Republic of Rwanda

SEASONAL AGRICULTURAL SURVEY

METADATA HANDBOOK

APRIL 2024

NATIONAL INSTITUTE OF STATISTICS OF RWANDA (NISR)

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FOREWORD

The National Institute of Statistics of Rwanda (NISR) has been conducting the Seasonal Agricultural Survey (SAS) since 2012. This survey aims to provide timely and accurate estimates on the national crop production, cultivated and harvested area, crop yield, agricultural inputs, and agricultural practices which are crucial for monitoring the progress of agriculture programs and policies in Rwanda. This survey is conducted in close collaboration with the Ministry of Agriculture and Animal Resources (MINAGRI), the National Agricultural Export Development Board (NAEB), and the Rwanda Agriculture and Animal Resources Development Board (RAB).

This metadata handbook describes the key characteristics of the Seasonal Agricultural Survey by providing detailed documentation and structure in order to facilitate data management, analysis, and dissemination. Having comprehensive metadata are crucial for researchers, policymakers, and other stakeholders who want to effectively use the Seasonal Agricultural Survey data. It allows users to understand the context of the data, assess its quality, and ensure its appropriate application for various purposes such as: Monitoring crop production and food security, evaluating agricultural programs and policies, informing market analysis and investment decisions, identifying trends and challenges in the agricultural sector, supporting evidence-based decision-making for sustainable agriculture.

NISR expects that this metadata handbook will promote the general understanding and the use of agricultural statistics across the National Statistical System (NSS), thereby enhancing evidence-based policy formulation and decision-making.

I am grateful to the NISR team who contributed to the realization of this document. Their commitment and hard work are greatly appreciated. Finaly, I highly encourage all key stakeholders make full use of this metadata handbook to enhance the quality of agriculture statistics in Rwanda.

MURENZI Ivan
Director General, NISR

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Abbreviations and Acronyms

GIS	Geographical Information System
GPS	Global Positioning System
LSF	Large-Scale Farmer
LUC	Land Use Consolidation Program
MFS	Multiple Frame Sampling
MINAGRI	Ministry of Agriculture and Animal Resources
NAEB	National Agriculture Export Development Board
NISR	National Institute of Statistics of Rwanda
NST	National Strategy for Transformation
NSS	National Statistical System
PPS	Probability Proportional to Size
PSTA	Strategic Plan for Agriculture Transformation
RAB	Rwanda Agriculture and Animal Resources Development Board
SAS	Seasonal Agricultural Survey
SSF	Small-Scale Farmer
FAO	Food and Agriculture Organization

Chapter 1: Introduction

1.1. Background

Agriculture is one of the main pillars to drive aspiration of Rwanda to become a higher income country by 2050. The Government of Rwanda set an ambitious agriculture strategy (PSTA4) aiming to increase agricultural productivity through transformation of agriculture from subsistence to knowledge based, hence ensuring availability of sufficient food for its population.

High-quality agricultural data are essential in evaluating the performance of agricultural programs, providing progress towards achieving results, and enabling data-driven decisions that benefit the agriculture sector. To monitor the progress towards these goals and targets, timely and reliable agricultural statistics are produced through seasonal agricultural surveys.

In addition to that, a metadata handbook describing agricultural production-related indicators was developed to help data users effectively use the survey data, support informed decision-making, and assist in policy formulation.

1.2. Purpose of handbook

The main objective of producing this metadata handbook was to facilitate:

i. Production of comparable agricultural data to increase usage and development of informed decisions and monitoring of the progress towards modernization of agriculture.

ii. Usability and interpretability of indicators reported in seasonal agricultural surveys.

iii. Understanding of the concepts, approaches to data collection, and estimation of indicators for the effective use of agricultural survey data.

1.3. Type of Indicators covered

The indicators covered in this handbook describe and assess performance, tracking progress toward sustainable agriculture and productivity. They include agricultural crop production, land use, soil and erosion control, water availability and biodiversity, farm management systems, and technology adoption in agriculture. These indicators are crucial for policymakers, researchers, and stakeholders to make informed decisions and monitor progress over time.

All indicators are categorized into four broad categories as follows:

1. Agricultural areas (Land uses, crop planted and harvested area);
2. Crop production (Production and yield of main crops);
3. Agricultural inputs uses (Seeds, use of fertilizers, pesticides, etc.) ;
4. Agricultural practices (Erosion control, irrigation, cropping system, sustainable agriculture practice, and mechanization).

Since the survey follows an area frame approach, it does not cover indicators that are not directly related to land, such as household linked indicators and others.

1.4. Structure of the Handbook

The Metadata handbook provides detailed information on all four categories of indicators. Within each category, these indicators are aligned with national development policies, regional or international frameworks, or other pertinent contexts for Rwandan agriculture. The handbook documents indicators according to the Data Documentation Initiative (DDI) metadata standards. Each indicator is described across eight elements: definition and concept, required variables, computation methods, unit of measurement, data source, disaggregation level, interpretation, and uses (applications). A full list of all indicators is provided in annex 3.

Chapter 2: Study description

2.1. Concepts and definitions

Under this section, we introduce concepts and definitions of the terms used in seasonal agricultural surveys. Most of these definitions are derived from international guidelines or locally adopted to suit the national context.

Agricultural land: It refers to the land used for growing crops and land that can be put back into cultivation (fallow or pastureland). It indicates land potential for agriculture.

Area frame

The global strategies for improving agricultural and rural statistics define area sampling frame as a set of land elements, which may be either points or segments of land. It can be compiled in a single stage or in multiple stages. If satellite data are available, land areas are classified by land cover to identify cultivated land from woodland and other non-agricultural land areas. Finally, land areas (segments or points) are selected and used as the sampling units(FAO 2015).

Fallow land: This refers to land that is temporarily free for cultivation for a short term (less than 5 years). This may be part of the farm's crop rotation system or because the normal crop cannot be planted because of flood damage, lack of water, unavailability of inputs or other reasons.

Farm: It is any piece of land, of one land tenure type, entirely surrounded by other land, water, road, forest or other features not forming part of the holding or forming part of the holding under a different land tenure type. A farm may consist of one or more plots adjacent to each other.

Large-Scale Farmers is a person, group of people, household, or institutions that operates on larger plots, fields, or parcels of land. They primarily engage in market-oriented agriculture, applying modern farming practices such as mechanization and irrigation. For the purposes of agricultural surveys, any farmer operating on at least 10 hectares, managing at least 70 units of large animals, 1,500 chickens, or 50 bee hives is classified as a large-scale farmer.

The total units of animals are calculated by adding the individual units of various animals kept by one farmer as follows:

$$\textbf{Total units} = \frac{\text{Number of Cows}}{1} + \frac{\text{Number of } pigs}{2} + \frac{\text{Number of } Goats}{5} + \frac{\text{Number of } sheep}{5}$$

Non-agricultural land: refers to land where no agricultural activities are conducted, and from which no agricultural products are derived. This includes land occupied by buildings, roads, paths, forests, bush, bare or rocky soil, and water bodies.

Pastureland: This refers to areas covered with natural grasses reserved for livestock rearing or cultivated with fodder crops.

Perennial crops Perennial crops are plants that last for more than two growing seasons, either dying back after each season or growing continuously and can be harvested annually after reaching maturity. multiple years. Unlike seasonal crops, they do not need to be replanted every year. Examples include Fruits, banana, and cassava(FAO 2017).

Plot: According to the world census of agriculture (WCA2020), a plot is defined as a part or whole of a field on which a specific crop or crop mixture is cultivated, or which is fallow or waiting to be planted(FAO 2017).

Segment Refers to the final land unit selected from an area sampling frame. It is defined as land area described by geographic boundaries or by geo-referenced(Gallego 2015).

Seasonal crops (or annual crop) are plants that do not last more than two growing seasons. Examples include maize, wheat, and tomatoes(FAO 2017).

Small-Scale Farmer: is a person or group of people who operate on small plots, fields, or parcels of land. They are mostly engaged in subsistence and labor-intensive farming systems. For the purposes of agricultural surveys, any farmer operating on less than 10 hectares is classified as a small-scale farmer(NISR 2022).

2.2. Sampling procedures

2.2.1. Frame design

To provide a foundation for conducting probability surveys that comprehensively cover farm-level data, and to enhance the precision of survey estimates, address gaps, and improved the quality and availability of agricultural statistics, the SAS employs a Multiple Frame Sampling (MFS) methodology. The MFS combines an area sampling frame, which provides complete coverage of the country's land, with a list frame of all commercial/large farmers. This method ensures that rarely observed crops are included, which might be not fully covered by the area frame approach alone (NISR, 2019). Constructing an area frame involves several steps, including land cover classification, land stratification, and selection of sampling units (point or segments). Various spatial layers and orthophotos available in the country, along with high-resolution satellite imagery data (50 to 30 cm), were analyzed and classified into fourteen non-overlapping homogeneous land-use strata, based on crop intensity and other land-use characteristics (see Table 1).

Table 1: List of Rwanda land cover classes

#	Agricultural-land cover class	Woodland and other non-crop land
1	Agricultural land on hills	Non cropped wetlands
2	Non-rice Agricultural Wetland	Forest
3	Mixed rangeland	National parks
4	Low-density built-up area	Water bodies
5	Paddy rice wetland[1]	High-density built-up area
6	Tea plantation[2]	Protected wetland
7		Bare land/rocks
8		Exclusive rangeland

2.2.2. Stratification

The stratification is based on land characteristics and fixed thresholds, combining sampling units (clusters) with land use/land cover. The entire country is divided into square clusters/segments of nine hectares each, which are then overlaid onto the land cover map. Each cluster is assigned a dominant land cover lass and given a new stratum based on thresholds described in table 2.

Table 2: List of strata

Stratum number	Stratum name	Definition
10	Dominant hill crop land	Clusters with Hillside agricultural land cover class greater or equal to 60 percent of the total area of the cluster
20	Dominant Wetland crops	Clusters with non-rice wetland land cover class greater than 25 percent of total area of the cluster
30	Dominant rangeland	Clusters with rangeland land cover class greater or equal to 60 percent of the total area of the cluster
40	Mixed	The rest of other possible combinations
90	Excluded	All clusters with excluded land cover classes greater or equal to 50 percent of the total area of the cluster

Source: SAS frame 2019

[1] Paddy rice wetlands are treated as special crops planted in a very specific area. They are classified as commercial farms and thus they are excluded from area frame to avoid double counting.

[2] Tea plantations consist of industrial larger tea plantation and are excluded from SAS frame: The area and production data are regularly collected by Rwanda export development board.

Out of fourteen land cover classes defined in the land cover map, four classes-hillside agricultural land, non-rice agricultural land, mixed rangeland, and low-density built-up areas (with potential for agricultural production including kitchen gardens, fruit trees, and livestock) were considered. Tea and rice wetland classes, although agricultural land, are classified under excluded strata to avoid double counting and to ensure cost efficiency. Rice wetlands are included in the list frame, and tea data are captured through administrative reporting.

2.2.3. Sampling method

The SAS survey employs a probability-based design with a two-stage sampling approach, supplemented by a complete enumeration of all large-scale farmers identified. The first stage, a representative sample of clusters or segments is selected from all districts of the country across four agricultural strata (dominant hill crop land stratum, dominant wetland crops stratum, dominant rangeland stratum and mixed stratum). In the second stage, within each selected cluster, 25 grid squares are placed with a 60-meters between them. Each grid square is assigned geographic coordinates for its center. Field workers then locate these points in the field and mark out the plots where the grid points are located.

A final sample of 1200 clusters/segments are selected and distributed across all districts using the power allocation method[3]. Within each district, the sample is further distributed using proportional allocation among strata.

2.2.4. Weighting procedures

Based on the stratified two-stage sample design used with the area frame, the first stage sampling probability for the sample segments in each stratum is calculated as:

$$p_{1h} = \frac{n_h}{N_h}$$

where:

p_{1h}=probability of selection of sample segments in stratum *h* (district by land use stratum)

N_h= adjusted total number of segments in the area frame for stratum *h*

n_h=number of sample segments selected in stratum *h*

[3] Bankier M.D. (1988) Power allocations: determining sample sizes for subnational areas. The American Statistician, Vol. 42, n. 3 pp. 174-177.

The values of N_h and n_h are adjusted to remove the segments of the area frame and the sample that overlap with the large farm sample.

The second stage probability was calculated at the plot level based on the assumption that the plots within each sample segment were implicitly selected with PPS using the area of the plot as the measure of size. Therefore, the second stage probability of selection can be expressed as follows:

$$p_{2hi} = \frac{g_{hi} \times A_{hij}}{A_{hi} \times g_{hij}}$$

where:

g_{hi}= number of grid squares selected in the *i*-th sample segment of stratum *h*; g_{hi} is generally equal to 25, but it is adjusted to remove any sample grid squares in the segment that overlaps with the large farm sample

A_{hij}= area (in m^2) of the *j*-th sample plot selected in the *i*-th sample segment of stratum *h*; if part of the plot is outside the boundaries of the segment, A_{hij} only includes the area of the plot inside the segment, which should be measured in the data collection

A_{hi} = area (in m^2) of the *i*-th sample segment of stratum *h*; A_{hi} is generally equal to 90000 m^2, but it is reduced by the area of any overlapping large farm sample

g_{hij} = number of selected grid squares in the *j*-th sample plot of the *i*-th sample segment of stratum *h*

The weight of a sample plot is equal to the inverse of the first and second stage probabilities of selection, as follows:

$$W_{Phij} = \frac{1}{p_{1h} \times p_{2hi}} = \frac{N_h \times A_{hi} \times g_{hij}}{n_h \times g_{hi} \times A_{hij}}$$

where

W_{Phij} = weight for the *j*-th sample plot in the *i*-th sample segment in stratum *h*

The final weights are adjusted to account for agricultural land areas in segments that were excluded from the area frame because they did not meet the threshold for inclusion in the different agricultural strata.

These adjustments are calculated based on the four land cover types within each district and are assigned to the individual grid squares according to their land cover classification. In the

case of plots with more than one grid square with different land cover classifications, the weight adjustment factor for the plot is calculated as the average of the adjustment factors for the different grid squares.

The final (adjusted) weight of each sample plot is calculated as follows:

$$W'_{Phij} = W_{Phij} \times cf_{Phij}$$

where:

W'_{Phij} = final (adjusted) weight for the *j*-th sample plot in the *i*-th sample segment in stratum *h*

cf_{Phij} = weight correction factor for the *j*-th sample plot in the *i*-th sample segment in stratum *h*

2.2.5. Data Collection Period

The SAS survey provides data on agricultural production in Rwanda and is conducted three times a year, aligning with the country's three main agricultural seasons.

- **Season A** runs from September to February of the following year. Data collection for this season occurs in two phases: phase one takes place between November and December, and phase two occurs from January to March.
- **Season B** starts in March and ends in June. Data collection for this season occurs in two phases: phase one takes place in April and May, and phase two occurs in June and July.
- **Season C** spans from July to September and is a shorter season primarily focusing on growing vegetables, sweet potatoes grown in swamps, and Irish potatoes cultivated in the volcanic agro-ecological zone. Data collection for this season occurs in two phases: phase one takes place in August and September and phase two occurs in September and October.

Screening Phase (Post-planting phase): This phase involves delineating plots at sampled grid points to collect information on land use, cultivated land area, crop types, erosion control measures, and agricultural practices.

Harvest Phase: This phase involves collecting information on crop production and its uses, inputs (such as fertilizers, pesticides, and seeds), and the cost of production.

2.2.6. Data Collection

2.2.6.1. Method and data collection procedure

The SAS survey employs GPS based area measurement and computer-assisted personal interviews (CAPI) for data collection. data are collected in two phases (screening and crop production):

During the screening activity, field workers utilize highly accurate GPS devices (less than 1m accuracy), GIS software and applications (such as Collector for ArcGIS, Field Map, Survey 123, Avenza Map, GNSS, etc..) for navigation to the segment; locate the sampled points; mapping and area measurement within the segment. Upon reaching the sampled point, enumerators, in collaboration with the farmer, identify plot boundaries and delineate the plot using the ArcGIS Application connected to GPS external device. This approach reduces measurement errors, enhancing precision in yield and crop production estimation, and is recommended for capturing crop production data (FAO, EAC guidelines for improving agricultural statistics).

After screening activity, there is a second phase that consists of collecting production, inputs, and the cost of production. During interviews with the farmer who operates the plot, after taking area measurements, additional information is collected and recorded on tablets using CS Entry application. Subsequently, the data is directly transmitted to servers for further processing and analysis. This approach enhances the ability to monitor data collection progress and ensures data quality.

1.1. 2.2.6.2. Tools and materials

Seasonal Agricultural Survey uses two questionnaires, the Screening and Plot questionnaires, digitized using the CS Pro application.

Screening Questionnaire: The questionnaire collects information for the delineated plot mainly related to land use, plot area and cultivated crops, all of which are recorded through enumerator observations.

Crop production Questionnaire: The questionnaire collects information on the sampled plots mainly related to crop production, agricultural inputs and practices gathered through interviews with the farmers.

2.2.7. Data quality and validation

Fieldwork monitoring and Supervision

Fieldwork activities are monitored using dashboard and Google Sheets for checking daily performance and quality assurance. This centralized platform effectively manages activities, resources, and performance. The effective monitoring of enumerator's attendance and performance is done by capturing GPS coordinates, including precise location and GPS time, allowing detailed analysis of field attendance.

Intensive field supervision is conducted to ensure the data quality throughout both screening and plot interview phases and supervisors are dispatched to all districts of the country to provide continuous oversight and support to field workers with responsibilities to provide technical guidance and monitoring the execution of data collection activities. as well as ensuring compliance with the data collection ethics and completeness of the workload.

2.2.8. Data processing and Cleaning

The CAPI data collection method used allows the enumerators to collect data using the tablets and synchronize to the central server at NISR headquarters where data are received and transmitted to editors for data preparation leaning and validation to ensure data accuracy by removing duplicates, correcting errors, handling missing values, standardize data formats and transform raw data into analyzable formats.

There is a team of editors that make daily follow-ups to clean data, identify and rectify discrepancies using STATA do files based on logical patterns and give feedback to fieldworkers, aiming to provide a cleaned raw dataset to the analysts' team for further analysis.

The analysts verify that the values for each variable fall within theoretical ranges. This includes detecting outliers of variables such crop production, fertilizer quantity, seed quantity, agricultural input prices, irrigation costs, and other related expenses etc.

The team also check for inconsistencies to ensure that the relationships between different variables in the dataset are logical and coherent. This involves verifying if the related variables, such as planted area and harvested yield, are consistent with each other. For instance, if the planted area for a particular crop is recorded as significantly larger than the available agricultural land in a segment, this indicates a data inconsistency that needs to be resolved. Checking inconsistency, also includes identifying and resolving duplicate records, missing values, or contradictory information within the dataset.

2.2.9. Analysis and Interpretation

Data are analyzed using STATA software, which offers robust capabilities for data management, including importing, cleaning, merging, and manipulating datasets. STATA enables the development of tabulation commands and the generation of survey tables, graphs, and charts. Furthermore, SPSS and STATA software are used for estimating survey sampling errors, ensuring the accuracy and reliability of the survey results.

2.2.10. Reporting and dissemination

Seasonal Agricultural Survey report is generated to communicate findings to stakeholders, including farmers, researchers, and policymakers helping them make decisions based on reliable evidence.

The Seasonal agricultural survey report is published on the official NISR website in three formats which are PFD, Excel, and anonymized microdata. The microdata is anonymized and documented following the Data Documentation Initiative (DDI), an international standard for describing the data produced by surveys and other observational methods in the social, behavioral, economic, and health sciences

2.2.11. Data access

The NISR data are freely accessible at data catalog portal :
https://www.statistics.gov.rw/statistical-publications/subject/agriculture-and-environment

2.2.12. Confidentiality

Confidentiality is paramount in data access policies at NISR. Measures are implemented to protect the privacy of survey respondents and sensitive information contained within the dataset. This includes anonymizing or de-identifying personal information to prevent the identification of individual respondents. Additionally, access to sensitive data is restricted to authorized personnel only, with stringent controls in place to prevent unauthorized disclosure or misuse.

Chapter 3: Indicators Covered

This section focuses on agricultural indicators used to evaluate the performance of Rwanda's agricultural sector. It covers indicators related to agricultural area and production, as well as farming inputs and good agricultural practices.

3.1. Area indicators

Agricultural land area

Elements	Description
Definition	It refers to the total land area used for farming and other land that can be brought back into cultivation such as fallow and pasture. This indicator provides information on potential land for agriculture in Rwanda.
Variable required	Land use including cropped land, fallow, temporarily meadow and pasture
Method of computation	It is calculated as the summation of three land uses areas: (i) Land under cultivation (Lc): Area occupied by different crops (ii) Fallow land (Lf): Area left un-cultivated in one season but with a plan to be planted in the next seasons (iii) Temporary or permanent pasture (Lp): Land used to grow fodder crops, or areas reserved as pasture.
Unit of measurement	Hectare
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	District
Interpretation	Agricultural land area indicator shows size of land that is available for farming activities in Rwanda. The larger agricultural land area generally indicates the potential to increase agricultural production.
Uses	Data on agricultural land helps to make informed decisions towards the efficiency of land use management, land reform and tenure, zoning for crop specialization, agricultural production, guide investments decision, and resource allocation.

Arable land

Elements	Description

Definition	Arable land is land that is used in most years for growing temporary crops. It includes land used for growing temporary crops during a twelve-month reference period, as well as land that would normally be so used but is lying fallow or has not been sown due to unforeseen circumstances. Arable land does not include land under permanent crops or land that is potentially cultivable but is not normally cultivated. Such land should be classified as "permanent meadows and pastures" if used for grazing or haying, "forest and other wooded land" if overgrown with trees and not used for grazing or haying, or "other area not elsewhere classified" if it becomes wasteland.
Variable required	Land use including cropped land, fallow, temporarily meadow and pasture, and Plot area
Method of Computation	The arable land is calculated as the simple summation of land used for growing seasonal crops, fallow land, and temporary midows/pastures. Formula: **Land under seasonal crops + Fallow land + Temporary pasture** Note: The total land under each land use is obtained by multiplying the area of each plot by its plot weight and then aggregating the results at the district level then national level.
Unit of Measurement	Hectare
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 Districts
Interpretation	Arable land area indicator indicates the size of land that is potential for agriculture in Rwanda.
Uses	Arable land area data plays a crucial role in supporting sustainable agriculture, land use planning, environmental conservation, food security, rural development, and scientific research. it can inform decision-makers about potential opportunities in specific agricultural sectors.

Physical cultivated land

Elements	Description
Definition	Physical area refers to the total area of the plot as physically measured. The physical agricultural area in a district is estimated by aggregating all weighted individual agricultural plots area for that district. **Note:** For physical land, each piece of land is counted only once. It does not account for crop occupation rate, germination rate, or cropping system (pure or mixed).
Variables required	plot area and land use
Method of Computation	Total physical cultivated land: sum of all cultivated plot areas in all districts. Plots with mixed crops are counted once Formula: $\hat{X}_p = \sum_{i=1}^{n=30} x_k \times W_{Phij}$ *Where:* $\hat{X}_p$ *:* Total estimated physical cultivated land area x_k : Measured plot area W_{Phij}=weight for the j-th sample plot in the *i-th* sample segment in stratum h
Unit of Measurement	Hectare
Data Sources	Seasonal Agricultural Survey
Disaggregation Geographical	Districts
Interpretation	This indicator provides actual land used for growing crops for a particular agricultural season. It gives insights on agricultural productivity, and land use over seasons.
Uses	Physical cultivated land data helps to understand the extent of land used for growing crops, facilitating the assessment of food security, identifying regions vulnerable to food shortages, and guiding interventions, informing decisions on agricultural investments and market strategies. Physical cultivated land data informs also land use planning decisions.

Area under seasonal crop

Elements	Description
Definition	It refers to the area occupied by temporary crops. Temporary crops are those which are both sown and harvested during the same agricultural season.
Variables required	Crops grown, crop proportion and plot area.
Method of Computation	Th indicator is calculated into two steps: Step 1: Estimate seasonal crop areas in the plot: $\boldsymbol{x_{ks} = z_k T_k}$ Step 2: Aggregate weighted crop areas at district level then at National level $\hat{X}_{sc} = \sum_{i=1}^{n=30} x_{ks} \times W_{Phij}$ *Where:* x_{ks} : Estimated seasonal crop area in the then atz_k : Proportion of the current crop visually estimated in the plot k. T_k : Area of the plot k $\hat{X}_{sc}$ *:* Total estimated seasonal crop area W_{Phij}=weight for the j-th sample plot in the *i-th* sample segment in stratum h
Unit of Measurement	Hectare
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 Districts
Interpretation	The Area under seasonal crops indicates the amount of land that farmers use to grow seasonal crops during a particular seasons.
Uses	Seasonal land area data can be used to ensure food security, promote sustainable practices, to inform policy decisions, and to guide market analysis and investment within the agricultural sector.

Area under permanent crop

Elements	Description
Definition	Land under permanent crops refers to: land cultivated with long-term crops which do not have to be replanted for several years; land under trees and shrubs producing flowers, such as roses and jasmine; and nurseries (except those for forest trees, which should be classified under "forest and other wooded land"). Land under permanent crops also includes land used for growing permanent crops under protective cover. Land under permanent meadows and pastures is excluded from land under permanent crops.
Variables required	Crops grown, crop proportion and plot area.
Method of Computation	The indicator is calculated into two steps: Step 1: Estimate permanent crop areas in the plot: $\boldsymbol{x_{ks} = z_k T_k}$ Step 2: Aggregate weighted crop areas at district level then at National level: $\hat{X}_{sp} = \sum_{i=1}^{n=30} x_{kp} \times W_{Phij}$ *Where:* $\hat{X}_{sp}$ *:* Total *e*stimated permanent crop area T_k : Area of the plot k z_k : Proportion of the current crop visually estimated in the plot k. x_{kp} : Estimated permanent crop area in the plot W_{Phij}: weight for the j-th sample plot in the *i-th* sample segment in stratum h
Unit of Measurement	Hectare
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 Districts
Interpretation	Area under permanent crop indicates the amount of land that is used for growing crops that occupy the land for many years.
Uses	The data on the area under permanent crops is essential for assessing long term agricultural production. this indicator can guide decisions towards market and investment opportunities.

Temporary fallow land area

Elements	Description
Definition	Land temporarily fallow refers to arable land at prolonged rest before re-cultivation. This may be part of the holding's crop rotation system or because the normal crop cannot be planted because of flood damage, lack of water, unavailability of inputs or other reasons.
Variables required	Land use and plot area
Method of Computation	Total fallow land: sum of all uncultivated land areas in all districts. Formula: $\hat{X}_f = \sum_{i=1}^{n=30} x_f \times W_{Phij}$ *Where:* $\hat{X}_f$ *:* Total estimated fallow land area x_f : Estimated fallow land area in the plot k W_{Phij}=Weight for the j-th sample plot in the *i-th* sample segment in stratum h
Unit of Measurement	Hectares
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 Districts
Interpretation	Temporary fallow land can be taken as a break for the soil to recover. It's part of good agricultural practices as During this time, the soil regains nutrients, prevent erosion, and control pests naturally. It's a way for farmers to keep their land healthy and productive in the long run.
Uses	Temporary fallow land can be a valuable tool for sustainable agriculture, helping to maintain soil health, conserve resources, and improve long-term productivity.

Temporary meadow and pasture

Elements	Description
Definition	Land under temporary meadows and pastures includes land temporarily cultivated with herbaceous forage crops for mowing or pasture. A period of less than five years is used to differentiate between temporary and permanent meadows and pastures. If country practice differs from this, the country definition should be clearly indicated in census reports.
Variables required	Crops grown, plot area, and land use
Method of Computation	Total temporary meadow and pasture: sum of all uncultivated temporary pastureland areas in all districts. Formula: $\hat{X}_f = \sum_{i=1}^{n=30} x_f \times W_{Phij}$ *Where:* $\hat{X}_f$ *:* Total estimated fallow land area x_f : Estimated fallow land area in the plot k W_{Phij}=weight for the j-th sample plot in the *i-th* sample segment in stratum h
Unit of Measurement	Hectare
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 Districts
Interpretation	This indicator indicates the amount of land that farmers allocate to to feed their livestock. It also gives insights into how they rotate pastures to maintain soil health and maximize productivity.
Uses	The temporary meadow and pasture data are crucial for various stakeholders in agriculture. Farmers can use these data for effective livestock management, ensuring the health and well-being of their animals. Governments and land managers utilize these data in strategic planning, environmental monitoring, policy development, and research to mitigate climate change concern. This information enables informed decision-making and supports sustainable agricultural development.

Area under permanent pasture

Elements	Description
Definition	Land under permanent meadows and pastures includes land used permanently (for five years or more) to grow herbaceous forage crops, through cultivation or naturally (as wild prairie or grazing land). Whether land under permanent meadows and pastures is cultivated or naturally grown has important environmental implications; therefore, countries are encouraged to further subdivide it according to this characteristic.
Variables required	land use and plot area
Method of Computation	Total area under permanent pasture: sum of all permanent pasture areas in all districts. Formula: $\hat{X}_{pasture} = \sum_{i=1}^{n=30} x_{pasture} \times W_{Phij}$ *Where:* $\hat{X}_{pasture}$ *:* Total estimated permanent pastureland area $x_{pasture}$: Estimated pastureland area in the plot k W_{Phij}=weight for the j-th sample plot in the *i-th* sample segment in stratum h
Unit of Measurement	Hectare
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 Districts
Interpretation	This indicator indicates the amount of land that farmers allocate permanently to feed their livestock.
Uses	Permanent pasture data can be used in the planning of livestock farming. Farmers can use these data for effective livestock management, ensuring the health and well-being of their animals. Governments and land managers utilize these data in strategic planning, environmental monitoring, policy development, and research to mitigate climate change concern. This information enables informed decision-making and supports sustainable agricultural development.

Area under agricultural practice

Elements	Description
Definition	This indicator refers to the area under which modern irrigation, erosion control, agroforestry trees, inorganic and organic fertilizers are used.
Variables required	Plot Area, irrigation techniques, erosion control, agroforestry trees, inorganic and organic fertilizers
Method of Computation	**Area under modern irrigation** is the sum of irrigated area using modern techniques (Flood irrigation, Drip irrigation, Sprinkler irrigation, and Pivot irrigation) **Area under erosion control** is the sum of area with erosion control practices. **Area under agroforestry trees** is the total number of hectares of land covered with agroforestry trees. **Area under organic fertilizers:** the total number of hectares of land in which organic fertilizers were applied **Area under inorganic fertilizers** is equal to the sum of area in which inorganic fertilizers were applied
Unit of Measurement	Hectares
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 District
Interpretation	The interpretation of these indicators is straight forward. These indicators simply represent the estimated size or area of land where specific agricultural practices were applied.
Uses	Data on area under agricultural practices are used for promoting sustainable practices, improving land management, informing policy decisions, and driving research and development in the agricultural sector. The data can contribute to a future of food security and environmental well-being.

Cultivated crop area (Area sown)

<table>
<tr><th>Elements</th><th>Description</th></tr>
<tr><td>Definition</td><td>The cultivated crop area refers to the area occupied by a given crop in a plot considering occupation. Enumerator estimates the proportion of each crop in the plot using the eye estimation method. It excludes patches, footpaths, ditches, headlands, shoulders, shelterbelts, and other non-crop areas; this proportion is applied to the physical area of the plot to obtain the area for each specific crop planted. Crop area is therefore equal to or less than the physical plot area. The cultivated area at district level is equal to the total weighted crop areas of plots in a district.

In context of Rwanda mixed cropping system is a general practice in agriculture. This practice makes it complex to estimate areas under crop cultivation. In case of pure stands (for crop completely covering a plot), crop area is equal or less to physical plot area (if a crop is partially covering the plot, the share is estimated then applied to the plot area). In case of mixed crops, there fours scenarios proposed in FAO guidelines as described in table below. The share of each crop in the plot is estimated by enumerator by eye estimation of crop density or occupation in a plot (in %) based on spacing between plants.

Mixed cropping scenarios and method of crop apportioning:
<table>
<tr><th>Mixed scenario</th><th>Crop proportion method</th></tr>
<tr><td>Temporary and temporary crops harvested at the same time Example: maize and bean</td><td>Plant proportion</td></tr>
<tr><td>Temporary and temporary crops harvested in different seasons. Example: cassava and sweet potato</td><td>Area double counted (but remove unplanted areas)</td></tr>
<tr><td>Permanent and temporary crop Example: mango and sorghum</td><td>Area occupied by temporary crop recorded in harvested season and entire crop area possibly recorded under permanent crop</td></tr>
<tr><td>Permanent crop and permanent crop Example: mango and guava</td><td>Area is apportioned on the basis of number of plants, with adjustment of the plant population of the pure crop of the component crop</td></tr>
</table>
</td></tr>
<tr><td>Variables required</td><td>Crop grown, Crop proportion and Plot area</td></tr>
</table>

Method of Computation	The indicator is calculated into two steps: Step 1: Estimate cultivated crop area in the plot: $\boldsymbol{x_k = z_k T_k}$ Step 2: Aggregate weighted cultivated crop area at District level then at national level: $\hat{X}_T = \sum_{i=1}^{n=30} x_k \times W_{Phij}$ $\hat{X}_T = \sum_{i=1}^{n=30} x_k \times W_{Phij}$ *Where:* $\hat{X}_T$ *:* $\hat{X}_T$ *:* Total estimated crop area T_k : T_k : Area of the plot k (sampled through a point) z_k : z_k : Proportion of the current crop visually estimated in the plot k. x_k : x_k : Estimated crop area in the plot k W_{Phij}=W_{Phij}=weight for the j-th sample plot in the *i-th* sample segment in stratum h
Unit of Measurement	Hectares
Data Sources	Seasonal Agricultural Survey The survey data are supplemented by tea and coffee data from National Agricultural Export Development Board (NAEB) collected through the routine activities of monitoring coffee and tea production.
Disaggregation Crops Geographical Farm category	 Crop group/type District Large/small scale farmer
Interpretation	Cultivated area by crop data tells us how much land is used to grow specific types of crops, such as wheat, rice, corn, or soybeans. It helps to understand which crops are being grown in a particular district and how much land is dedicated to each crop.
Uses	This indicator is important for farmers, policymakers, and researchers to plan agricultural activities, assess crop production, and understand food supply and demand.

Harvested crop area

Elements	Description
Definition	It refers to the total area of cultivated land that are harvested during a specific agricultural season. For seasonal crops, the harvested area is assumed to be equal to the cultivated area. However, for perennial crops such as bananas or cassava, where harvesting occurs continuously across multiple seasons, the harvested area is calculated by multiplying the cultivated area by the proportion of the crop area harvested in the current season.
Variables required	Crop grown, Plot area, crop proportion, number of planted plants and harvested plants, and harvesting period.
Method of Computation	Formula: Estimated harvested crop area = ($\hat{X}_{cd}$ × Average harvested ratio)/100 Where: $\hat{X}_{cd}$: Estimated cultivated crop area for a crop c for a district d The harvested ratio is the area of crop that is harvested which is harvested for a particular agricultural season over the total cropped land. It is calculated as follows: • For seasonal crops are types of crops that have a short maturation period and typically do not have a harvesting cycle that extends across different agricultural seasons (e.g., Irish potatoes, beans). The harvesting ratio for these crops is assumed to be equal to the cultivated area. • Perennial crops are types of crops whose harvesting cycles span more than two agricultural seasons. For these crops, sometimes only a part of the land may be harvested due to various economic or other reasons. To account for the non-harvested areas, the harvesting rate is calculated and applied to the total cropped land. The harvesting ratio is calculated as the ratio of harvested areas to the total cropped area, or the number of harvested plants divided by the total number of cultivated plants.
Unit of Measurement	Hectare
Data Sources	Seasonal Agricultural Survey
Disaggregation Crop	Crop group/type

Geographical Farmer type	District Small/Large scale farmer
Interpretation	The data on harvested area by crop provides information about the land where crops have been cultivated and successfully harvested. This data offers insights into the types of crops grown in a particular area and the quantity of each crop produced.
Uses	Harvested area data are important for farmers, policymakers, and researchers to understand crop production trends, plan future planting decisions and assess agricultural productivity.

3.2. Production Indicators

Average crop yield of major crop

Elements	Description
Definition	It refers to the average amount of produce harvested per unit of land for different types of crops.
Variables required	Crop production, Harvested area
Method of Computation	The indicator can be estimated at different levels: Yield estimation at the plot level: $y_k = \frac{p_k}{a_k} = \frac{p_k}{T_k z_k}$ The average crop yield at district level: $\hat{y}_c = \frac{1}{n_j} \sum_{i=1}^{n} \frac{p_k}{a_k} \times W_{Phij}$ *where:* $\hat{y}_c$: Estimate of the weighted average crop yield for a particular district y_k : Crop yield at plot level a_k : Estimate harvested area for a given crop in particular plot k p_k : The reported production of a given crop in plot k (Farmer estimate) n_j : Number of sampled plots that has the crop of interest in the district W_{Phij}=weight for the j-th sample plot in the *i-th* sample segment in stratum h
Unit of Measurement	Kilograms/Hectare (kg/ha)
Data Sources	Seasonal Agricultural Survey
Disaggregation Geographical Crops Farmer type	 District Crop group/Crop type Large/Small scale farmer
Interpretation	Average crop yield indicates the productivity of a given crop in the district for a particular season.
Uses	Data on average crop yield is crucial for farmers to make decisions about which crops to grow, for policymakers to assess food security and agricultural productivity, and for researchers to study agricultural trends and develop strategies to improve crop yields.

Crop production

Elements	Description
Definition	Volume of agricultural crop production harvested in a specific agricultural season (Season A, B, or C for the case of Rwanda) in the district then aggregated at national level.
indicators required	Average crop yield and harvested crop area at district level.
Method of Computation	This indicator is calculated by calculating the average crop yield in that district and then multiply it to the crop area. This average yield is estimated using sample data from farmers' reports on their current crops in selected plots. Then, the average yield is multiplied by the estimated harvested crop area in the district to get the total crop production at district level. The crop production in different districts is aggregated to get national level estimate. Formula: $\widehat{\boldsymbol{P}}_{\boldsymbol{c}} = \widehat{\boldsymbol{y}}_{\boldsymbol{c}} \times \widehat{\boldsymbol{A}}_{\boldsymbol{c}}$ *where:* $\hat{P}_c$ =Weighted estimate of total production of crop c in particular district $\hat{y}_c$ = Estimate of average yield per hectare for crop c in particular district $\hat{A}_c$ =Weighted estimate of total area harvested for crop c in particular district
Unit of Measurement	Metric Tons
Data Sources	Seasonal Agricultural Survey:
Disaggregation Crop type Geographical Farmer type	 Crop group/ crop type. District Small/Large scale farmer
Interpretation	Crop production shows the quantity of each crop that has been produced. This is an estimate production that can be available at the market or for consumption
Uses	Crop production indicator can serve several purposes including assessing agricultural productivity, planning food supply, and understanding market trends. By tracking production trends over time, policymakers can identify potential food shortages and take proactive measures to mitigate them, such as increasing imports or promoting alternative crops.

Use of crop production

Elements	Description
Definition	Use of crop production indicator refers to the utilization of the harvested produce as reported by farmers.
Variables required	Total quantity transformed, Total quantity sold, Total quantity auto consumed, Total quantity paid as wage, Total quantity used as rent, Total quantity offered, Total quantity used as fodder, Total quantity used as exchange, Total quantity used as seed, Total quantity stored, Total quantity losses, Total quantity used for other purpose
Method of Computation	The use of production is calculated as the ratio of production usage over the total crop production. The uses take different forms based on choice of the farmers, such as household consumption, selling, storage of seeds for another season, etc. **Formula:** $\frac{1}{n}\sum_{k=0}^{n}\frac{P_u}{P_t}\times 100$ Where: P_u: Qty of crop produced used in different ways (sold, auto-consumption, wage, rent, given-out, fodder, seeds, exchanged for other goods, stored, etc...) P_t: Total quantity of crop production of the farmer for a crop c **Total Crop Production**: The total crop production can be calculated as the sum of all crop production utilization
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Crop	 Major crop name
Interpretation	The data on the use of crop production shows how the harvested crops produce have been used. It provides information on quantity used by household as household consumption, quantity sold, quantity used as wage, quantity offered, quantity used for exchange, used as fodder, quantity transformed, quantity lost, or quantity used for other purposes
Uses	This data helps understand the various ways in which crops contribute to human nutrition, animal feed, industry, and other sectors of the economy.

3.3. Agricultural inputs indicators

Percentage of farmers using improved seeds

Elements	Description
Definition	This indicator refers to the proportion of farmers who used improved seeds over the total number of farmers in sampled segments.
Variables required	Crop grown, type of seeds
Method of Computation	Formula: **% of farmers using improved seeds= (N_f / T_f) ×100** Where: N_f is the number of farmers using improved seeds. T_f is the total number of farmers.
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographic Farmer types Crop type	 Districts Large-Scale Farmers /Small-Scale Farmers Major crops
Interpretation	The "use of improved seeds" indicator is interpreted as the adoption of improved seeds among different farmer categories (small-scale and large-scale farmers) and districts.
Uses	Use of improved seeds data helps different users to assess the impact of improved seed adoption on agricultural productivity, food security, and livelihoods. The indicator can guide interventions and services to increase the use of improved seeds among diverse farmer groups.

Percentage of farmers by source of improved seeds

Elements	Description
Definition	This indicator refers to the proportion of farmers who obtained improved seeds from a specific source over the total number of farmers who used improved seeds.
Variables required	Crop grown, Type of seeds and Sources of improved seeds
Method of Computation	Formula: **% of farmers by source of improved seed= (**Nf_s **/** Tf_s**) ×100** Nf_s: Number of farmers obtaining improved seeds from source S Tf_s: Total number of farmers who used improved seeds
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Crop type	 Districts Major crops
Interpretation	This indicator shows where farmers get their improved seeds from, such as government agencies, recognized seed multipliers, Agro-dealers, NGOs, markets, agricultural cooperative, and other sources.
Uses	The data are used to rate the channels through which improved seeds are distributed to farmers and how different sources contribute to seed availability. It also provides clarification into the effectiveness of seed dissemination programs, the role of public and private sectors in seed supply, and the preferences of farmers in accessing quality seeds.

Percentage of improved seeds by source per crop

Elements	Description
Definition	This indicator refers to the ratio of plots in which improved seeds were used and from a specific source for a given crop to the total number of plots in which improved seeds were used for a given crop.
Variables required	Crop grown, Type of seeds and Sources of improved seeds.
Method of Computation	Formula: **% of improved seeds by source per crop= (Qi_s / Tq_c) ×100** Where: **Qi_s:** Number of plots using improved seeds from a specific source for a given crop **Tq_c:** Total Number of plots using improved seeds for a given crop
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Crop type Source of seeds	Major crops
Interpretation	The source of improved seed shows where farmers obtain their improved seeds for specific crops, such as government agencies, recognized seed multipliers, Agro-dealers, NGOs, markets, agricultural cooperatives, and other sources.
Uses	The source of improved seeds per crop type is used by users and researchers to identify opportunities to improve seed access, strengthen seed systems, and promote the adoption of modern agricultural technologies to enhance crop productivity and food security. It helps to assess the production through the quality of seeds used, sources of seeds, and the role of different stakeholders in providing improved seeds to farmers.

Use of organic fertilizer

Elements	Description
Definition	Indicators related to the use of organic fertilizers include: • Percentage of farmers who applied organic fertilizer, which refers to the proportion of farmers who applied organic fertilizer over total farmers in the segments. • Percentage of plots in which organic fertilizer was applied, which refers to the proportion of plots in which organic fertilizer was applied over total number of sampled plots • Percentage of land size in which organic fertilizer was applied, which is the ratio between the total area of plots in which organic fertilizer was applied and the total area of all sampled plots in the segments.
Variables required	Farmer type, use of organic fertilizers, plot area
Method of Computation	Formula: • Percentage of farmers who applied organic fertilizer= $\frac{\textbf{Total number of farmers applied organic fertilizer}}{\textbf{Total number of farmers}} \times 100$ • Percentage of plots in which organic fertilizer was applied= $\frac{\textbf{Number of Plots with Organic Fertilizer}}{\textbf{Total Number of sampled Plots}} \times 100$ • Percentage of land size in which organic fertilizer was applied= $\frac{\textbf{Total Area with Organic Fertilizer}}{\textbf{Total Area of sampled Plots}} \times 100$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Farmer type	 Districts LSF/SSF
Interpretation	This indicator shows the adoption of organic farming practices among different farmer groups and their contribution to sustainable agriculture. It also provides insights into district differences in organic fertilizer application and the effectiveness of extension services and support programs in promoting organic farming.
Uses	The data on organic fertilizer use by farmer type per district provide information on opportunities to enhance the adoption of organic farming practices, that improve soil health and promote sustainable agricultural practices.

Use of inorganic fertilizer

Elements	Description
Definition	Indicators related to the use of organic fertilizers include: • Percentage of farmers who applied inorganic fertilizer, which refers to the proportion of farmers who applied inorganic fertilizer over total number of farmers. • Percentage of plots in which inorganic fertilizer was applied, which refers to the proportion of plots in which inorganic fertilizer was applied over total number of sampled plots in the segments. • Percentage of land size in which organic fertilizers were applied, which is the ratio between the total area of plots in which inorganic fertilizer was applied and the total area of all sampled plots.
Variables required	Farmer type, use of inorganic fertilizers, plot area
Method of Computation	Formulas: • Percentage of farmers who applied inorganic fertilizers= $\frac{\textbf{Number of farmers who used inorganic fertilizers}}{\textbf{Total number of farmers}} \times 100$ • Percentage of plots in which inorganic fertilizers were applied = $\frac{\textbf{Number of Plots with Inorganic Fertilizer}}{\textbf{Total Number of sampled Plots}} \times 100$ • Percentage of land size in which inorganic fertilizers were applied = $\frac{\textbf{Total Area with Inorganic Fertilizer}}{\textbf{Total Area of sampled Plots}} \times 100$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Farmer type	 Districts Large /small Scale Farmers
Interpretation	This indicator shows the adoption of inorganic fertilizer use among farmers and their contribution to agriculture production. It also provides insights into district differences in inorganic fertilizer application as well as the effectiveness of extension services.
Uses	The data on inorganic fertilizer use by farmer type per district provides information on opportunities to enhance the adoption of inorganic fertilizer application to increase productivity.

Percentage of farmers by source of inorganic fertilizers

Elements	Description
Definition	This indicator refers to the proportion of farmers who applied inorganic fertilizers from a specific source over total number of farmers who applied inorganic fertilizers.
Variables required	Use of inorganic fertilizers, Source of inorganic fertilizer
Method of Computation	Formula: **% of farmers by source of inorganic fertilizers= (**FI_s **/** TF_I**) ×100** FI_S: Number of farmers who applied inorganic fertilizer from source S TF_I: Total number of farmers who applied inorganic fertilizers
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Sources of inorganic fertilizers	 Districts Agro dealers, Government, ….
Interpretation	This indicator shows main channels through which farmers access inorganic fertilizers such as government agencies, Agro-dealers, NGOs, agricultural cooperatives, or local markets and other sources, and the distribution patterns across different districts.
Uses	The data on sources of inorganic fertilizers are used by various stakeholders for different purposes: • **Policymakers** use the data to understand fertilizer distribution and availability, guiding policies on subsidies, distribution networks, and agricultural productivity programs. • **Agribusinesses** analyze the data to understand market trends and demand patterns, informing strategic planning, marketing, and resource allocation. • **Extension services** utilize the data to tailor outreach programs that promote efficient and sustainable fertilizer use across districts. • **Environmental agencies** assess the data to evaluate potential environmental impacts and develop strategies to mitigate risks.

Percentage of inorganic fertilizer used by type and by source

Elements	Description
Definition	This indicator represents the ratio of plots using inorganic fertilizers from a specific source for a given type of inorganic fertilizer to the total number of plots using inorganic fertilizers for a given type of inorganic fertilizer.
Variables required	Sources of inorganic fertilizers, types of inorganic fertilizers
Method of Computation	Formula: **% of inorganic fertilizer by source per crop= (Qf_s / Tf_c) ×100** Where: **Qf_s**: Number of plots using inorganic fertilizer from a specific source for a given type of inorganic fertilizer **Tf_c**: Number of plots using inorganic fertilizers for a given type of inorganic fertilizer
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Fertilizer type Sources of fertilizer	 NPK, Urea, DAP, … Agro dealers, Government, ….
Interpretation	The source of inorganic fertilizer indicator shows the origin and distribution channels of various types of inorganic fertilizers. It indicates whether these fertilizers are sourced from government agencies, private suppliers, agricultural cooperatives, or other sources. By analyzing this data, we can understand which types of inorganic fertilizers are predominantly sourced from specific channels and how the distribution varies across different suppliers or sources.
Uses	The data on source of inorganic fertilizer by type allows for the analysis of market trends and demand for various inorganic fertilizers. Understanding distribution channels helps in strategic planning, marketing, and inventory management for agribusinesses and fertilizer manufacturers. It can also help to formulate fertilizer policies like subsidies, pricing, and distribution networks using this data. And use to assess environmental impacts of different inorganic fertilizer types.

Percentage of plots by type of inorganic fertilizer

Elements	Description
Definition	This indicator refers to proportion of plots in which specific inorganic fertilizer was applied to the total number of plots in which inorganic fertilizers were applied.
Variables required	Type of inorganic fertilizers, use of inorganic fertilizers
Method of Computation	Formula: **% of plots by type of inorganic fertilizer = (Nf_s/ Tf) ×100** Where: **Nf_s**: Number of plots in which specific inorganic fertilizer was applied **Tf**: Total number of plots in which inorganic fertilizers were applied
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Types of fertilizer	 Districts NPK, Urea, DAP, …
Interpretation	This indicator indicates the prevalence of different types of inorganic fertilizers across different districts. It helps to understand which types of inorganic fertilizers are commonly used in agricultural production and how their application varies.
Uses	The data are used to plan for fertilizer application strategies effectively, and to assess the effectiveness of different types of inorganic fertilizers in enhancing crop growth, yield, and quality.

Use of Pesticides

Elements	Description
Definition	Indicators related to the use of pesticides include: • Percentage of farmers who applied pesticides, which refers to the proportion of farmers who applied pesticides over total number of farmers. • Percentage of plots in which pesticides were applied, which refers to the proportion of plots in which pesticides were applied over total number of sampled plots. • Percentage of land size in which pesticides were applied, which is the ratio between the total area of plots in which pesticides were applied and the total area of all sampled plots.
Variables required	Farmer type, Use of pesticides, plot area
Method of Computation	Formulas: • Percentage of farmers who applied pesticides = $\frac{\textbf{Number of farmers who used pesticides}}{\textbf{Total number of farmers}} \times 100$ • Percentage of plots in which pesticides were applied = $\frac{\textbf{Number of Plots with pesticides}}{\textbf{Total Number of sampled Plots}} \times 100$ • Percentage of land size in which pesticides were applied = $\frac{\textbf{Total Area with pesticides}}{\textbf{Total Area of sampled Plots}} \times 100$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Farmer type	 Districts Large/ small Scale Farmer
Interpretation	This indicator shows the adoption of pesticides application among farmers and their contribution to agriculture production. It also provides insights into district differences in pesticides application as well as the effectiveness of extension services.
Uses	The data on pesticides used by farmer type per district provides information on how to enhance the adoption of pesticides application to increase productivity. It facilitates the development of policies that ensure safe and responsible pesticide application.

Percentage of plots by type of pesticide

Elements	Description
Definition	This indicator refers to the proportion of plots in which specific pesticide was applied over total number of plots in which pesticides were applied.
Variables required	Type of pesticides, use of pesticides
Method of Computation	Formula: **% of plots by type of pesticide = (Np_s / Tp) ×100** Where: **Np_s**: Number of plots in which specific pesticide was applied **Tp**: Total number of plots in which pesticides were applied
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Type of pesticides	 Districts Dithane, Rocket, Cypermetrin, ….
Interpretation	This indicator indicates the prevalence of different types of pesticides across different district. It helps to understand which types of pesticides are commonly used in agricultural production and how their application varies.
Uses	The data are used to plan for pesticides application strategies effectively, and to assess the effectiveness of different types of pesticides in enhancing crop growth, yield, and quality. Researchers utilize this data to evaluate pest management strategies and explore sustainable alternatives to chemical pesticides, promoting environmentally friendly agricultural practices.

3.4. Agricultural Practices indicators

Sowing dates by district

Elements	Description
Definition	This indicator refers to the percentage of crops planted within a specific time frame during a particular agricultural season relative to the total crops grown in the same season. The sowing dates are grouped into a two-week range as (1st to 15th day and from 16th to 30th).
Variables required	Sowing date, crop grown
Method of Computation	Formula: $\frac{\text{Number of crops planted in time } t_i}{\text{Number of all sampled plots in a district d}} \times 100$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Crop type	 District Major crops
Interpretation	Sowing dates describes the percentage of crop planted in a specific period
Uses	Sowing dates helps to understand the patterns of planting period for different crops. The sowing period can be correlated to the geographic location and rainfall availability for a particular agriculture season. sowing dates can vary from one district to another due to differences in local climate, soil types, and agricultural practices.

Percentage of Cultivated area by cropping system

Elements	Description
Definition	This indicator refers to the cultivated area under pure or mixed cropping system over the total cropped land. Pure cropping or monocropping, refers to when a single crop is grown in a plot, while mixed cropping involves growing more than one crop in the same field with the same farming practices (e.g., application of fertilizers, irrigation).
Variables required	cropping system, plot area and crop proportion
Method of Computation	The indicator is computed by taking area cultivated under pure of mixed system over total area. **Formula:** $\frac{Total\ cultivated\ area\ under\ pure\ or\ mixed\ cropping}{Total\ physical\ croped\ land} \times 100$ The cultivated area is equal to sum of weighted plot area of cultivated plots.
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Cropping system	 District Pure/Mixed
Interpretation	This indicator indicates at what extent the farming system in Rwanda is mono-cropped and/or mixed.
Uses	The indicator can be used to understand the effect of cropping system on crop productivity as well as to describe how farming practices differ from district to district.

Percentage of farmers who protected against erosion/ who used mechanical equipment/ who practiced irrigation/who practiced agroforestry

Elements	Description
Definition	Indicators related to the application of agricultural practices include: • Percentage of farmers who protected land against erosion, refers to the proportion of farmers who protected their land against erosion over the total number of farmers • The percentage of farmers who used any mechanical equipment in agriculture activities, refers to the proportion of farmers who used mechanical equipment in their farming activities over the total number of farmers. • The percentage of farmers who practiced irrigation refers to the proportion of farmers who practiced irrigation over the total number of farmers. • Percentage of farmers who practiced agroforestry, refers to the proportion of farmers who practiced agroforestry over the total number of farmers.
Variables required	Anti-erosion activities, use of mechanical equipment's, irrigation practice, and agroforestry practices
Method of Computation	These indictors can be computed as follows: • Percentage of farmers who protected land against erosion = $\frac{\textbf{Number of farmers who protected land against erosion}}{\textbf{Total number of farmers}} \times 100$ • Percentage of farmers who used mechanical equipment's = $\frac{\textbf{Number offarmers who used mechanical equipment's}}{\textbf{Total number of farmers}} \times 100$ • Percentage of farmers who practiced irrigation = $\frac{\textit{Number of}\ \textbf{farmers who practiced irrigation}}{\textbf{Total number of farmers}} \times 100$ • Percentage of farmers who practiced agroforestry = $\frac{\textit{Number of}\ \textbf{farmers who practiced agroforestry}}{\textbf{Total number of farmers}} \times 100$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 Districts

Farmer type	LSF/SSF
Interpretation	These indicators provide insights into which good farming practices are employed by different categories of farmers in different districts. It indicates the level of application of specific practices, such as erosion control, mechanical equipment's, irrigation practices and agroforestry practices among various farmers.
Uses	The data can be used to track trends in agricultural practices among different farmer types, including the adoption of modern methods, and assesses their impact on common risks like soil erosion and water pollution. In addition, it evaluates the effectiveness of these practices in enhancing crop productivity, conserving natural resources, and building resilience to climate change, informing evidence-based recommendations for sustainable agriculture.

Percentage of plots by type of irrigation used

Elements	Description
Definition	This indicator represents the ratio of plots in which specific irrigation technique was applied to the total number of plots in which irrigation were applied.
Variables required	Irrigation techniques, irrigated plots
Method of Computation	Formula: % of plots by type of irrigation used = $\frac{\textbf{Number of plots with specific irrigation technique}}{\textbf{Total number of plots in which irrigation were applied}} \times 100$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Irrigation techniques	 Districts Modern and Traditional techniques
Interpretation	This indicator shows which irrigation techniques are being utilized in different districts.
Uses	Policymakers and agricultural organizations use irrigation data to plan irrigation infrastructure and water management strategies for sustainable agriculture. Environmental agencies use the data to monitor water usage patterns and assess the impact of irrigation practices on local water

	resources. Researchers use data to analyze the efficiency and effectiveness of different irrigation techniques in water conservation, crop yield improvement, and environmental sustainability.

Percentage of plots by source of water used for irrigation

Elements	Description
Definition	This indicator represents the ratio of plots in which specific source of water was used for irrigation to the total number of plots in which irrigation were applied.
Variables required	Source of water, irrigated plots
Method of Computation	Formula: % of plots by source of water used for irrigation = $\frac{\textbf{Number of plots with specific source of water}}{\textbf{Total number of plots in which irrigation were applied}} \times \mathbf{100}$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Water sources	 Districts Lake / streams, underground, Rainwater, ….
Interpretation	This indicator indicates the reliance on different water sources and the availability of irrigation water in different districts.
Uses	Data on the sources of water used for irrigation per district can serve various purposes: Policymakers and agricultural organizations rely on this data to evaluate the availability and sustainability of water resources for irrigation across different districts. It is also used to monitor water resource utilization for irrigation and assess potential impacts on water availability, quality, and ecosystems within each district.

Percentage of plots by type of anti-erosion activities

Elements	Description
Definition	This indicator represents the ratio of plots in which specific anti-erosion activity was applied for irrigation to the total number of plots in which anti-erosion activities were applied.
Variables required	Types of anti-erosion activities, plots with anti-erosion activities
Method of Computation	Formula: % of plots by type of anti-erosion activities = $\frac{\textbf{Number of Plots with Specific Anti erosion activity}}{\textbf{Total Number of Plots with Anti erosion Activities}} \times 100$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical Types of anti-erosion Activities	 Districts Progressive/Bench terraces, Cover plants, water drainage, ……
Interpretation	This indicator shows the extent at which different Anti-erosion activities are being applied in different district, these activities include progressive/bench terraces, cover plants, and water drainage.
Uses	Data on anti-erosion activities per district serves multiple purposes: identifying regions with robust or lacking soil conservation efforts, guiding policy development and infrastructure planning for sustainable land management, selecting suitable techniques to safeguard soil integrity and agricultural productivity, monitoring implementation and assessing impacts on soil health and biodiversity, and enabling research on the effectiveness and long-term impact of erosion control strategies tailored to specific conditions, thus contributing to soil conservation and environmental sustainability efforts

Percentage of plots by degree of erosion

Elements	Description
Definition	This indicator represents the ratio of plots with specific degree of erosion to the total number of plots with erosion. Degree of erosion refers to the level at which the soil is eroded (Low, Moderate or severe). Severe erosion signifies urgent land degradation requiring immediate intervention, moderate erosion denotes noticeable soil loss requiring management to prevent worsening, low erosion indicates soil displacement necessitating measures to prevent long-term degradation, and very low erosion or splash refers to initial soil disturbance manageable with monitoring to prevent escalation
Variables required	Degree of erosion, plots with erosion
Method of Computation	Formula: % of plots by degree of erosion = $\frac{\textbf{Number of Plots with Specific degree of erosion}}{\textbf{Total Number of Plots with erosion}} \times 100$
Unit of Measurement	Percentage
Data Sources	Seasonal Agricultural Survey
Disaggregation: Geographical	 Districts
Interpretation	This indicator shows the levels of erosion at which the soil is exposed in different districts, ranging from low to severe.
Uses	Data on plots by degree of erosion per District helps to understand the degree of erosion on individual plots within each district which is essential for effective land management, environmental conservation, and natural hazard mitigation efforts. These data provide valuable information for policymakers, land managers, and researchers to assess the impact of erosion, prioritize resource allocation, and implement targeted interventions aimed at reducing erosion risk and promoting sustainable land use practices.

4. References

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ANNEXES

Annex1: Phase 1 Screening Questionnaire

1. General information of the segment/Large Scale Farmer.
   - 1.1. Province: the province where the segment is located
   - 1.2. District: the district where the segment is located.
   - 1.3. Stratum: the stratum where the segment or LSF is classified in
   - 1.4. Segment/LSF ID: The ID of the segment or LSF you are screening in the current agricultural season.
   - 1.5. LSF Names: the name of the farmer
   - 1.6. LSF farm address
     - 1.6.1. Sector: the Sector in which the farm is located
     - 1.6.2. Cell: the Cell in which the farm is located
     - 1.6.3. Village: the village in which the farm is located
   - 1.7. LSF phone number
   - 1.8. Farm manager name
   - 1.9. Farm Manager Contact
   - 1.10. LSF Category: Either individual; or Cooperative / Company / Association
   - 1.11. Enumerator name and code
   - 1.12. Team leader name and code
   - 1.13. Number of grids sampled in the segment: the number of the sampled grids in the segment under the current screening.

2. Plot information.
   - 2.1. Plot number: the plot number is based on the given numbering to respect order and keep the plot-related information.
   - 2.2. Large Scale Farmer / LSF Bloc number: for the plot under screening in the farm of LSF
   - 2.3. Number of grid points that fall in the plot
   - 2.4. Which grids fall in the plot: Specify the grids falling in the plot you are screening by writing their code/numbering one by one
   - 2.5. Plot size in square meter: As the plot size is measured using GPS, the data collection application shows the plot size automatically on the screen of the tablet in the space reserved for that purpose
   - 2.6. Plot Operator's address: the full address of the farmer/operator by specifying his / her names, ID, location (Sector, Cell, Village, and the contact/telephone number)
   - 2.7. Plot land use: the land use can be Agricultural land; Pasture land; Fallow land, Non-agricultural land
   - 2.8. Non-agricultural land type for a plot: can be; Pasture land; Fallow land
   - 2.9. Anti-erosion activity on the plot: Yes or Non
   - 2.10. Types of anti-erosion activities existing on the plot: List of 3 main activities includes Ditches; Water drainage, Trees / Windbreak / Shelterbelt; Mulching, Bench terraces; Beds / Ridges, Progressive terraces; Water channel; Cover plants / Grasses; Other(specify)
   - 2.11. Is there any agroforestry practice on the plot: Yes or No
   - 2.12. Types of agroforestry trees planted in the plot: list includes Calliandra, Leucaena, Sesbania, Acacia, Erythrina, Casuarina, Maesopsis, Alnus acuminata, Grevillea,

Fruit trees, Markhamia lutea, Tephrosia Vogelii hhk, Velnonia Amygdalina del, Ricinus communis, Other (specify)

2.13. Type of fruit tree in the plot: Yes, or Non

2.14. Type of fruits planted in the plot: this includes Tree tomato, Avocado, Palm, Mango, Apple, Papaya, Orange, Lemon, Guava, Olive, Mandaline, Jack fruits, Sugar apple / Coeur de boeuf/Annona squamosa, other fruit tree (specify)

2.15. For each type of fruit tree planted in the plot, specify the number of trees existing in the plot.

2.16. For each type of fruit tree planted in the plot: How many fruit trees will be harvested during the concerned agricultural season

2.17. Is this plot located in land consolidation site: Yes, or non (NB: This question is only for the plot with the agricultural land only)

2.18. Cropping system:

2.18.1. Pure cropping / Monoculture: One crop or variety is grown alone in pure stands in the same field.

2.18.2. Inter-cropping: It is the practice of growing two or more crops in proximity/in the same field.

2.18.3. Traditional mixed cropping: Cropping system that includes traditional knowledge, especially with over mixing crops in the same field/plot.

NB: This question is only for the plot with agricultural or pastureland use

2.19. Number of main crops in the plot: NB: The maximum allowed is 5 crops in the same plot, only consider crops occupying at least 10% of total plot area.

3. Main crops grown in the plot

3.1. **Crop name**: Enumerators are tasked to identify the crop grown in the plot for the ongoing agricultural season focusing on those occupying at least 10% of the plot area. The crops eligible for surveying include both seasonal/annual crops with a theoretical growth period corresponding to the ongoing season, and perennial crops in the plot but not surveyed in the previous season.

The real time of ploughing varies among farmers due to factors related to input availability, individual plans based on rainfall, and crop categories. Before recording crops during the screening phase, enumerators consider three aspects: Firstly, they assess current crops in the plot, their planting and harvest times, as well as the land use history and plans. Secondly, they note previous crops harvested and their respective harvest times. Lastly, they inquire about upcoming crops and their planned planting times. These questions facilitate the identification of crops for surveying without confusion.

3.2. **Crop proportion in %:** The crop occupation in the plot compared to the total plot area should vary depending on different factors like germination rate etc. This area occupied by the crop refers to the crop proportion vis a vis the total plot area and it is evaluated in percentage for the purpose of the survey.

3.3. **Crop density in %:** The crop density is defined as the number of plants per unit area in the cropped field and it is relative to the crop spacing between rows and plants and the more the space between rows and plants is small, the more the crop density is high, and this has impact on crop produce. The crop density is expressed in percentage (%) based on the crops spacing as mentioned above.

3.4. **Types of Bananas planted**: For cooking banana, dessert banana, and banana for beer together with the farmer, enumerators should specify the number of banana plants individually counting them and utilizing estimation techniques based on spacing intervals. This total count encompasses both the plants currently present in the plot and those harvested during the current agricultural season. By meticulously tallying the banana plants and considering seasonal variations, the survey ensures accurate data collection regarding banana cultivation across different varieties, aiding in agricultural analysis and planning.

3.5. To specify if the crop was planted in the current agricultural season: Yes or Non

3.6. To specify if the crop is planned to be harvested in the current season: Yes or Non

3.7. To specify the expected period for harvesting this crop: in ranges

3.8. Date of interview for the plot: automatically indicated by the data collection application.

Annex 2: Crop names and classification

SEASONAL CROPS:

101*- Maize,* ***102-*** *Paddy rice,* ***103-*** *Sorghum,* ***104-*** *Wheat,* ***105-*** *Other cereal(specify),* ***106-*** *Bush bean,****107-*** *Climbing bean,* ***108-*** *Pea,* ***109-*** *Other pulse,* ***110-*** *Irish potato,* ***111-*** *Sweet potato,****112-****Taro,****113-****Yams,* ***114-****Other tubers,****115-*** *Tomato,* ***116-****Cabbage,* ***117-****Cauliflower,* ***118-*** *Onion,* ***119-*** *Carrot,* ***120-****Eggplant,* ***121-****Other seasonal vegetables(specify),* ***122-*** *Soybean,* ***123-*** *Groundnut,* ***124-*** *Sun flower,* ***125-*** *Black eggplant****, 126-****Sweet pepper,****127****-Amaranth,****128****-Celery* ***,129-*** *Spinach,* ***130-*** *Small red bean,* ***131-*** *Sugar beet,* ***132-*** *Garlic****, 133-*** *African cabbage,* ***134-*** *Leek,* ***135-****French beans,* ***136-*** *Lettuce,* ***137-*** *Broccoli,* ***138-*** *Millet,* ***139-*** *Cucumber,* ***140****-Chia seeds,****141-****Other seasonal crops(specify)*

ANNUAL CROPS:

201- Pyrethrum ,202-Pepper,203-Pumpkin,204-Napia grass,205-Sugar cane, 206-Tobacco, 207-Other annual crops(specify),

PERENNIAL CROPS:

300-Banana,301- Cooking banana, 302- Dessert banana, 303-Banana for beer, 304-Coffee,305-Cassava,306-Mulberry, 307-Jatropha,308-Stevia,309-Macadamia,310-Tea, 311-Other perennial crop (Specify).

FRUITS TREES:

401-Tree tomato, 402-Pineapple, *403-Avocado,* 404-Passion fruits *,405-Palm,406- Mango, 407- Apple, 408- Papaya, 409- Orange, 410- Lemon, 411- Guava, 412-Oliver,* 413-Water melon *,414-Mandaline, 415-Jack fruits,* 416-Gooseberry, 417-Strawberry *,418-Sugar apple/Coeur de boeuf/Annona squamosa, 419- Other fruits(specify).*

FODDER CROPS:

501-Napia grass for fodder, 502-Maize for fodder, 503- Soybean for fodder, 504-Leucena, 505-Desmodium, 506-Mucuna, 507-Setaria, 508-Tripsacum, 509-Herbaceous 510- Other fodder crop (specify)

Annex2 : Phase II Plot questionnaire

1. General information
   1.1. Province: the province where the segment is located
   1.2. District: the district where the segment is located.
   1.3. Stratum: the stratum where the segment or LSF is classified in
   1.4. Segment/LSF ID: The ID of the segment or LSF you are screening in the current agricultural season.
   1.5. Farmer's names / LSF:
   1.6. Farmer ID
   1.7. Farmer/LSF type: Can be - small scale farmer as individual; - Small Scale farmer as Cooperative/Company/Association, - Large scale farmer as individual, -Large scale farmer as Cooperative/Company/Association
   1.8. Farmer/LSF's Gender indicating that he/she is male or female.
   1.9. Farmer's Age:
   1.10. Farmer's address: The full address for the farmer is necessary during data collection.
      1.10.1. Sector
      1.10.2. Cell
      1.10.3. Village
   1.11. Farmer's phone Number
   1.12. Names of respondent
   1.13. Respondent's phone Number
   1.14. Relationship of respondent to the farmer: can be Spouse; Adopted child, Child; Relative; Parent; housekeeper; Manager; Other
   1.15. Enumerator's names and ID:
   1.16. District Team leader's names and ID

2. Crops grown, seeds, production, use of production, production losses: This section mainly provides details on surveyed plots covering the crops grown, the seeds used and related production as well as its use.
   2.1. **Crops**
      2.1.1. Plot Number: the number is based on the given numbering to respect order and keep the plot related information.
      2.1.2. Plot area (m2): As the plot size is measured using GPS, the data collection application shows the plot size automatically on the screen of the tablet in the space reserved for that purpose.
      2.1.3. Number of main crops in the plot: Specify the number of main crops grown in the plot with reference to the list of all crops as given in the tablet. (NB: the maximum allowed is 5 crops in the same plot, only consider crops occupying at least 10% of total plot area.)
      2.1.4. Crop name.
      2.1.5. Number of plants in the plot [For perennial crops only]

2.1.6. Number of plants to be harvested in the agricultural season [For perennial crops only]

2.2. **Seeds**

2.2.1. Sowing date
2.2.2. Expected period for crop harvesting.
2.2.3. Did you use improved seed for this crop in any of your plots in this season? Yes, or Non (NB: Plots outside the segment are also included for this question)
2.2.4. Source of improved seeds: (N.B: Plots outside segment included) the source can be - Government (MINAGRI/RAB/NAEB); - Agro-dealers; -NGOs; - Market; - Other (specify)
2.2.5. Type of seeds sown in the plot: Can be - Traditional seeds - Improved seeds – Mixture of traditional and improved seeds.
2.2.6. Is the seed sown in this plot for the current season? Yes, or Non (to clarify if really the crop is planted during the theoretical period of sowing for the current agricultural season)
2.2.7. Use of traditional and improved seeds: (to provide information on the type seeds used while planting)
2.2.8. Quantity of traditional seeds sown in this plot: (to measure the quantity in kgs of traditional seeds used)
2.2.9. Quantity of traditional seeds purchased and sown in the plot: (the quantity purchased and sown and it is estimated in kg)
2.2.10. Amount spent for the purchase of traditional seeds for this plot (in Rwf)
2.2.11. Quantity of improved seeds sown in the plot: (to measure the quantity in kgs of improved seeds used)
2.2.12. Quantity of improved seeds purchased and sown in this plot
2.2.13. Amount spent for the purchase of improved seeds sown in the plot (in Rwf)

2.3. **Crop harvest**.

2.3.1. Quantity already harvested during the theoretical period of the current agricultural season (Estimated post-harvest losses included)
2.3.2. Remaining quantity to be harvested (estimated post-harvest losses included)
2.3.3. Total quantity of harvest for this season (in Kg)
2.3.4. Total quantity of harvest for the crop during the current season (Kg) NB: Even plots outside the segment are now included.
2.3.5. Could you compare the production of the surveyed crop during the current agricultural season and its production in the same last agricultural season? To compare the crop harvest in terms of quantity per unit area for 2 different agricultural seasons, the corresponding proposed codes are as follows: 1= Highly increased; 2= Increased; 3= No change; 4= Decreased; 5= Highly decreased; 6= First time to grow the crop

2.3.6. Explanation on crop production status: Crop production may increase or decrease due to various reasons: *1-Drought; 2- Heavy rainfall/Hailstones; 3-Insufficient rainfall; 4-insuffiicient/Lack of fertilizers; 5-Late sowing; 6- Flood; 7-Landslide; 8-Crop destroyed by animals (grazes); 9-Diseases and pests;10-Unfertile soil; 11- Inappropriate seeds; 12=Biennial effect (for coffee);13-Lack of improved seeds; 13-lack of improved seed; 14-Strong winds ;15-Perennial crops not yet mature ;16-Appropriate use of fertilizers; 17-Good quality of seeds; 18-Appropriate agricultural practices; 19-Good harvest as it was expected; 20-Other reason (Specify)*

2.4. **Use of crop production for the current agricultural season**

2.4.1. On the total production of the concerned crop, what was the quantity transformed/to be transformed at farm level? (in Kg): Transformed & used as food, drinks, or other ways.

2.4.2. On the total production of the crop, what is the quantity that has been sold/to be sold? (Kg)

2.4.3. On which market this crop harvest was sold? (1-Farm/Home; 2-Market; 3-Cooperative/company/Association; 4-Another selling place)

2.4.4. What was the selling price per kilogram? (Rwf/Kg) (In case the farmer has sold at more than one place, on different unit price, just record the most recent selling price)

2.4.5. On the total production of the crop, what is the quantity that has been used/ to be used as auto consumption? (in Kg)

2.4.6. On the total production of the crop, what is the quantity that has been used/to be used as wage for hired labour? (in Kg)

2.4.7. On the total production of the concerned crop which quantity has been used /to be used as farm rent? (in Kg): The production to be recorded on this question is that production used or planned to be used as farm rent instead of money.

2.4.8. On the total production, what is the quantity that has been offered/to be offered as a gift? (in Kg) This may include production used for usual gift, church purpose, etc.

2.4.9. On the total production of the crop, what is the quantity that has been exchanged/ to be exchanged with other things? (in Kg) includes the production exchanged or planned to be exchanged to get other things.

2.4.10. On the total production, what is the quantity that has been used/to be used as seeds? (in Kg)

2.4.11. On the total production, what is the quantity that has been used/to be used as fodder? (in Kg)

2.4.12. On the total production, what is the quantity that has been stored/to be stored (in Kg)

2.4.13. What is the storage facility used by farmers during the current agricultural season? The type of storage facilities commonly known:1-Own storage; 2-

Public storage; 3- Storage owned by Cooperatives or private companies 4- Other storage(specify)

2.4.14. Quantity of production stored in public storage (in kg)

2.4.15. On the total production, what is the quantity that has been used /to be used in any other way rather than being consumed at home, sold, used as wage for hired labour, as farm rent, offered as gift, exchanged with other things, used as seeds, used as fodder/to feed animals, or stored? (in Kg)

2.4.16. The quantity of crop production losses?

2.5. **Production losses**

2.5.1. Pre-harvest losses

2.5.1.1. What was the total quantity of crop stollen at farm level? (kg)

2.5.1.2. What was the total quantity of crop damaged by insects or pests at farm level? (kg) (Visually assessment, Yield loss estimation)

2.5.1.3. What was the total quantity of crop lost due to birds or other animals? (in kg)

2.5.1.4. What was the total quantity of crop's stalks fallen to the ground? (in kg)

2.5.1.5. What was the total quantity of crop lost during harvesting procedures? (in kg)

2.5.2. Post-harvest losses

2.5.2.1. What was the total quantity of crop production lost in the transport of produce? (in kg) post-harvest inspection; Weight reconciliation

2.5.2.2. What was the total quantity of crop production lost during storage procedures? (in kg) Periodic inspections; Weight reconciliation

2.5.2.3. What was the total quantity lost during harvest processing? (in kg) Weight reconciliation; Waste measurement

2.5.2.4. What was the total quantity of harvest lost during packaging? (in kg) Weight reconciliation, Waste measurement

2.5.2.5. What was the total quantity of harvest lost at sales? (in kg) Sales reconciliation, Inventory tracking

3. Use of agricultural inputs

3.1. **Use of organic Fertilizer**

3.1.1. Did you use organic fertilizer in any of your plots during the current agricultural season?

3.1.2. Where did organic fertilizer used came from? There are many ways of getting organic fertilizer among them are: 1=Own preparation, 2=Bought, 3=Received for free, 4=Other source (specify)

3.1.3. Have you used organic fertilizer in the surveyed plot during the current agricultural season?

3.1.4. The total cost for the organic fertilizer purchased and used in the surveyed plot (in Frw)

3.1.5. Was the quantity of organic fertilizer used sufficient compared to the quantity supposed to be used in the surveyed plot?

3.1.6. If the organic fertilizer used was not sufficient, what are the main reasons of not using the quantity supposed to be used? Many reasons are behind the use of insufficient organic fertilizer and the codes corresponding to the given answers are as follows:1=No livestock, 2=Few livestock at home, 3=Not available on market, 4=Lack of financial means, 5=Lack of transport facilities, 6=Other reason (specify)

3.2. **Use of inorganic fertilizers and pesticides/fungicides**

3.2.1. Did you use inorganic fertilizer in any of your plots during this season?

3.2.2. What is the main source of inorganic fertilizer used during the current agricultural season? The main sources of inorganic fertilizers for farmers are clarified using the following codes: 1 - Government (MINAGRI/RAB/NAEB); 2-Agro-dealers; 3-NGOs; 4 -Market; 5-Other (specify the other source)

3.2.3. Have you used inorganic fertilizer in this plot during th current agricultural season?

3.2.4. Types of inorganic fertilizer used during the current agricultural season: The types of inorganic fertilizers differ from farmer to farmer and crop to crop type, soil type, and the following are the related codes corresponding to the farmers/respondents answers: 1= NPK 17-17-17; 2= NPK 20-10-10; 3= NPK 25-5-5; 4= NPK 22-6-12; 5=Other NPK; 6=Urea; 7=Urea liquid (mbonea majimaji) ; 8=DAP; 9= TSP;10= KCL/MOP;11=Omax; 12= Winner; 13=Yara Viva;14=Amidas; 15= Cereal; 16=Boaster;17=Chaux;18=Risobium;19=DI Grow; 20=Dyna gro; 21= Other fertilizer (specify the type)

3.2.5. 3.12 Total quantity of inorganic fertlizers used in the plot during the current agricultural season

3.2.6. According to the type of fertlizers used by farmer, the Enumerator must record the total used quantity for each type of fertilizer and remember to conduct conversation with farmer so that he/she should get the needed related information. the quantity may be given in eithe kg, g, L or CC as mentioned in the previous question on fertilizer's measurement unit.

3.2.7. Quantity purchased and used in this plot

3.2.8. Inorganic fertilizer's unit price (Rwf/unit of measurement)

3.2.9. The main crop on which the inorganic fertilizer was applied on

3.2.10. Did you use any type of micro-nutrients in any of your plots during the current agricultural season? (Even plots outside segment are included for this question) The main soil micronutrients include: Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Molybdenum (Mo), Boron (B), Chlorine (Cl).

3.2.11. Did you use any type of micro-nutrients in the concerned surveyed plot during this current agricultural season?

3.3. **Use of pesticides/fungicides**

3.3.1. Did you use Pesticides/Fungicides in any of your plots during the current agricultural season? ***(Even plots outside segment are included for this question)***

3.3.2. Have you used pesticides/Fungicides in the surveyed plot during this current season?

3.3.3. Type of pesticides/fungicides used during the current agricultural season.: *1-Dithane; 2- Ridomil; 3- Dimethoate (DUDU); 4- Cypermethrin; 5-Dursiban; 6-Tilt; 7- Pilkare; 8-Rocket; 9-Beam; 10-Lava; 11-Rodazim; 12-Thiovit; 13-Safari max; 14-Victory; 15-Copper (akaribata); 16-Supra; 17-Alfatox;18-Daconil; 19-Vendex; 20-Ortivatop; 21-Mastercop; 22-Atoce; 23-Lambdex; 24-Evisect; 25-Prove; 26-Abamectin; 27-Fenvalerate; 28- Copper oxychloride; 29-Othello; 30-Balcolex; 31- Cabrio; 32- Commando; 33- Confidor; 34-Cypro; 35-Easygrowth; 36- Endofil; 37-Indofil M45; 38-Safari; 39- Jacket; 40-Lambda; 41- Mancozeb; 42-Millmax; 43- Miovit; 44-Octiva; 45-Orius; 46- Ramdan; 47-Profex super; 48- Round all; 49- Safari Zeb; 50- Scower; 51-Sumithio; 52-Vital; 53-Other pesticides/fungicides (specify the name)*

3.3.4. Pesticides/fungicides measurement unit: the commonly used units of measurement for farmers are 1-Kg; 2-g; 3-L; 4-Cc

3.3.5. Total quantity of pesticide/fungicide used for the crop in the plot: 1-Kg; 2-g; 3-L; 4-Cc

3.3.6. Total quantity of pesticides/fungicides purchased and used in the plot

3.3.7. Total amount spent on quantity of pesticides/fungicides purchased and used

4. **Agricultural Practices**

4.1. ***Soil* erosion *control measures***

4.1.1. What is the degree of erosion on the plot? *1=Severe (Rill erosion, Gully erosion, Mass movement/landslides) 2=Moderate (Diffuse overland flow Erosion, Overland flow erosion, erosion by Infiltration) 3=Low (Wind erosion) 4=Very Low (Splash erosion)*

4.1.2. Is there any anti-erosion activity in any of your plots?

4.1.3. Is there any anti-erosion activity on the sampled plot?

4.1.4. Were these anti-erosion activities done during the current agricultural season?

4.1.5. What is the total cost of anti-erosion activities done during this agricultural season (Frw)?

4.1.6. Is this plot located in consolidated site in this agricultural season?

4.1.7. What do you gain as support from land consolidation program?

4.2. ***Soil* preparation *and Irrigation***

4.2.1. Did you use any mechanical equipment for agriculture activities in any of your plots during the current agricultural season? N.B: Farmer's plots outside the segment are also considered.

4.2.2. Did you use any mechanical equipment for agriculture activities on the sampled plot during the current agricultural season?

4.3. **Agriculture mechanization**

4.3.1. Use of ploughing animals (oxen)

4.3.1.1. Have you used ploughing animals (oxen) on the plot during the current agricultural season?

4.3.1.2. At which stage of agriculture practice have you used animal ploughing? Stages of ploughing: 1-Ploughing; 2-Soil leveling; 3-Raking; 4-Manuring; 5-Sowing; 6-Weeding; 7-Irrigation; 8-Harvesting; 9-Threshing; 10-Winnowing; 11-Harvest packing; 12-Pesticides Spraying; 13-Other stage of agricultural practice (Specify).

4.3.1.3. Amount paid on ploughing animals used during the current agricultural season (in Rwf)

4.3.2. Use of tractors (Plowing, Tilling, Harrowing, Planting, Spraying, and Hauling)

4.3.2.1. Have you used a ploughing tractor in the sampled plot during the current agricultural season?

4.3.2.2. At which stage of agriculture practice have you used ploughing tractor? The common stages of farmers 'agricultural practices on which mechanical equipment can be used: 1-Ploughing;2-Soil leveling;3-Raking;4-Manuring;5-Sowing;6-Weeding;7-Irrigation;8-Harvesting;9-Threshing;10-Winnowing;11-Harvest packing;12-Pesticides Spraying;13-Other stage of agriculture practice (Specify)

4.3.2.3. Amount paid on ploughing tractors during the current agricultural season. (in Rwf)

4.3.2.4. Have you used any other mechanical equipment different from ploughing animals or ploughing tractors in the plot during the current agricultural season?

4.3.2.5. At which stage of agriculture practices have you used any other mechanical equipment different from ploughing animals or tractors during the current season?

4.3.2.6. Name of other mechanical equipment used different from ploughing animals or tractors during the current agricultural season.

4.3.2.7. Amount paid for the other mechanical equipment used during the current season. (in Rwf)

4.3.2.8. Amount spent on hired labour used to prepare land, sowing and any other related agricultural activity until harvesting in the current agricultural season (in Rwf)

4.4. **Irrigation practices**

4.4.1. Did you practice irrigation techniques in any of your plots during the current agricultural season? (even the plots outside the segments are considered)

4.4.2. Has the plot been irrigated during the current agricultural season?

4.4.3. What is the irrigation technique used on the plot during the current agricultural season? 1-Surface irrigation; 2-Flood irrigation (especially for rice); 3-Drip irrigation; 4-Sprinkler irrigation; 5-Pivot irrigation; 6-Traditional techniques.

4.4.4. What is the source of water for crop irrigation? The source of water for irrigation in the case of Rwanda are the following:1-Rainwater harvesting; 2-Water treatment plant; 3-Underground water; 4-Lake/stream water; 5-Water catchment (dam); 6-Other source (specify).

4.4.5. What irrigation tool have you used during the current agricultural season? The commonly used tools in Rwanda are codified as follows:1-Irrigation machine; 2-Moto pump; 3-Tube wells; 4-Water can; 5-Water channels; 6-Jerycan/basin; 7-Another too (specify)

4.4.6. What is the amount spent on irrigation activities during the current agricultural season? (in Rwf)

5. **Information on fruits trees**

5.1.1. Is there any type of fruit trees scattered in the plot and that have not been captured in the surveyed plots?
5.1.2. What kind of fruit trees are planted in the plot?
5.1.3. How many fruit trees are in the plot for each type?
5.1.4. How many fruit trees are expected to be harvested in the current agricultural season?
5.1.5. What is the total quantity of fruits that will be produced in the current agricultural season?
5.1.6. On the total production of the fruit tree within the agricultural season, what is the quantity that has been sold/to be sold? (Kg)
5.1.7. On the total production of the fruit, what is the quantity that has been used/ to be used by the household (auto consumption)? (in Kg)
5.1.8. On the total production of this fruit what is the quantity that has been used /to be used in any other way? (Kg)
5.1.9. Do you have fruit trees anywhere else outside the sampled plots?
5.1.10. What kind of fruit trees do you have outside the sampled plots?
5.1.11. How many fruit trees for each fruit type do you have outside the sampled plots?
5.1.12. Date of interview for the farmer/household

Annex 3: List of Indicators reported and their sources

Indicator category	Indicator name
1. Land use indicators	1.1. Agricultural land area
	1.2. Arable land
	1.3. Physical cultivated land
	1.4. Area under seasonal crop
	1.5. Area under permanent crop
	1.6. Temporary fallow land area
	1.7. Temporary meadow and pasture
	1.8. Area under permanent pasture
	1.9. Area under agricultural practice
2. Crop area	2.1. Cultivated crop area (Area sown)
	2.2. Harvested crop area
3. Production	3.1. Average crop yield of major crop
	3.2. Crop production
	3.3. Use of crop production
4. Agricultural inputs indicators	4.1. Percentage of farmers using improved seeds
	4.2. Percentage of farmers by source of improved seeds
	4.3. Percentage of improved seeds by source per crop
	4.4. Use of organic fertilizer
	4.5. Use of inorganic fertilizer
	4.6. Percentage of farmers by source of inorganic fertilizers
	4.7. Percentage of inorganic fertilizer used by type and by source
	4.8. Percentage of plots by type of inorganic fertilizer
	4.9. Use of Pesticides
	4.10. Percentage of plots by type of pesticide
5. Agricultural Practices indicators	5.1. Sowing dates by district
	5.2. Percentage of Cultivated area by cropping system
	5.3. Percentage of farmers who protected against erosion/ who used mechanical equipment/ who practiced irrigation/who practiced agroforestry
	5.4. Percentage of plots by type of irrigation used
	5.5. Percentage of plots by source of water used for irrigation
	5.6. Percentage of plots by degree of erosion