

Agricultural Production Analysis

County-Level Planning for Sustainability and Food



Data Quality & Cleaning Process

Data Quality Issues Identified

- **1** Inconsistent column naming conventions with typos (e.g., 'TOTAL HOUSHOLDS', mixed case, spacing issues)
- **2** Missing values in critical demographic columns (Population, Area, Density)
- **3** Non-county administrative units mixed with county data (12 forest/park entries)
- **4** Data type inconsistencies with numeric columns containing non-numeric values
- **5** Potential outliers and data validation issues requiring verification

Cleaning Steps Taken

- **1** Standardized all column names to consistent snake_case format, fixed typos
- **2** Removed 12 non-county entries (forests/parks) to focus on county-level analysis
- **3** Removed counties with missing critical data; filled agricultural data gaps with 0
- **4** Converted all relevant columns to proper numeric data types with coercion
- **5** Validated data integrity, checked for negatives, recalculated population density

Key Descriptive Indicators



6.35M

Total Households Engaged in Farming

Represents the total number of households across all analyzed counties actively participating in agricultural activities



4.51

Average Household Size

Mean number of persons per household, a key demographic factor for food security and resource planning



60.7%

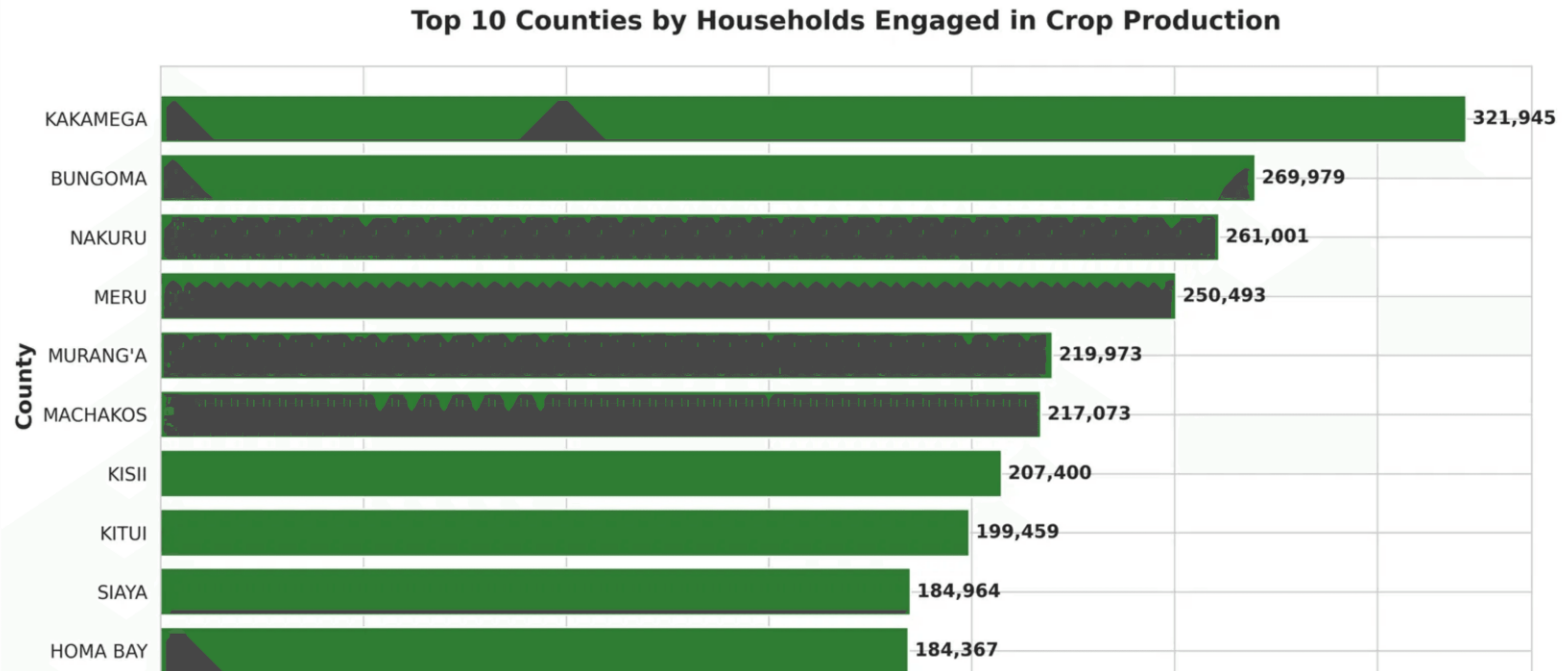
Agricultural Specialization Index

Average percentage of households engaged in farming across counties, indicating agricultural dependency

Interpretation: A significant portion of the population across the analyzed counties is engaged in agriculture, highlighting the sector's critical importance for livelihoods and economic development. The average household size provides essential context for food security planning and resource allocation strategies.

Top Counties by Crop Production

Households Engaged in Crop Production by County



Crop Production: Key Insights & Policy Implications

01

Kakamega leads with over 321,000 households engaged in crop production, followed closely by **Bungoma** (270,000) and **Meru** (250,000), demonstrating significant regional agricultural capacity.

02

The top 10 counties represent geographically diverse regions across the country, indicating that crop production is not concentrated in a single area but spread across different agro-ecological zones.

03

These counties collectively account for a significant portion of national crop production capacity, making them priority areas for agricultural investment and support programs to maximize food security outcomes.

04

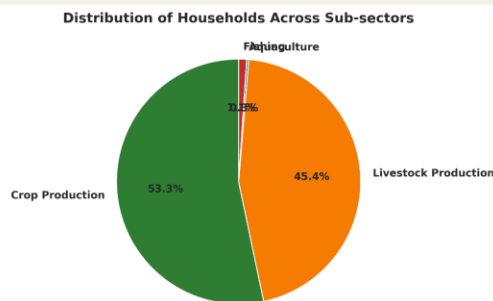
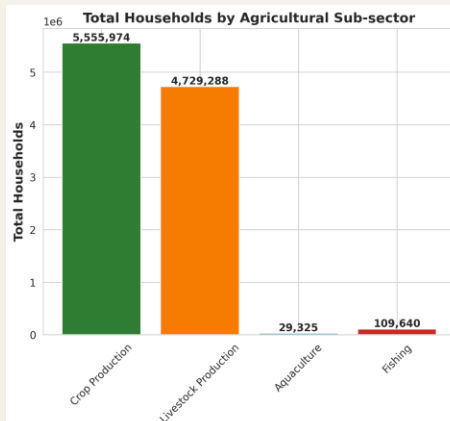
The distribution suggests varying scales of agricultural activity, from large-scale farming regions to intensive smallholder systems, requiring differentiated support strategies.



Policy Implications & Recommendations

- ◆ **Targeted Investment:** Prioritize agricultural infrastructure development, extension services, and input subsidies in these high-engagement counties to maximize return on investment and national food security impact.
- ◆ **Value Chain Development:** Strengthen market linkages, storage facilities, and processing capacity in top-producing counties to reduce post-harvest losses and improve farmer incomes.
- ◆ **Technology Transfer:** Establish demonstration farms and farmer training centers in leading counties to promote adoption of improved crop varieties, sustainable farming practices, and climate-smart agriculture.

Agricultural Sub-Sectors Comparison



Total Households by Sub-Sector

| | |
|----------------------|--------|
| Crop Production | 5.56M |
| Livestock Production | 4.73M |
| Aquaculture | 29.3K |
| Fishing | 109.6K |

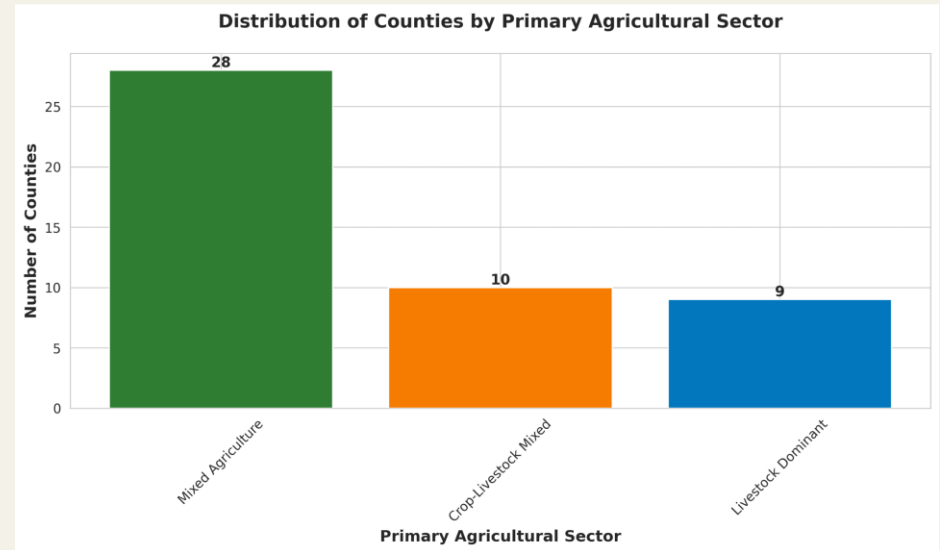
Interpretation: Crop production is the dominant agricultural sub-sector, accounting for over half of all agricultural households, followed by livestock production. The top counties in crop production are geographically diverse, indicating widespread engagement across different regions. Aquaculture and fishing represent smaller but important niche sectors, particularly in coastal and lake regions. This distribution provides a strong foundation for targeted interventions in the crop sub-sector while recognizing the need

Primary Agricultural Sector Classification

Transformation Logic

- ◆ **Step 1:** Compare four main sub-sectors (Crop, Livestock, Aquaculture, Fishing) by household count for each county
- ◆ **Step 2:** Identify the dominant sector with the highest number of engaged households
- ◆ **Step 3:** Apply threshold criterion—dominant sector must have $\geq 50\%$ more households than the second-largest sector
- ◆ **Step 4:** If threshold not met, classify as 'Mixed Agriculture' indicating diversified agricultural economy
- ◆ **Step 5:** Special case—if Crop and Livestock sectors are within 20% of each other, classify as 'Crop-Livestock Mixed'

Distribution of Counties



Interpretation: The majority of counties (28) exhibit a 'Mixed Agriculture' economy, indicating diversified agricultural bases that reduce risk and enhance resilience. 'Crop-Livestock Mixed' counties (10)

Policy Metric 1: Crop Yield Potential Intensity

Definition: Number of households engaged in crop production per square kilometer of county area | **Formula:** Crop Production ÷ Area (sq km) | **Unit:** Households per sq km

| County | Crop Production (HH) | Area (sq km) | Crop Intensity |
|----------|----------------------|--------------|----------------|
| VIHIGA | 108,522 | 563.8 | 192.48 |
| KISII | 207,400 | 1,323.0 | 156.76 |
| NYAMIRA | 102,856 | 897.3 | 114.63 |
| KAKAMEGA | 321,945 | 3,020.0 | 106.60 |
| BUNGOMA | 269,979 | 3,023.9 | 89.28 |



Policy Interpretation

These counties demonstrate the highest concentration of crop farming households relative to their land area, suggesting intensive agricultural land use. This may indicate high agricultural productivity potential, limited land availability requiring efficient use, or high population pressure on agricultural land. Policy interventions should focus on



Limitation

This metric does not account for land quality, climate suitability, or actual crop yields. Counties with smaller total areas may appear more intensive even with moderate farming activity. Additionally, the metric does not distinguish between subsistence and commercial farming, nor does it reflect farm productivity or income levels.

Policy Metric 2: Agricultural Engagement Rate

Metric Definition

Formula: $(\text{Farming} / \text{Total_Households}) \times 100$

Unit: Percentage (%)

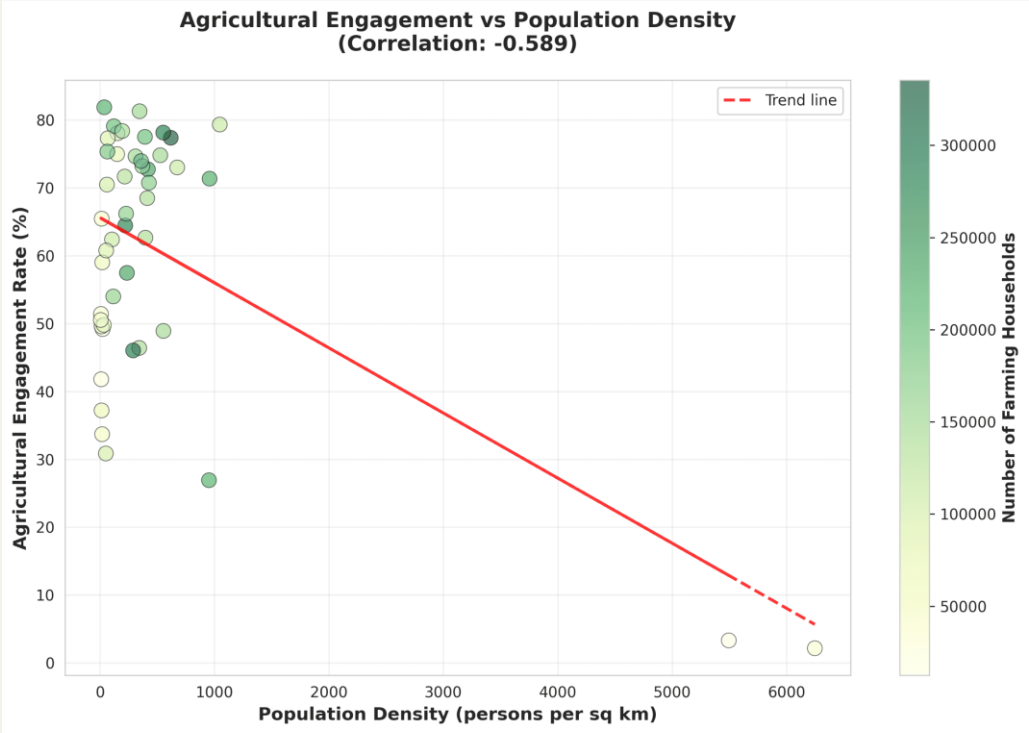
Correlation with Population Density

-0.589

($p < 0.0001$)

Top 5 Counties

| County | Engagement Rate | Density/km ² |
|---------|-----------------|-------------------------|
| KITUI | 81.9% | 37.3 |
| BOMET | 81.3% | 346.0 |
| VIHIGA | 79.3% | 1046.5 |
| MAKUENI | 79.1% | 120.9 |



Policy Metric 2: Interpretation & Limitations

Policy Interpretation

The **negative correlation coefficient of -0.589** reveals a statistically significant inverse relationship between agricultural engagement rates and population density across counties. This finding indicates that counties with higher proportions of households engaged in farming tend to have lower population density, suggesting these are predominantly rural areas where agriculture remains the primary livelihood strategy.

Counties with high agricultural engagement rates (above 75%) show **greater livelihood dependency on farming**, which may reflect limited alternative employment opportunities, strong agricultural traditions, or favorable agro-ecological conditions.

Key Policy Recommendations:

- ◆ **Value Chain Development:** Strengthen agricultural value chains to improve market access and increase farmer incomes through better linkages to processors and markets
- ◆ **Market Access Infrastructure:** Invest in rural roads, storage facilities, and market information systems to reduce post-harvest losses
- ◆ **Agricultural Extension Services:** Scale up extension services focusing on productivity enhancement and climate-smart agriculture
- ◆ **Income Diversification:** Support on-farm and off-farm income diversification strategies to reduce household vulnerability

Limitations & Caveats

This metric provides valuable insights into agricultural engagement patterns but has important limitations that must be considered when interpreting results and designing interventions.

Subsistence vs. Commercial:

The metric does not distinguish between subsistence farming and commercial agriculture, limiting our understanding of economic viability and market integration

Farm Size & Productivity:

No information on farm sizes or actual productivity levels means we cannot assess land use efficiency or income generation potential.

Conclusions & Recommendations

1 Targeted Agricultural Support Programs

Develop differentiated support programs based on the Primary Agricultural Sector classification. Counties classified as 'Crop Dominant', 'Livestock Dominant', or 'Mixed Agriculture' require distinct intervention strategies tailored to their specific agricultural profiles and resource needs.

2 Sustainable Farming Practices

In counties with high Crop Yield Potential Intensity (e.g., Vihiga, Kisii, Nyamira), promote sustainable intensification practices including soil health management, water conservation, and access to improved seeds and technologies to mitigate land degradation risks while maximizing productivity.

3 Economic Diversification

In counties with high Agricultural Engagement Rates but limited economic alternatives (e.g., Kitui, Bomet, Makueni), invest in value chain development, market access infrastructure, and non-farm employment opportunities to reduce livelihood vulnerability and enhance household resilience.

4 Further Research Needs

Conduct deeper analysis incorporating data on farm sizes, income levels, actual crop yields, and climate suitability. Distinguish between subsistence and commercial farming to enable more precise targeting of interventions and better assessment of agricultural productivity and food security outcomes.

This analysis demonstrates the power of data-driven MEL approaches in transforming raw agricultural data into actionable strategic insights. By combining rigorous data cleaning, descriptive analysis, and policy-relevant metrics, we can support evidence-based decision-making for improved agricultural sustainability and food