

This project, titled “Data-Driven Insights into the Rural Farming Ecosystem of Andhra Pradesh,” aims to analyze the rural agricultural and household ecosystem of the state using official government data. The study focuses on five key analytical objectives.

First, it examines the distribution of irrigation and the irrigation gap across districts, highlighting disparities between irrigated and unirrigated land. Irrigation remains a critical determinant of agricultural productivity, and understanding its spatial variation is fundamental to improving farming outcomes.

Second, the project analyzes household access to essential amenities, including piped water, food grain support through government schemes, and clean energy. These amenities play a vital role in improving living standards, food security, and overall well-being in rural areas. Third, the study assesses housing and basic living vulnerability, using indicators such as kuccha housing, government housing scheme coverage, and permanent waitlists to identify areas with higher socio-economic risk.

Fourth, the project evaluates the adoption of modern farming practices across districts, focusing on soil testing, micro-irrigation (drip and sprinkler systems), and organic farming. Adoption of such practices is a key indicator of agricultural modernization and sustainability. Finally, the project identifies top-performing districts by developing a multi-metric agricultural performance score, which integrates irrigation, farming, and welfare-related indicators to provide a holistic assessment of district-level performance.

Power BI is used as the primary tool for data modeling, analysis, and visualization due to its ability to manage large datasets, create dynamic measures using DAX, and support interactive exploration through slicers and filters. The dashboard design emphasizes clarity, consistency, and interpretability, enabling users to easily compare districts and identify patterns.

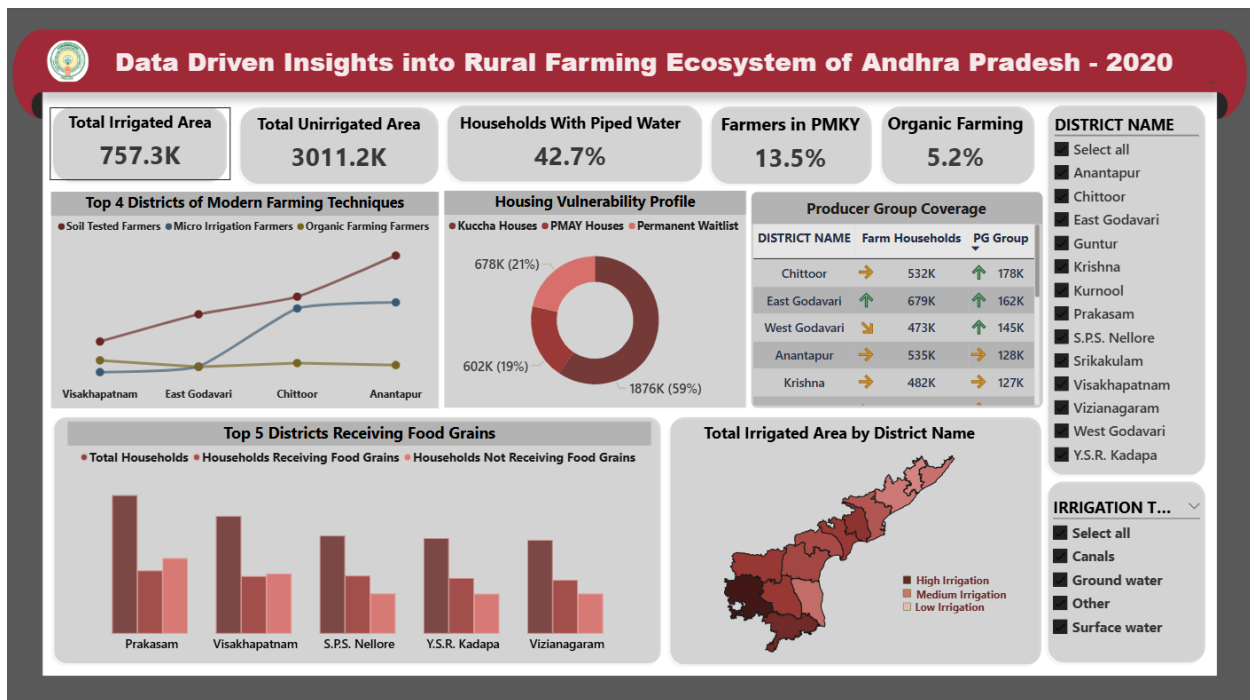
Overall, this project demonstrates how data-driven analysis can be applied to real-world rural development challenges. By integrating multiple agricultural and household indicators into a single analytical framework, the study provides meaningful insights into the rural farming ecosystem of Andhra Pradesh and highlights the potential of Business Intelligence tools in supporting evidence-based agricultural planning and policy evaluation.

2. SCOPE AND FOCUS OF STUDY

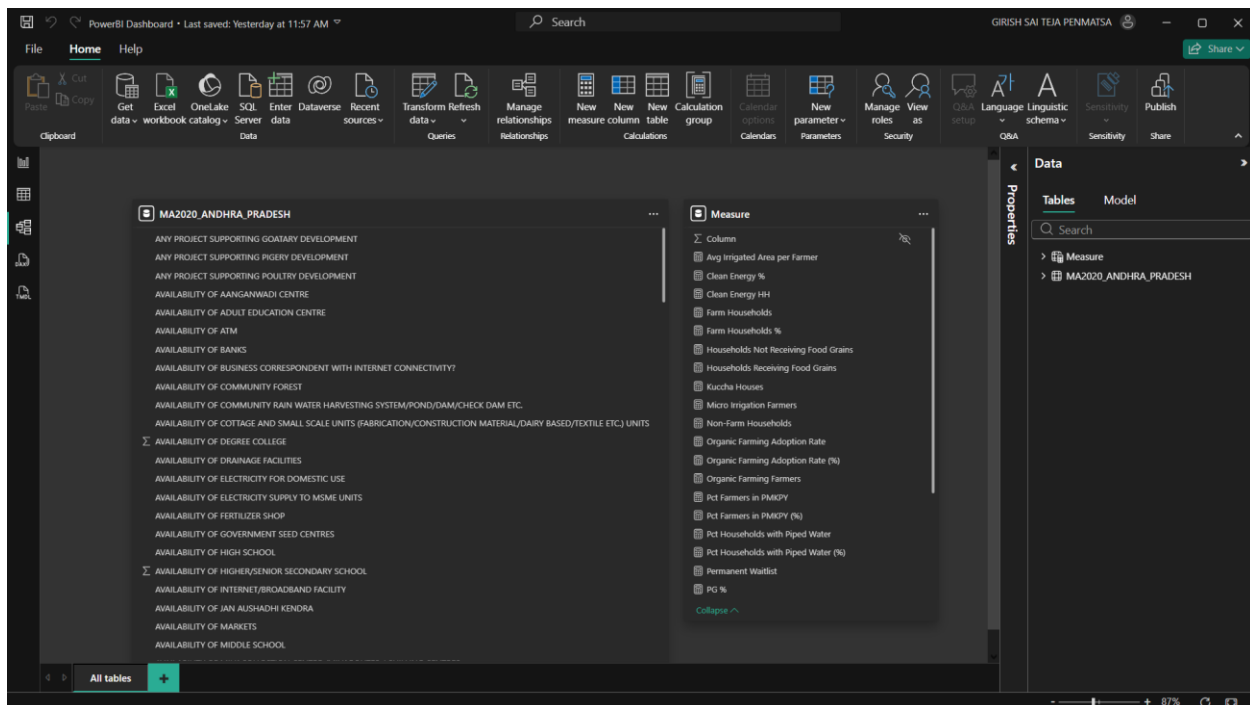
- Agriculture is a primary source of livelihood for rural households in Andhra Pradesh, making irrigation, infrastructure, and farmer welfare critical areas of study.
- Government open data from data.gov.in provides comprehensive information on agriculture, household amenities, housing, and rural development indicators.
- Large-scale rural datasets require Business Intelligence tools for effective analysis, comparison, and visualization.
- This project uses Power BI to transform raw government data into interactive dashboards for district-level analysis.
- The study focuses on irrigation distribution and irrigation gaps to identify disparities in agricultural infrastructure.
- Household access to essential amenities, including water supply, food grain support, and clean energy, is analyzed to assess rural living conditions.
- Housing and basic living vulnerability is evaluated using indicators such as kuccha housing and government housing scheme coverage.
- Adoption of modern farming practices such as soil testing, micro-irrigation, and organic farming is analyzed to understand agricultural modernization.
- A multi-metric agricultural performance score is developed to identify top-performing districts across multiple dimensions.
- The project demonstrates the role of data-driven decision-making in supporting sustainable agriculture and rural development planning.

2.DASHBOARD

2.1 REPORT VIEW:



2.2 MODEL VIEW



3.SOURCE OF DATASET

The dataset contains district-level and village-level information for Andhra Pradesh, covering multiple aspects of rural development and agriculture. It includes data related to irrigation, farmer welfare schemes, housing conditions, household amenities, energy access, and adoption of modern farming practices. The data represents conditions during the reference year 2020 and is compiled from official government surveys and administrative records.

Since the dataset is sourced from a government-authorized platform, it ensures data credibility, accuracy, and consistency, making it suitable for academic analysis and business intelligence applications. The use of this dataset also aligns with academic requirements for working with authentic and verifiable data sources.

3.1 Dataset Source:

Platform: Government open data portal ([dataset.link](#))

Format: CSV (Comma Separated Values)

Nature: Secondary data (official records)

3.2 Key Dataset Attributes:

The data set used in this project contains the following major fields:

- State Name – Name of the state (Andhra Pradesh)
- District Name – District-level administrative unit for analysis
- Sub-District Name – Mandal / sub-district classification
- Total Number of Households – Overall household count in each region
- Number of Farm Households – Households primarily engaged in farming activities
- Number of Non-Farm Households – Households engaged in non-agricultural livelihoods
- Total Number of Farmers – Count of registered farmers
- Total Irrigated Area – Area under irrigation (in hectares)
- Total Unirrigated Land Area – Rain-fed or non-irrigated land area

- Farmers Using Drip/Sprinkler Irrigation – Indicator of micro-irrigation adoption
- Farmers Receiving Soil Testing Reports – Measure of scientific farming practices
- Farmers Adopting Organic Farming – Indicator of sustainable agriculture
- Farmers Benefited under PMFBY – Crop insurance coverage
- Farmers Registered under PMKPY – Pension scheme participation
- Households Receiving Food Grains – Coverage under public distribution system
- Households with Piped Water Connection – Access to drinking water
- Households Using Clean Energy (LPG/Biogas) – Clean energy adoption
- Housing Condition Indicators – Kuccha houses, PMAY houses, permanent waitlists
- Producer Group and SHG Participation – Collective farming and social organization indicators

These attributes collectively represent agricultural infrastructure, farmer welfare, household amenities, housing conditions, and livelihood patterns at the district level.

3.3 Relevance of the Dataset

This dataset is suitable for analytical study because:

- It covers multiple dimensions including agriculture, irrigation, housing, welfare schemes, and household amenities.
- It enables district-wise comparative analysis, helping identify regional disparities within Andhra Pradesh.
- It supports distribution and gap analysis, particularly in irrigation coverage, housing conditions, and access to essential services.
- It allows assessment of modern farming practice adoption, such as soil testing, micro-irrigation, and organic farming.
- It facilitates the creation of composite performance indicators to identify top-performing and underperforming districts.
- It provides policy-oriented insights, making it useful for evaluating the impact of government welfare and agricultural schemes.

The structured and multi-dimensional nature of the dataset makes it highly suitable for use with Power BI's data modeling, DAX calculations, filtering, and interactive visualization capabilities, enabling effective data-driven insights into the rural farming ecosystem of Andhra Pradesh.

3.4 SAMPLE DATASET FOR THIS PROJECT:

STATE NAME	DISTRICT NAME	SUB DISTRICT NAME	BLOCK NAME	GP NAME	VILLAGE NAME	NUMBER OF TOTAL POPULATION	NUMBER OF MALE	NUMBER OF FEMALE	NUMBER OF TOTAL HOUSEHOLD	
ANDHRA PRADESH	S.P.S. Nellore	Kondapuram	KONDAPURAM	CHINTHALADEEVI	Thurpu- Brahmanapalle	420	212	208	120	120
ANDHRA PRADESH	S.P.S. Nellore	Kondapuram	KONDAPURAM	KOMMI	Kumara Venkatapuram	1	1	0	1	1
ANDHRA PRADESH	Prakasam	Markapur	MARKAPUR	KONDEPALLI	Narasimha Puram	500	230	270	40	40
ANDHRA PRADESH	S.P.S. Nellore	Naidupet	NAIDUPETA	MENAKUR	Lankapalem	2	1	1	1	1
ANDHRA PRADESH	S.P.S. Nellore	Naidupet	NAIDUPETA	MENAKUR	Palepolam	219	114	105	60	60
ANDHRA PRADESH	Anantapur	Beluguppa	BELUGUPPA	RAMANEPALLU	Narasapuram	2135	920	895	530	530
ANDHRA PRADESH	S.P.S. Nellore	Venkatagiri	VENKATAGIRI	VALLIVADU	China Bandarupalle	10	5	5	2	2
ANDHRA PRADESH	Anantapur	Ramagiri	RAMAGIRI	PERUR	Perur	9102	5181	3921	2115	2115
ANDHRA PRADESH	Guntur	Narasaraopet	NARASARAOPETA	ISSAPALEM	Mulakalur	3975	1983	1992	1962	1962
ANDHRA PRADESH	S.P.S. Nellore	Udayagiri	UDAYAGIRI	KRISHNAMPALLE	Chowdepalle	2	1	1	1	1
ANDHRA PRADESH	Guntur	Nekarikallu	NEKARIKALLU	ZILLAPETA THAND	Kunkatagunta	526	272	254	125	125
ANDHRA PRADESH	Prakasam	Tripuranthakam	TRIPURANTHAKAM	VELLAMAPALLI	Miniam Palle	210	128	82	60	60
ANDHRA PRADESH	Prakasam	Tripuranthakam	TRIPURANTHAKAM	VELLAMAPALLI	Viswanadhapuram	310	175	135	60	60
ANDHRA PRADESH	Vizianagaram	Bobbili	BOBBILI	PIRIDI	Yembanavalasa	1	1	0	1	1
ANDHRA PRADESH	Vizianagaram	Bobbili	BOBBILI	SEETHAYAPETA	Venkatarayudu Peta	4	2	2	2	2
ANDHRA PRADESH	S.P.S. Nellore	Indukurpet	INDUKURPET	KOMARIKA	Komarika	2610	1305	1305	753	753
ANDHRA PRADESH	S.P.S. Nellore	Indukurpet	INDUKURPET	KORUTUR	Koduruturu	2850	1367	1483	893	893
ANDHRA PRADESH	S.P.S. Nellore	Indukurpet	INDUKURPET	MUDIVARTHI PALE	Mudivarthi Palem	2322	1180	1142	652	652
ANDHRA PRADESH	S.P.S. Nellore	Tada	TADA	VATEMBEDU	Devuni Khandrika	2	1	1	1	1
ANDHRA PRADESH	S.P.S. Nellore	Tada	TADA	VATEMBEDU	Thopu Khandrika	2	1	1	1	1
ANDHRA PRADESH	Prakasam	Naguluppala Padu	NAGULUPPALA PA	M.MURPALLA	Maddirala Muppalla	2100	1100	1000	900	900
ANDHRA PRADESH	Guntur	Narasaraopet	NARASARAOPETA	ELLAMANDA	Elamanda	6333	3070	2989	1720	1720
ANDHRA PRADESH	YSR, Kadapa	Chapadi	CHAPADI	N.OBAYAPALLI	Thummalapadu	2	1	1	1	1
ANDHRA PRADESH	YSR, Kadapa	Chapadi	CHAPADI	T.OBAYAPALLI	Chivvopadu	1316	695	621	380	380
ANDHRA PRADESH	Prakasam	Naguluppala Padu	NAGULUPPALA PA	MATTIGUNTA	Mattigunta	1200	650	550	400	400
ANDHRA PRADESH	Visakhapatnam	Chodavaram	CHODAVARAM	GANDHAVARAM	Gandhavaram	2203	1087	1116	528	528
ANDHRA PRADESH	Visakhapatnam	Chodavaram	CHODAVARAM	GANDHAVARAM	M.Kothapalle	752	380	372	202	202
ANDHRA PRADESH	Guntur	Repalle	REPALLE	NALLURU NORTH	Nalluru	1098	531	567	426	426
ANDHRA PRADESH	Guntur	Repalle	REPALLE	NALLURU NORTH	Nalluru	764	304	330	764	764

4. DATASET PREPROCESSING

4.1 Understanding the Raw Dataset

Before performing any transformations, the raw dataset obtained from data.gov.in was carefully examined to understand its structure and content. This initial assessment focused on:

- The nature and meaning of each attribute
- Data types and value ranges
- Presence of missing, null, or inconsistent values
- Identification of redundant or non-analytical columns

The dataset consists of district- and village-level records related to agriculture, irrigation, farmer welfare schemes, housing conditions, and household amenities across Andhra Pradesh.

Since the data was compiled from multiple administrative sources, variations in column naming conventions, formatting styles, and value representations were observed.

This initial understanding was essential in identifying appropriate preprocessing steps required to ensure accurate and meaningful analysis.

4.2 Data Cleaning and Quality Assessment

4.2.1 Removal of Duplicate Records:

Each record in the dataset represents a unique administrative unit (village or district). Duplicate records may arise due to repeated entries or data consolidation processes. Such duplicates can lead to overestimation of household counts, farmer participation, and irrigated area.

Duplicate detection and removal were carried out using:

- Combination of State Name, District Name, Sub-District, and Village identifiers
- Row count comparison before and after duplicate removal

This ensured that each administrative unit was represented only once in the dataset.

4.2.2 Handling Missing and Null Values:

Missing and null values were identified across several attributes, including irrigation-related fields, household amenities, and welfare scheme participation indicators. The following strategies were applied:

- Records with missing critical geographic identifiers (State Name or District Name) were removed
- Missing values in numeric indicators (such as irrigation area or household counts) were reviewed and retained only when they did not affect aggregate-level analysis
- Null values representing non-applicability (e.g., absence of a facility or scheme) were preserved to avoid misrepresentation
- Consistent null-handling logic was applied across all numerical and categorical fields

This approach ensured that incomplete or inconsistent data did not distort analytical results.

4.2.3 Standardization of Categorical Values:

The dataset contained several categorical attributes, including irrigation sources, availability indicators, and scheme participation fields. Inconsistencies in spelling, capitalization, and formatting were corrected to ensure uniformity.

Examples include:

- Standardizing responses such as Yes / No across all availability fields
- Ensuring consistent naming for districts and sub-districts to avoid duplicate grouping in visuals
- Normalizing irrigation source categories for accurate classification

Standardization was critical to ensure accurate grouping, filtering, and aggregation within Power BI visuals.

4.3 Data Type Validation and Transformation

Accurate data types are essential for aggregation, filtering, and visualization. The following transformations were applied:

- Household and farmer counts → Converted to numeric (Whole Number)
- Irrigated and unirrigated land area → Converted to numeric and standardized to hectares
- Scheme participation indicators → Maintained as numeric or categorical based on usage
- State, District, and Sub-District Names → Retained as text fields

Incorrect or inconsistent data types were corrected to prevent calculation errors and visualization inconsistencies.

4.4 Column Optimization and Feature Selection

Not all columns in the raw dataset were relevant to the analytical objectives. Column optimization was performed to enhance model efficiency and analytical clarity.

4.4.1 Removal of Irrelevant Columns:

Administrative codes and metadata fields that did not contribute to any analytical objective were removed, including:

- State, district, block, and village codes
- Assembly constituency identifiers
- Pin codes and administrative reference fields

This reduced data model complexity and improved dashboard performance.

4.5 Data Consistency Checks

After cleaning and transformation, several validation checks were conducted to ensure data integrity:

- Verification of total household and farmer counts
- Cross-checking irrigation area totals across districts
- Ensuring no unintended data loss occurred during preprocessing
- Confirming slicers and filters behaved correctly in Power BI

These checks ensured that preprocessing steps preserved the accuracy and reliability of the dataset.

4.6 Preparation for Visualization and Analysis

The final cleaned dataset was structured to support:

- District-wise aggregation and comparison
- Analysis of irrigation gaps and land-use patterns
- Evaluation of household access to basic amenities
- Assessment of modern farming practice adoption
- Calculation of composite agricultural performance scores

The optimized dataset was then loaded into Power BI's data model, enabling efficient rendering of visuals and smooth interactive exploration.

4.7 Importance of Preprocessing in This Project

Effective preprocessing was critical for:

- Accurate KPI and percentage calculations
- Meaningful comparison across districts and objectives
- Reduction of noise and inconsistencies
- Improved dashboard performance and interpretability

Without systematic preprocessing, the insights derived from the dashboard would have been unreliable and potentially misleading.

4.8 Summary

In summary, the preprocessing phase transformed raw government agricultural data into a clean, consistent, and analysis-ready dataset. Through structured data cleaning, validation, transformation, and optimization, the dataset was prepared for advanced visualization and decision-support analysis using Power BI. This preprocessing stage laid a solid foundation for all subsequent analytical objectives and ensured the credibility of insights presented in the final dashboard.

5. ANALYSIS ON DATASET

OBJECTIVE 1: To analyze the irrigation distribution and irrigation gap across districts

Objective Description:

Irrigation plays a crucial role in determining agricultural productivity, crop stability, and farmer livelihoods, especially in an agrarian state like Andhra Pradesh. Unequal distribution of irrigation infrastructure across districts can lead to significant regional disparities and increased dependency on rainfall. This objective focuses on analyzing the district-wise distribution of irrigated land and identifying irrigation gaps by comparing irrigated and unirrigated land areas.

Indicators Used for Analysis:

The following dataset attributes were used to support this analysis:

- Total Irrigated Area (in hectares)
- Total Unirrigated Land Area (in hectares)
- Total Number of Farmers
- District Name

These indicators collectively enable an assessment of irrigation coverage and the extent of reliance on rain-fed agriculture across districts.

Visualization Methodology:

To accurately represent district-level irrigation patterns, a custom geographic map of Andhra Pradesh was used in Power BI. The map was created using a TopoJSON file, which provides precise district boundaries and ensures accurate spatial representation.

The TopoJSON-based map enabled:

- Accurate alignment of district names with geographic boundaries
- Reliable district-wise aggregation of irrigation data
- Enhanced visual clarity compared to default mapping options

A custom color gradient was applied to represent irrigation intensity, where darker shades indicate higher irrigation coverage and lighter shades indicate lower irrigation coverage. A manual three-level legend (Low, Moderate, High Irrigation) was included to improve interpretability and maintain consistency with the dashboard's visual theme.

Analysis and Observations:

The map-based visualization highlights considerable variation in irrigation coverage across districts in Andhra Pradesh. Districts with higher irrigated land areas are visually distinguishable through darker color intensity, indicating stronger irrigation infrastructure and better access to water resources.

Conversely, several districts appear lighter on the map, reflecting lower irrigation coverage and a higher dependence on unirrigated or rain-fed agriculture. This spatial variation clearly demonstrates the uneven distribution of irrigation facilities across the state.

The visualization effectively reveals regional irrigation disparities that may not be easily identifiable through tabular analysis alone. The use of a TopoJSON map enhances spatial accuracy, making it easier to interpret district-level irrigation patterns.

Assessment of Irrigation Gap:

The irrigation gap is assessed by comparing irrigated and unirrigated land areas within each district. Districts with a larger proportion of unirrigated land indicate greater vulnerability to rainfall variability and climatic risks. Such districts may face limitations in crop diversification, yield stability, and adoption of modern agricultural practices.

The analysis shows that despite the presence of irrigated regions, a substantial share of agricultural land across Andhra Pradesh remains unirrigated, highlighting persistent gaps in irrigation coverage.

Implications for Agricultural Planning:

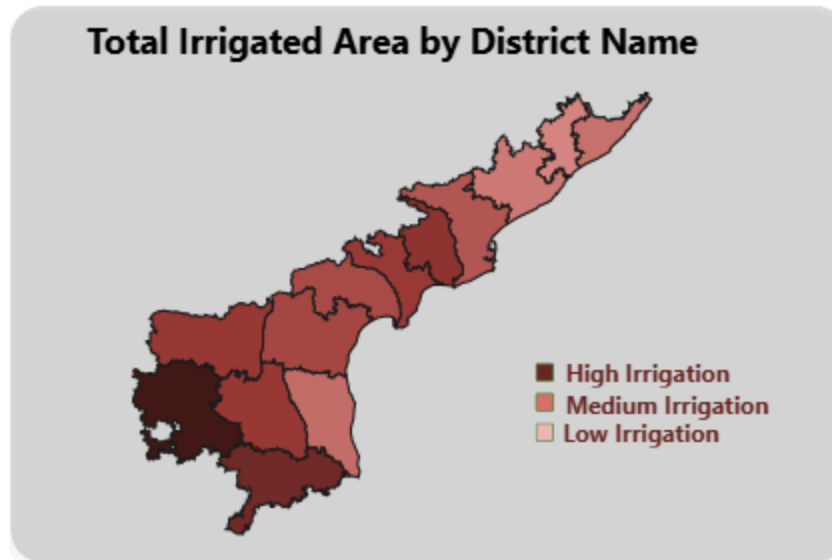
The findings from this analysis have important implications:

- Identification of districts requiring priority irrigation investment
- Support for targeted expansion of micro-irrigation and water-efficient technologies
- Improved planning for equitable allocation of water resources
- Data-driven support for regional agricultural development strategies

The spatial insights derived from the TopoJSON-based map can assist policymakers and planners in focusing interventions on districts with significant irrigation deficits.

Conclusion of Objective 1:

In conclusion, the use of a TopoJSON-based Andhra Pradesh district map enabled a precise and visually effective analysis of irrigation distribution and irrigation gaps. The analysis highlights significant inter-district disparities in irrigation coverage and underscores the continued reliance on rain-fed agriculture in several regions. Addressing these irrigation gaps is essential for enhancing agricultural productivity, improving farmer resilience, and achieving sustainable rural development.



OBJECTIVE 2: To understand household access of food grains

Objective Description

Food security is a fundamental component of rural welfare and plays a critical role in improving living standards and reducing vulnerability among economically weaker households. In India, the Public Distribution System (PDS) serves as a key mechanism for ensuring access to subsidized food grains. This objective aims to analyze household access to food grains across districts in Andhra Pradesh, with a focus on identifying districts with higher coverage as well as existing gaps in food grain distribution.

Indicators Used for Analysis:

The following dataset attributes were used to assess food grain access:

- Total Number of Households
- Households Receiving Food Grains from Fair Price Shops
- Households Not Receiving Food Grains
- District Name

These indicators enable comparison between total household demand and actual food grain coverage at the district level.

Visualization Methodology:

To achieve this objective, a comparative bar chart was used to display the Top 5 districts receiving food grains. The visualization compares:

- Total households
- Households receiving food grains
- Households not receiving food grains

for each selected district. This approach allows for a clear visual comparison of food grain coverage within high-population districts.

Analysis and Observations:

The visualization indicates that districts such as Prakasam, Visakhapatnam, S.P.S. Nellore, Y.S.R. Kadapa, and Vizianagaram have a relatively low number of households receiving food grains through government distribution mechanisms. However, a noticeable gap exists between the total number of households and those receiving food grains in each district.

Among the analyzed districts, Prakasam shows the lowest overall household count as well as a lower number of beneficiaries, indicating substantial reliance on food grain support schemes. Similarly, Visakhapatnam and S.P.S. Nellore demonstrate significant coverage, yet a portion of households remains outside the distribution network.

The presence of households not receiving food grains in all five districts highlights incomplete coverage and suggests that eligible households may still be excluded due to identification gaps, documentation issues, or supply constraints.

Assessment of Food Grain Access Gap:

The difference between households receiving and not receiving food grains represents the food security gap at the district level. Districts with larger gaps may face challenges such as uneven beneficiary identification, migration-related exclusions, or administrative inefficiencies.

This gap indicates that while food grain distribution schemes have achieved broad reach, universal access has not yet been fully realized, particularly in districts with large and diverse populations.

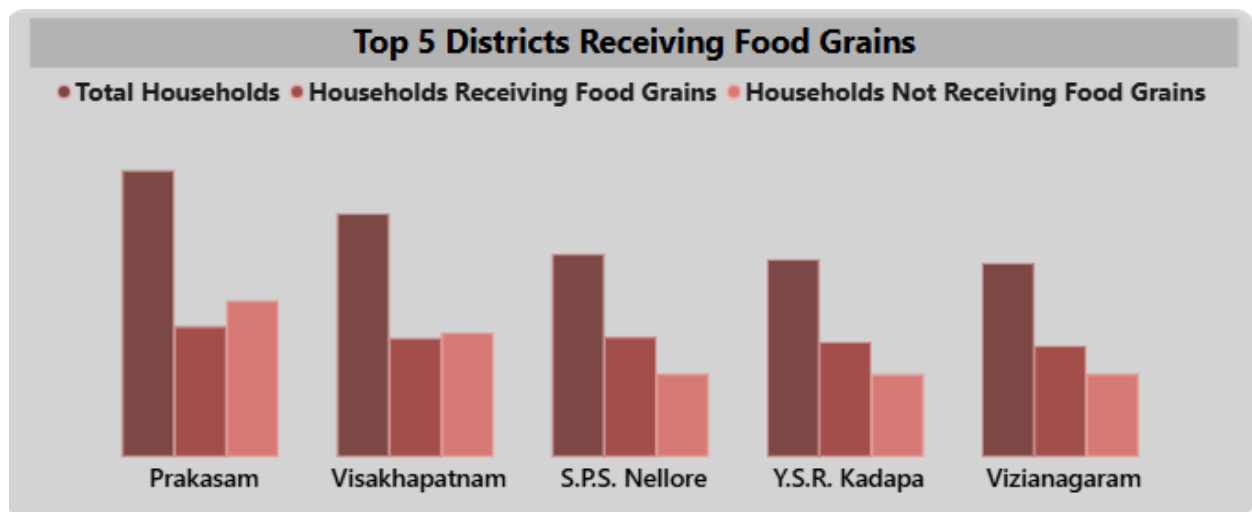
Implications for Rural Welfare:

The findings from this analysis have important implications:

- Strengthening beneficiary identification mechanisms can improve coverage.
- Improved monitoring of PDS delivery systems can reduce exclusion errors.
- Districts with higher gaps may require targeted interventions and policy attention.
- Enhanced food grain access can contribute to improved nutritional security and reduced rural vulnerability.

Conclusion of Objective 2:

In conclusion, the analysis of household access to food grains reveals that while government distribution systems have reached a substantial portion of rural households in Andhra Pradesh, coverage gaps persist across major districts. The comparative visualization effectively highlights disparities between total households and beneficiaries, underscoring the need for improved targeting and inclusive food security measures to ensure that all eligible households benefit from food grain support schemes.



Objective 3: To Identify Top-Performing Districts Based on Producer Group Coverage

Objective Description:

Farmer collectivization plays a crucial role in strengthening agricultural value chains, improving bargaining power, and enhancing access to markets, credit, and government support. Producer Groups (PGs) are an important institutional mechanism that enables small and marginal farmers to work collectively, reduce input costs, and improve income stability. This objective aims to analyze district-wise Producer Group coverage and identify top-performing districts based on the proportion of farm households mobilized into Producer Groups.

Rationale for Analyzing Producer Group Coverage:

Individual farmers often face challenges such as limited market access, price volatility, and lack of institutional support. Participation in Producer Groups helps address these challenges by promoting collective action and shared resources. Analyzing PG coverage provides insights into:

- The extent of farmer organization at the district level
- Effectiveness of collective farming initiatives
- Districts with stronger institutional support systems
- Regional disparities in farmer mobilization

Producer Group coverage is therefore a key indicator of institutional strength and inclusive agricultural development.

Indicators Used for Analysis:

The following dataset attributes were used to assess Producer Group participation:

- Number of Farm Households
- Number of Households Mobilized into Producer Groups (PGs)
- Producer Group Coverage Percentage
- District Name

The Producer Group Coverage Percentage was calculated as the ratio of PG households to total farm households, allowing fair comparison across districts of varying sizes.

Methodology and Visualization Approach:

To visualize Producer Group coverage, a tabular (matrix-style) representation was used, displaying district-wise values for:

- Farm households
- PG households
- PG coverage

Conditional indicators (arrows/icons) were applied to highlight districts with relatively higher or lower PG participation. This visualization enables easy identification of top-performing districts while also supporting comparative analysis across regions.

Analysis and Observations:

The analysis reveals significant variation in Producer Group coverage across districts. Districts such as Chittoor and East Godavari demonstrate relatively higher PG participation, indicating stronger farmer mobilization and effective implementation of collective farming initiatives.

In contrast, some districts with a large number of farm households show comparatively lower PG coverage, suggesting the presence of untapped potential for farmer organization. These differences highlight uneven progress in institutional development across districts.

Higher PG coverage is often associated with better access to information, collective bargaining, and participation in government-supported agricultural programs. Districts with lower PG participation may face barriers such as limited awareness, organizational challenges, or weaker institutional outreach.

Identification of Top-Performing Districts:

Top-performing districts are identified based on higher Producer Group coverage percentages, rather than absolute numbers alone. This approach ensures that districts are evaluated fairly, regardless of population size, and highlights regions where a larger share of farm households benefits from collective organization.

Such districts can serve as benchmark models for expanding Producer Group initiatives in other regions.

Implications for Agricultural Development:

The findings from this objective have important implications:

- Districts with high PG coverage demonstrate stronger farmer collaboration and institutional support.
- Low-coverage districts may require targeted awareness programs and capacity-building initiatives.
- Strengthening Producer Groups can improve farmer income, market access, and resilience.
- PG coverage analysis supports policy decisions aimed at promoting inclusive and collective agricultural growth.

Conclusion of Objective 3:

In conclusion, the analysis of Producer Group coverage provides valuable insights into the level of farmer organization across districts in Andhra Pradesh. By identifying top-performing districts based on PG participation, the study highlights areas of institutional strength as well as regions requiring focused intervention. Enhancing Producer Group coverage can play a vital role in improving agricultural sustainability, farmer empowerment, and rural economic development.

Producer Group Coverage				
DISTRICT NAME		Farm Households		PG Group
Chittoor	➡	532K	⬆	178K
East Godavari	⬆	679K	⬆	162K
West Godavari	➡	473K	⬆	145K
Anantapur	➡	535K	➡	128K
Krishna	➡	482K	➡	127K
Srikakulam	➡	457K	➡	118K
Vizianagaram	⬇	356K	➡	114K
Prakasam	➡	462K	➡	110K
Visakhapatnam	➡	432K	➡	106K
Kurnool	➡	513K	➡	99K
Guntur	➡	574K	⬇	88K
S.P.S. Nellore	⬇	360K	⬇	79K
Y.S.R. Kadapa	⬇	348K	⬇	55K

OBJECTIVE 4: To assess housing and basic living vulnerability among rural households

Objective Description:

Housing conditions and access to basic living infrastructure are critical indicators of socio-economic well-being in rural areas. Poor housing quality and inadequate access to basic facilities expose households to health risks, environmental hazards, and economic insecurity. This objective aims to assess housing and basic living vulnerability among rural households in Andhra Pradesh by analyzing housing conditions and the extent of coverage under government housing schemes.

Rationale for Housing Vulnerability Analysis:

In rural regions, housing vulnerability often reflects broader development challenges such as poverty, lack of infrastructure, and limited access to welfare schemes. Assessing housing conditions helps in:

- Identifying economically vulnerable households
- Understanding gaps in housing scheme implementation
- Evaluating the effectiveness of rural housing interventions
- Supporting targeted policy measures for inclusive development

Housing vulnerability analysis is therefore essential for improving living standards and ensuring social security in rural communities.

Indicators Used for Analysis:

The following dataset attributes were used to assess housing and living vulnerability:

- Number of Households with Kuccha Walls and Kuccha Roofs
- Number of Households Benefited under PMAY (Completed or Sanctioned)
- Number of Households in Permanent Housing Waitlists
- Total Number of Households
- District Name

These indicators collectively represent housing quality, access to government housing support, and unmet housing demand.

Methodology and Visualization Approach:

A donut chart visualization was used to present the distribution of rural households across different housing categories, including:

- Kuccha houses (vulnerable housing)
- PMAY-supported houses
- Households on permanent waitlists

This visualization provides a clear proportional view of housing conditions and allows easy comparison between supported and vulnerable segments. The use of percentage-based representation improves interpretability and highlights the relative scale of housing challenges.

Analysis and Observations:

The analysis reveals that a significant proportion of rural households continue to live in vulnerable housing conditions, as indicated by the high share of kuccha houses. This suggests persistent housing insecurity in many districts.

While government housing schemes such as Pradhan Mantri Awas Yojana (PMAY) have provided support to a notable segment of households, a considerable number of families remain on permanent waitlists, indicating unmet demand for housing assistance.

The coexistence of high kuccha housing and substantial waitlists highlights the gap between housing needs and scheme coverage. This gap suggests challenges related to beneficiary identification, funding limitations, or implementation constraints at the district level.

Assessment of Living Vulnerability:

Housing vulnerability is closely linked with broader living conditions, including sanitation, safety, and resilience to environmental stress. Households residing in kuccha houses are more susceptible to extreme weather events and health-related issues.

The analysis indicates that despite ongoing government interventions, housing vulnerability remains a significant concern in rural Andhra Pradesh, particularly among economically weaker sections.

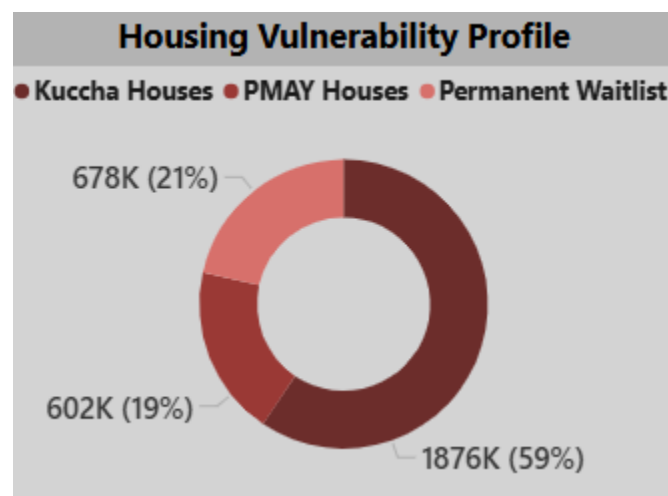
Implications for Rural Development:

The findings from this objective have important policy and planning implications:

- Increased investment is required to expand rural housing coverage.
- Districts with higher vulnerability need priority attention.
- Strengthening monitoring of housing scheme implementation can reduce waitlists.
- Improving housing conditions contributes directly to better health, safety, and quality of life.

Conclusion of Objective 4:

In conclusion, the assessment of housing and basic living vulnerability highlights persistent challenges in rural housing conditions across Andhra Pradesh. Although government housing schemes have made measurable progress, a substantial proportion of households remain vulnerable or underserved. Addressing these gaps through targeted interventions and improved implementation can significantly enhance rural living standards and promote inclusive development.



Objective 5: To Analyze the Adoption of Modern Farming Practices Across Districts

Objective Description:

The adoption of modern farming practices is a key indicator of agricultural modernization, sustainability, and long-term productivity. Practices such as soil testing, micro-irrigation, and

organic farming enable efficient resource utilization, improve crop yields, and reduce environmental impact. This objective aims to analyze the extent of adoption of modern farming practices across districts in Andhra Pradesh and identify regional variations in the uptake of scientific and sustainable agricultural methods.

Rationale for Analyzing Modern Farming Practices:

Traditional farming methods often result in inefficient water usage, soil degradation, and unstable crop productivity. The adoption of modern agricultural practices helps farmers make data-driven decisions, conserve natural resources, and adapt to changing climatic conditions. Analyzing district-wise adoption levels helps:

- Assess progress toward agricultural modernization
- Identify districts with higher technological adoption
- Highlight regions lagging in modern practice uptake
- Support targeted agricultural extension and awareness programs

Indicators Used for Analysis:

The following indicators from the dataset were used to assess modern farming practice adoption:

- Number of Farmers Receiving Soil Testing Reports
- Number of Farmers Using Drip/Sprinkler (Micro-Irrigation) Systems
- Number of Farmers Adopting Organic Farming
- Total Number of Farmers
- District Name

These indicators represent key dimensions of scientific, efficient, and sustainable farming.

Methodology and Visualization Approach:

To visualize the adoption of modern farming practices, a comparative visualization was used that displays district-wise values for soil testing, micro-irrigation, and organic farming adoption. This approach enables simultaneous comparison of multiple practices across selected districts.

Percentage-based measures were calculated to normalize adoption levels relative to the total number of farmers in each district, ensuring fair comparison regardless of district size. Interactive filters were applied to allow focused analysis of specific districts.

Analysis and Observations:

The analysis reveals significant variation in the adoption of modern farming practices across districts. Soil testing shows relatively higher adoption compared to organic farming, indicating greater acceptance of advisory-based interventions. Micro-irrigation adoption varies across districts, reflecting differences in water availability, infrastructure, and awareness.

Organic farming adoption remains comparatively low across most districts, suggesting that sustainable farming practices are still at an early stage of adoption. Districts with higher adoption levels typically show better access to extension services, irrigation infrastructure, and farmer awareness programs.

The disparity in adoption levels highlights the uneven diffusion of agricultural innovations across regions.

Assessment of Agricultural Modernization:

The combined analysis of soil testing, micro-irrigation, and organic farming adoption provides a holistic view of agricultural modernization. Districts demonstrating higher adoption across multiple practices indicate stronger readiness for sustainable and climate-resilient agriculture.

Conversely, districts with low adoption levels may face barriers such as limited access to technical knowledge, financial constraints, or insufficient institutional support.

Implications for Agricultural Development:

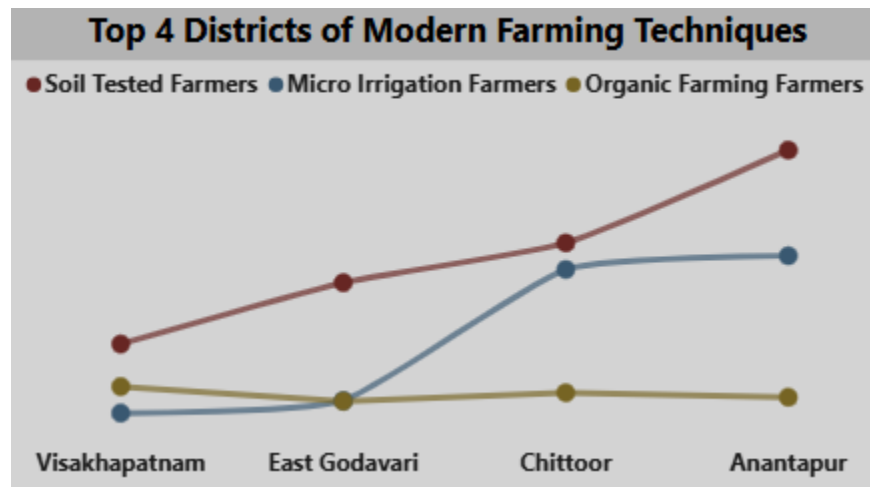
The findings from this objective have several important implications:

- Increased farmer awareness programs can improve adoption of modern practices.
- Expansion of micro-irrigation subsidies can enhance water efficiency.
- Promotion of organic farming can support sustainable and environmentally friendly agriculture.
- District-specific strategies are required to bridge adoption gaps.

Encouraging modern farming practices can significantly enhance productivity, resilience, and farmer income.

Conclusion of Objective 5:

In conclusion, the analysis of modern farming practice adoption highlights varying levels of agricultural modernization across districts in Andhra Pradesh. While certain districts show encouraging adoption of soil testing and micro-irrigation, organic farming adoption remains limited. Strengthening extension services, infrastructure support, and incentive mechanisms can accelerate the adoption of modern farming practices and contribute to sustainable agricultural development.



6. CONCLUSION

- This project successfully demonstrates the practical application of data analytics and visualization using Microsoft Power BI to analyze a large-scale government rural and agricultural dataset for Andhra Pradesh sourced from *data.gov.in*. The primary objective of the study was to transform raw administrative data related to agriculture, irrigation, household amenities, housing conditions, and farmer welfare schemes into meaningful and actionable insights that can support data-driven decision-making for policymakers, planners, and rural development stakeholders.
- Through systematic data preprocessing, objective-driven analysis, and interactive dashboard design, the project provides a comprehensive view of the rural farming ecosystem across multiple dimensions, including irrigation coverage, food security, farmer collectivization, housing vulnerability, and adoption of modern farming practices.

- **6.1 Summary of Analytical Findings:**

The analysis of irrigation distribution and irrigation gaps reveals significant disparities across districts in Andhra Pradesh. While certain districts demonstrate higher irrigation coverage, a large proportion of agricultural land remains unirrigated, indicating continued dependence on rain-fed farming. This imbalance highlights the need for targeted irrigation expansion and efficient water management strategies.

The assessment of household access to food grains shows that government distribution systems have reached a substantial share of rural households. However, the presence of households not receiving food grains in every major district indicates gaps in scheme coverage and beneficiary inclusion, pointing toward the need for improved monitoring and implementation mechanisms.

- **6.2 Farmer Organization and Producer Group Insights:**

The analysis of Producer Group (PG) coverage highlights uneven levels of farmer collectivization across districts. While some districts show strong participation of farm households in Producer Groups, others exhibit low coverage despite having a large farming population. This variation suggests differences in institutional support, awareness, and implementation effectiveness. Strengthening Producer Groups can enhance farmer bargaining power, market access, and income stability.

- **6.3 Housing and Basic Living Vulnerability Assessment:**

The evaluation of housing and basic living conditions reveals that a significant proportion of rural households continue to reside in vulnerable housing structures such as kuccha houses. Although housing schemes like Pradhan Mantri Awas Yojana (PMAY) have provided support to many households, the existence of permanent waitlists indicates unmet housing demand. These findings emphasize persistent socio-economic vulnerability in rural areas and the need for sustained housing interventions.

- **6.4 Adoption of Modern Farming Practices:**

The analysis of modern farming practices, including soil testing, micro-irrigation, and organic farming, indicates varying levels of adoption across districts. Soil testing and micro-irrigation show moderate adoption, while organic farming remains limited in most regions. This suggests that while awareness of scientific farming practices is improving, further efforts are required to promote sustainable and climate-resilient agriculture.

- **6.5 Role of Power BI in the Project:**

1. A key outcome of this project is the demonstration of Power BI as an effective decision-support and analytical tool for rural and agricultural analysis. Power BI enabled:
2. Efficient data cleaning and transformation using Power Query
3. Creation of DAX measures for KPIs and percentage-based analysis
4. Interactive filtering and slicing across districts and indicators
5. Clear visual storytelling through maps, charts, matrices, and donut visuals
6. Consolidation of multiple insights into a single, intuitive dashboard
7. The interactive nature of the dashboard allows stakeholders to explore district-wise patterns dynamically rather than relying on static reports.

- **6.6 Overall Project Significance:**

1. This project bridges the gap between raw government agricultural data and meaningful insight generation. By integrating multiple rural development indicators into a unified analytical framework, the study demonstrates how data analytics can support:
2. Evidence-based agricultural planning
3. Identification of regional development gaps
4. Evaluation of farmer welfare and housing schemes
5. Promotion of sustainable and inclusive rural development

- **6.7 Concluding Remarks:**

In conclusion, the project achieves its intended objectives by delivering a structured, data-driven analysis of the rural farming ecosystem of Andhra Pradesh. The insights derived from the dashboard highlight both strengths and areas requiring intervention in irrigation, food security, farmer organization, housing, and modernization of agriculture. The study reinforces the importance of data preprocessing, objective-based analysis, and effective visualization design in producing reliable and impactful analytical outcomes. Overall, this work demonstrates the potential of data analytics and business intelligence tools in supporting informed decision-making and sustainable rural development.

7. Future Scope

Although the current project provides meaningful insights into the rural farming ecosystem of Andhra Pradesh, there is significant scope for further enhancement and deeper analysis. Some potential future improvements are outlined below.

7.1 Integration of Crop and Yield Data:

Future analysis can integrate crop-wise production and yield data to assess how irrigation availability and modern farming practices influence agricultural output. This would enable productivity-based evaluation in addition to infrastructure analysis.

7.2 Longitudinal Year-on-Year Analysis:

The current dashboard analyzes data for a single reference period. Extending the dataset to include multiple years would allow trend analysis to study changes in irrigation coverage, housing conditions, and farming practice adoption over time, supporting long-term policy evaluation.

7.3 Predictive Analytics for Agricultural Planning:

Predictive modeling techniques can be applied to forecast future irrigation demand, housing requirements, and farmer welfare participation. Such models can help authorities proactively plan resource allocation and development interventions.

7.4 Integration of Climate and Rainfall Data:

Incorporating rainfall, drought frequency, and climate variability data would strengthen irrigation gap analysis and support climate-resilient agricultural planning, particularly for rain-fed districts.

7.5 Deployment Using Power BI Service:

Deploying the dashboard through Power BI Service would enable automated data refresh, scheduled updates, and secure sharing with stakeholders. This would make the solution scalable, dynamic, and suitable for real-world government or institutional use.

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10. GITHUB

<https://github.com/girishsaiteja/Andhra-Pradesh-Agriculture-Analytics---2020>

11. GOOGLE DRIVE LINK

https://drive.google.com/drive/folders/1EOgtJhzb9DrRamTxGYCU2uvLTpGG4GjX?usp=drive_link