**Appendix A: Framework**

**Overview of the Framework**

The Sub-Saharan AgriTech Integration Model (SAIM) is a comprehensive approach that aims to improve agricultural practices by integrating digital technologies. This model is highly relevant to this thesis, as it provides a lens through which the transformative impact of Digital Agriculture (DA) on Yield Stability (YS) in Sub-Saharan Africa (SSA) can be understood. SAIM encompasses a range of components, such as the utilization of mobile technology, the adoption of Internet of Things (IoT) devices, the use of precision farming tools, and advanced data analytics. These components help to illuminate the direct and indirect relationships between DA and yield YS, demonstrating how technological advancements in agriculture can result in more stable and sustainable agricultural practices.

**Detailed Description of the Framework**

**Components of the Framework:**

Mobile Technology Utilization: Investigates the effectiveness of mobile technologies in expanding market access and disseminating information in the agricultural sector to provide real-time communication and access to market prices, aiding in informed decision-making.

IoT Device Adoption: Explores the influence of IoT technologies on precision farming, facilitating real-time monitoring of crop health and environmental conditions, leading to informed interventions.

Precision Farming Tools: Examines the application of GPS technology and drones for optimal resource allocation and crop management to map fields and apply these resources accurately.

Data Analytics: Emphasizes the significance of data analysis in delivering proactive insights for improved agricultural planning, allowing farmers to anticipate and respond to potential challenges, thereby enhancing yield stability.

**How the Framework is Applied in the Thesis:**

The framework is used to analyze the impact of digital agriculture on yield stability in Sub-Saharan Africa.

It helps understand how various digital technologies collectively improve agricultural practices and outcomes.

The thesis uses this framework to effectively propose policies and strategies for implementing digital agriculture.

**Appendix B: Codebook**

**Introduction to the Codebook**

This codebook offers comprehensive information regarding the variables in the research article dataset on digital innovation in agriculture. It is a reference manual for gaining insight into and applying the data for analytical purposes. The aim is to facilitate further research and inquiries by utilizing this collected body of literature.

**Detailed Description of Each Variable**

**Title**

The article's title conveys the central technological concept or agricultural context examined in the paper. Some common themes across titles are mobile phones, IoT sensors, big data analytics, digital advisory services, and geographic contexts like Sub-Saharan Africa or Nigeria.

**Authors**

The author list offers a glimpse into the principal investigators who spearheaded and disseminated the study. This permits a more in-depth scrutiny of their expertise and collaborative partnerships.

**Adoption Rates**

This variable encapsulates the essence of conversations about the current state of technology adoption and the obstacles that impede further growth or expansion. It serves as a metric for assessing the prevailing challenges and deficiencies that must be remedied before realizing the anticipated influence.

**Technologies/Innovations**

This categorical variable refers to the digital solutions and enablers mentioned in the articles, including hardware, sensors, and software, such as advisory platforms. By grouping the articles according to the dominant technologies, it is possible to trace the diffusion patterns.

**Food Insecurity Prevalence**

The variable in question serves to quantify the extent to which discourse surrounding food security within targeted agricultural contexts emphasizes technology adoption as a means of addressing these concerns while simultaneously assessing the motivating factors behind such adoption and its intended impact. Employing regional statistical data may provide a valuable means of evaluating and benchmarking progress.

**Recommendations**

Researchers have proposed the following suggestions for intervention to overcome barriers, encourage technology integration, and unlock agriculture's full potential. These recommendations include implementing policies, investing in infrastructure, providing private sector incentives, training farmers to develop necessary skills, and supporting research and development.

**Research Gaps**

This variable represents the recognized limitations in the current literature on adoption dynamics, causal mechanisms, and optimal solutions, which hinder a comprehensive understanding. It underscores the need for further research in key areas.

**Integration Strategies**

The variable encompasses the proposed mechanisms, models, platforms, and collaborative approaches designed to facilitate the integration of various technologies and maximize their viability and value to farmers. Additionally, it offers guidance on potential implementation strategies that have the potential to be successful.

**Potential Impact**

The proposed agricultural transformation, as outlined in th2 framework, serves as a benchmark against which the impact can be gauged in the long term. This evaluation will allow for assessing progress as theoretical concepts are put into practical application. The focus areas for this evaluation include productivity, sustainability, food access, farmer welfare, and value chain efficiency.

**Country/Region Focus**

The articles offer a platform for conducting in-depth examinations of the geographic context in which they are situated. These analyses can delve into the specific challenges, adoption patterns, and agricultural indicators within each region, as well as the impacts of factors such as investments, policies, culture, infrastructure, institutions, and development outcomes over time.

**Findings**

The findings gathered in this variable can be utilized to conduct comparative analyses across similar research studies, thereby validating knowledge and identifying any unusual or abnormal conclusions. Additionally, the variable can facilitate meta-analyses that explore the connections between various factors.

**Statistics**

The availability of quantitative data on adoption rates, outputs, technology access metrics, agricultural indicators over time, and other relevant information permits the contextualization and analysis of trends. Additionally, comparative benchmarking across different regions can be conducted using this data.

**Appendix C: Detailed Overview of CSV Data Sets**

**Introduction to Data Sets**

The datasets included in this study are paramount in comprehending various dimensions associated with the thesis topic. These datasets, obtained from dependable global databases, offer an all-encompassing perspective on food insecurity, agricultural productivity, economic indicators, and telecommunication trends. Each dataset provides a unique vantage point and significantly enriches the holistic understanding of the subject matter. The ensuing sections offer a detailed account of each dataset, delineating their layout, content, and potential applications in research.

**Food Insecurity Indicators Data**

**Structure and Content**

The "Food Insecurity Indicators" dataset is meticulously organized and includes several critical columns, each offering valuable insights:

* **Domain Code and Domain**: This identifies the data category, specifically indicating its relevance to food security indicators.
* **Area Code and Area**: These are geographic identifiers, with 'Area Code (M49)' being a numeric code and 'Area' being the name of the country or region.
* **Element Code and Element**: 'Element Code' is a numeric identifier, and 'Element' describes the data's nature, in this case, 'Value'.
* **Item Code and Item**: 'Item Code' is also a numeric identifier, while 'Item' provides detailed descriptions of indicators such as "Prevalence of undernourishment."
* **Year Code and Year**: These serve as temporal identifiers, with 'Year Code' in a specific numeric format and 'Year' indicating the timeframe covered by the data.
* **Unit**: This denotes the measurement unit, '%' (percent) for the given data rows.
* **Value**: The numerical value of the indicator.
* **Flag and Flag Description**: 'Flag' is typically a single-letter code (e.g., 'E'), and 'Flag Description' provides context such as 'Estimated value'.
* **Note**: An additional column for notes appears to be empty in the provided rows.

**Key Observations**

The dataset has been thoughtfully organized, with each row as a precise indicator for a specific country and time period. It encompasses qualitative features, such as 'Area', 'Item', and 'Flag Description', and quantitative dimensions, including 'Value'. Remarkably, the dataset concentrates on food security indicators, one of which is the prevalence of undernourishment. The data covers many years, enabling an examination of patterns over time.

**Potential Uses**

This dataset is pivotal for:

* Analyzing trends in food security by country and region.
* Identifying areas with increasing or decreasing food insecurity.
* Comparing the prevalence of undernourishment across different countries and time periods.

The present resource, which provides a comprehensive overview of food security indicators in numerous countries and over many years and employs a structured format that unambiguously delineates the geographic, temporal, and categorical dimensions, constitutes an indispensable tool for examining global trends in food security.

**Agriculture Production Indices Data**

**Structure and Content**

The "Agriculture Production Indices" dataset is a valuable resource that contains several key columns:

* **Domain Code and Domain**: These fields categorize the data, indicating its relevance to agricultural production indices.
* **Area Code and Area**: These are geographical identifiers, with the 'Area Code' being numerical and 'Area' indicating the specific country or region.
* **Element Code and Element**: The 'Element Code' is a numeric identifier, while 'Element' describes the data type, such as 'Gross Production 1999-2001 (100)'.
* **Item Code and Item**: Here, 'Item Code' is a numeric identifier, and 'Item' details the agricultural product, like 'Cereals, Total'.
* **Year Code and Year**: These columns provide time identifiers, with 'Year Code' in numeric format and 'Year' denoting the data's timeframe.
* **Unit**: This column specifies the unit of measurement, such as 'index (2004-2006 = 100)'.
* **Value**: The numerical value of the index.
* **Flag and Flag Description**: 'Flag' contains a code (e.g., 'F'), and 'Flag Description' provides additional information, like 'FAO estimate'.

**Key Observations**

The dataset in question has been compiled with great attention to detail and offers a thorough examination of agricultural production trends over an extended period. It encompasses various agricultural products and provides a comprehensive perspective on the agricultural sector's performance across multiple countries and regions. Employing indices based on a consistent reference period (2004-2006) facilitates accurate comparisons over time.

**Potential Uses**

The dataset is critical for:

* Tracking changes in agricultural production over time.
* Comparing agricultural output across different countries and regions.
* Evaluating the performance of specific agricultural sectors (like cereals, fruits, livestock).

The hierarchical organization of this dataset, encompassing its spatial and temporal dimensions, renders it an indispensable resource for scholars and decision-makers invested in exploring agricultural patterns and productivity assessment.

**Agriculture Yield Data**

**Structure and Content**

The "Agriculture Yield" dataset provides comprehensive data with key columns including:

* **Domain Code and Domain**: Indicating the data category relating to agricultural yields.
* **Area Code and Area**: Geographic identifiers, with 'Area Code' as a numeric code and 'Area' indicating the name of the country or region.
* **Element Code and Element**: 'Element Code' is a numeric identifier, while 'Element' defines the nature of the data, such as 'Yield'.
* **Item Code and Item**: These columns identify the agricultural product, with 'Item Code' being numeric and 'Item' describing the crop, like 'Wheat'.
* **Year Code and Year**: Temporal identifiers, with 'Year Code' as a numeric code and 'Year' indicating the relevant year.
* **Unit**: The unit of measurement, typically 'hg/ha' (hectogram per hectare).
* **Value**: The numerical value representing the yield.
* **Flag and Flag Description**: 'Flag' includes a code (e.g., 'A'), and 'Flag Description' provides context like 'Aggregate data'.

**Key Observations**

The dataset offers a comprehensive and detailed perspective on agricultural production figures for various crops across numerous nations and years. It enables in-depth examination of yield patterns and is a valuable tool for evaluating farm productivity and efficiency. The data's high level of specificity promotes a thorough comprehension of agricultural output at both the national and global scales.

**Potential Uses**

This dataset is vital for:

* Analyzing yield trends of different crops over time.
* Comparing agricultural efficiency across countries and regions.
* Assessing the impact of agricultural policies, climate change, and other factors on crop yields.

The "Agriculture Yield" dataset, with its detailed crop-wise and country-wise data, is an indispensable tool for agronomists, economists, and policymakers interested in agricultural productivity and food security.

**Economic Indicators Data**

**Structure and Content**

The "Economic Indicators" dataset is rich with data, characterized by several key columns:

* **Indicator Name and Indicator Code**: These columns define the specific economic indicator and its corresponding code. For example, 'GDP growth (annual %)' with its unique code.
* **Country Name and Country Code**: Geographic identifiers with 'Country Name' specifying the nation and 'Country Code' as its corresponding abbreviation.
* **Year**: This column denotes the year for which the data is relevant.
* **Value**: The actual numerical value for the economic indicator in the specified year.

**Key Observations**

The dataset provides a thorough overview of multiple economic indicators from various countries over an extended period of time. It includes fundamental indicators, such as GDP growth and inflation rates, essential for economic analysis. The dataset's time-series format allows for identifying trends and patterns in economic development and performance.

**Potential Uses**

The dataset is essential for:

* Tracking economic performance of countries over time.
* Conducting a comparative analysis of economic growth and development.
* Assessing the impact of global events and policies on national economies.

The "Economic Indicators" dataset, with its wide range of variables and historical depth, is an invaluable asset for economists, researchers, and policymakers engaged in global economic analysis, policy formulation, and trend forecasting.

**Mobile Phone Subscribers Data**

**Structure and Content**

The "Mobile Phone Subscribers" dataset includes the following significant columns:

* **Country Name and Country Code**: These provide geographic identification of the data, with the country name and its corresponding code.
* **Year**: The year to which the data point relates.
* **Value**: The number of mobile phone subscribers in the country for that particular year, typically expressed per 100 people.

**Key Observations**

This dataset provides valuable insights into the proliferation of mobile technology across various countries and over time. It illustrates the rapid growth of mobile phone usage and its penetration in different societies, reflecting both technological adoption and aspects of economic development and societal change.

**Potential Uses**

The data is crucial for:

* Analyzing global trends in mobile technology adoption.
* Understanding the correlation between mobile phone usage and socio-economic factors.
* Evaluating the digital divide and connectivity disparities among countries.

With its focus on mobile phone subscribers, this dataset offers a unique perspective on technological advancement and its societal implications, making it a key resource for researchers in telecommunications, economics, and social sciences.

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