

Economic Commission for Africa (ECA)
East African Community Secretariat

East Africa Regional Statistics Program-for-Results
(EARSP-for-R)

Final Verification Report for
National Institute of Statistics of Rwanda

February 18, 2026

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List of Acronyms

ACS	African Centre for Statistics
API	Application Programming Interface
AWEI	Automated Water Extraction Index
CNN	Convolutional Neural Network
COSTECH	Tanzania Commission for Science and Technology
DEM	Digital Elevation Model
DLI	Disbursement Linked Indicator
DLR	Disbursement Linked Result
EAC	East African Community
EARSP-for-R	East Africa Regional Statistics Program for Results
GIS	Geographic Information System
GeoAI	Geospatial Artificial Intelligence
GNSS	Global Navigation Satellite System
HDC	Health Data Collaborative
IVA	Independent Verification Agency
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
NISR	National Institute of Statistics of Rwanda
NBS	National Bureau of Statistics
REMA	Rwanda Elevation Model and Imagery
SAS	Seasonal Agricultural Survey
SDGs	Sustainable Development Goals
SQL	Structured Query Language
UNECA	United Nations Economic Commission for Africa

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Table1: Summary of *Final* Verification Results, Rwanda

Executive Summary

The United Nations Economic Commission for Africa (UNECA), serving as the Independent Verification Agency (IVA) under the Eastern Africa Regional Statistics Program for Results (EARSP-for-R), conducted the January 2026 off-site (EARSP-for-R) verification for the Republic of Rwanda. The off-site verification was, undertaken in close collaboration with the East African Community (EAC) Secretariat, focused on verifying one Disbursement Linked Result (DLR): the use and analysis of data from remote sensors to improve production of agricultural statistics (DLR 2.6a).

The verification confirmed that the National Institute of Statistics of Rwanda (NISR) has made substantial progress in integrating geospatial data and advanced remote sensing technologies into its national statistical system. The 2023 upgrade of the Seasonal Agricultural Survey (SAS) sampling frame represents a major advancement in applying Earth Observation methods, machine learning, and automated geoprocessing to enhance agricultural statistics production. The initiative demonstrates Rwanda's commitment to leveraging Big Data and innovation technologies for evidence-based policymaking.

NISR successfully implemented a comprehensive geospatial framework that includes:

1. **Advanced Remote Sensing Integration:** Deployment of high-resolution satellite imagery (Maxar building footprints, Sentinel-2 multispectral data) combined with deep learning models for automated feature extraction
2. **Innovative Land-Cover Mapping:** Use of machine learning algorithms to detect dynamic land-cover changes, including automated building footprint extraction, tea plantation mapping, and wetland classification
3. **Automated Geoprocessing Workflows:** Implementation of ArcGIS Model Builder tools for consistent, reproducible spatial analysis and frame construction
4. **Systematic Sampling Frame:** Development of a nationwide 300m × 300m grid-based sampling system stratified by remote-sensing-derived land-cover classes

The comprehensive technical report on the design of upgraded frames for the Seasonal Agricultural Survey (2023) is published, publicly accessible, and demonstrates methodological rigor aligned with international standards.

The verification team of ECA hereby confirms that Rwanda has **achieved** DLI 2.6(a) on the use and analysis of remote sensor data to improve agricultural statistics, and no further actions are required for disbursement under this result.

However, the verification also identified opportunities for further enhancement, including expanded application of Geospatial AI (GeoAI), integration of climate projections into vulnerability assessments, and strengthening of inter-institutional data-sharing frameworks. With continued investment in technical capacity, infrastructure, and institutional coordination, Rwanda is well-positioned to become a regional leader in the application of geospatial technologies for official statistics.

Summary of Verification Results

Disbursement Indicator	Linked	Narrative	Status for January 2026 Verification Window
DLI 2.6 (a)		Use and analysis of data from remote sensors to improve production of agricultural statistics	Achieved

Table 1: Summary of Final Verification Results, Rwanda

Section I: Geospatial Data - Gained Experience with Big Data and New Technologies

1. Summary

The Independent Verification Agency (UNECA), through the African Centre for Statistics (ACS), conducted the January 2026 verification for Rwanda under the Eastern Africa Regional Statistics Program for Results (EARSP-for-R). The verification team was tasked with verifying the achievement of DLR 2.6(a): the use and analysis of data from remote sensors to improve production of agricultural statistics.

The review confirmed full achievement of this objective under the DLI 2.6(a). The National Institute of Statistics of Rwanda (NISR) has produced and published a comprehensive technical report documenting the 2023 upgrade of the Seasonal Agricultural Survey (SAS) sampling frame. This upgrade demonstrates sophisticated integration of remote sensing, machine learning, and automated geoprocessing to enhance the accuracy, reproducibility, and sustainability of agricultural statistics production.

The verification noted exceptional progress in applying geospatial technologies, particularly in the areas of:

- Automated building footprint extraction using deep learning
- Machine learning-based land-cover classification
- Systematic validation and change detection workflows
- Construction of robust, stratified sampling frames

The verification concludes that Rwanda has successfully demonstrated meaningful progress toward becoming a regional leader in the application of Big Data and geospatial innovation for official statistics production.

2. Context and Discussion

2.1 Disbursement Linked Results and Indicators for January 2026 Window

DRL/DLI	Narrative
DLI 2.6 (a)	Use and analysis of data from remote sensors to improve production of agricultural statistics
DLR 2.6	Gained experience with big data sources and new technologies
DLI Description	(a) Use and analysis of data from remote sensors to improve production of agricultural statistics. NISR produces reports demonstrating the application of remote sensor data, satellite imagery, and other Big Data sources in modernizing agricultural statistics, with emphasis on improved sampling frame design, land-cover mapping, and statistical innovation
Expected Milestone	Technical report(s) documenting the integration of remote sensing and Big Data analytics into the SAS sampling frame design and agricultural statistics production system, published and publicly accessible

Table 2: Summary of DLI 2.6(a), Rwanda

2.2 Verification Protocols and Methodologies Deployed

In accordance with the Programme Cooperation Agreement (PCA) and established verification procedures, UNECA conducted validation of evidence submitted by the National Institute of Statistics of Rwanda (NISR) for DLR 2.6(a).

The verification focused on:

a) **Evidence Accessibility:** Confirming that technical reports demonstrating the use of remote sensor data and Big Data analytics were produced, published, and made publicly accessible through NISR's official channels and online platforms

b) **Methodological Soundness:** Assessing the technical rigor of geospatial methodologies, remote sensing workflows, and the integration of machine learning techniques into agricultural statistics production

c) **Innovation Assessment:** Evaluating the extent to which NISR has adopted advanced technologies (satellite imagery, deep learning, automated geoprocessing) and developed institutional capacity for ongoing application

d) **Reproducibility and Documentation:** Verifying that methodologies are well-documented, validated through fieldwork, and designed for long-term sustainability

e) **Accessibility and Online Availability:** Ensuring that reports, data, and technical documentation are published and accessible to stakeholders through NISR's geospatial data portal and official statistical websites

The verification steps included:

- Desk review of the technical report on SAS 2023 frame upgrade
- Assessment of remote sensing methodologies and data sources
- Review of machine learning and geoprocessing workflows
- Examination of validation processes and field-work protocols
- Verification of online accessibility and public availability

2.3 Reports and Links Reviewed

As per the agreed protocol, the independent verification team was presented with the following reports and evidence:

Primary Documentation:

1. **Technical Report: Design of Upgraded Frames for Seasonal Agricultural Surveys (2023)**
 - Link: <https://geospatial-open-data-site-nisrgis.hub.arcgis.com/apps/nisrgis::design-of-sampling-frame-for-seasonal-agriculture-survey/about>
 - Status: Published and publicly accessible
2. **NISR Geospatial Data Portal**
 - Primary Link: <https://geospatial-open-data-site-nisrgis.hub.arcgis.com/>
 - Secondary Link: <https://statistics.gov.rw/data-portals-e-gddssdds>
 - Status: Operational, with downloadable datasets and documentation
3. **Interactive SAS Sampling Frame Application**
 - Platform: ArcGIS Hub/Portal
 - Content: Visualization and documentation of the 2023 SAS frame design
 - Accessibility: Public access with metadata and technical specifications

Supporting Documentation:

- Updated land-cover map (2023)
- Field validation reports (Survey123 and ArcGIS Field Maps data)
- Change detection analysis (2019-2023)
- Sampling frame construction models (ArcGIS Model Builder documentation)
- Stratification and sample allocation specifications

3. Verification Findings and Discussions

3.1 Alignment of Evidence for DLR 2.6(a)

Following comprehensive review of the submitted documentation and verification of online accessibility, UNECA confirmed that the evidence provided by NISR was consistent with the established verification plan and served as a reliable basis for confirming reported results. The technical report demonstrates sophisticated application of remote sensing and Big Data technologies in a manner that exceeds minimum verification requirements.

3.2 Measurement of Achievement of DLR 2.6(a)

Finding: The verification confirms **complete achievement** of DLR 2.6(a) - the use and analysis of remote sensor data to improve production of agricultural statistics.

NISR's 2023 SAS frame upgrade represents a comprehensive, technically sound, and well-documented application of geospatial innovation to agricultural statistics. The initiative demonstrates:

1. Advanced Remote Sensing Application

NISR successfully integrated multiple remote sensing data sources:

- **High-Resolution Satellite Imagery:** Maxar building footprints and 0.25-0.5-meter resolution imagery for automated building detection and settlement classification
- **Multispectral Satellite Data:** Sentinel-2 observations with derived spectral indices (NDVI, NDWI, AWEI) for land-cover classification and water-body mapping
- **Elevation Data:** Rwanda Elevation Model (REMA) integration for enhanced contextual analysis and geomorphological classification
- **Deep Learning Models:** ESRI's pretrained Convolutional Neural Networks (CNNs) for building footprint extraction, achieving significantly improved detection in urbanizing areas

2. Machine Learning Integration for Land-Cover Mapping

The verification confirmed sophisticated application of machine learning techniques:

a) Tea Plantation Mapping:

- **Methodology:** Random Forest classifier trained on spectral features extracted from high-resolution imagery
- **Training Data:** Geo-referenced field samples combining tea and non-tea reference points
- **Performance:** 95% overall accuracy for mature tea, 86% accuracy for young tea plantations
- **Innovation:** Identification of both established plantations and expansion areas through comprehensive zone delineation

- **Validation:** Field verification through targeted Survey123 and ArcGIS Field Maps campaigns, with 73% of required visits completed

b) Built-Up Area Classification:

- **Deep Learning Extraction:** Automated building footprint detection from high-resolution satellite imagery
- **Density Classification:** Distinction between high-density (compact urban/rural cores) and low-density (dispersed with agricultural open space) built-up areas
- **Expert Validation:** Manual classification by NISR experts for contextual accuracy
- **Application:** Integration into land-cover stratification for improved SAS sampling precision

c) Wetland Mapping Refinement:

- **Data Integration:** Official REMA datasets with validated field observations
- **Classification:** Separation of rice and non-rice wetlands, plus non-cropped wetlands
- **Purpose:** Capture intensive multi-season cultivation patterns unique to wetland zones

d) Rangeland Classification:

- **Refinement:** Reclassification into exclusive and mixed rangeland categories
- **Basis:** High-resolution imagery interpretation and spectral analysis
- **Value:** Improved representation of pastoral and agro-pastoral land-use dynamics

3. Automated Geoprocessing and Reproducibility

The verification confirmed implementation of fully reproducible, automated workflows:

- **ArcGIS Model Builder Integration:** Development of standardized geoprocessing models for consistent, transparent geospatial analysis
- **Change Detection Tools:** Automated comparison of 2019 and 2023 land-cover maps highlighting potential transitions
- **SQL Server Automation:** Systematic replicate-based sampling through automated database scripts
- **Documentation:** Comprehensive methodology documentation enabling future updates and institutional continuity
- **Quality Assurance:** Automated topology checking, overlay cleaning, and polygon validation procedures

4. Systematic Sampling Frame Design

The updated sampling frame reflects methodological advancement:

- **Grid-Based System:** Nationwide 300m × 300m square cells (9 hectares each) serving as primary sampling units
- **Stratification:** Each cell classified according to proportions of remote-sensing-derived land-cover classes
- **Robust Classification:** Reflects observed conditions including hill crops, wetlands, exclusive and mixed rangeland, built-up areas, and excluded zones

- **Systematic Sampling:** Two-dimensional replicate sampling approach automated through structured database queries
- **Validation:** Field-based validation for change detection, with Survey123 data collection forms and ArcGIS Field Maps integration
- **Results:** 73% completion of field validation visits, with 63% confirmed as valid changes requiring no revision, 26% requiring reclassification, and 11% requiring geometry modification

Category	2016 Classification	2019 Classification	2023 Classification	2023 Innovation
Agricultural Land	Hill crops (lumped)	Hill crops (code 1)	Hill crops (code 1)	Maintained as baseline
Wetlands	Basic wetland	Non-rice wetland (21), Paddy rice (22), Non-cropped (23)	Non-rice wetland (21), Paddy rice (22), non-cropped (23)	Refined with satellite imagery
Rangeland	Single class	Single class (code 3)	Exclusive (30), Mixed with cropland (31)	ML-based classification
Settlement	Basic settlement	Rural (4), Urban (41)	Low-density (4), High-density (41)	Deep learning footprint extraction
Other Classes	Basic classification	Enhanced (water, forest, protected areas)	Enhanced with dynamic updates	Updated with REMA datasets
Tea Plantations	Manual digitization	Manual mapping (code 10)	Automated ML mapping (code 10)	95% accuracy ML detection

Table 3: Land-Cover Classes Classification System Evolution

3.3 Key Innovations and Technical Achievements

1. Deep Learning for Building Extraction

NISR deployed ESRI's pretrained deep learning models (CNNs) for automated building footprint detection. This innovation:

- Significantly improved detection of structures in rapidly urbanizing zones
- Provided fast, consistent, and scalable footprint extraction
- Demonstrated technical sophistication in deploying state-of-the-art AI methods
- Enabled integration with census mapping activities (2022 Population and Housing Census)

2. Machine Learning-Based Land-Cover Classification

The Random Forest classifier applied to tea plantation detection achieved:

- 95% accuracy for mature green tea plantations
- 86% accuracy for young/expanding tea areas
- Automated detection of both established and developing agricultural areas
- Spectral feature extraction from multispectral imagery combined with elevation data
- Automated block-based classification across the entire country

3. Automated Geoprocessing Workflows

Implementation of ArcGIS Model Builder tools provided:

- Reproducible, transparent geospatial processing pipelines
- Consistent formatting and topology consistency across layers
- Automated layer integration from multiple data sources
- Change detection workflows comparing historical and current land-cover maps
- Systematic polygon validation and error correction

4. Systematic Field Validation

Integration of modern field data collection:

- Survey123 forms for standardized data capture
- ArcGIS Field Maps for mobile, offline-capable field work
- Targeted validation of change detection results
- Dashboard-based monitoring of validation progress
- Documented decision-making for change classification (63% confirmed valid, 26% reclassified, 11% geometry-modified)

5. Multi-Source Data Integration

Successful integration of diverse geospatial datasets:

- Maxar high-resolution building footprints
- Sentinel-2 free, open-access multispectral imagery
- Rwanda Elevation Model (REMA) official government dataset
- 2022 Population and Housing Census building data
- Cadastral parcel boundaries for settlement delineation
- Institutional datasets from sectoral partners (NAEB for tea monitoring)

3.4 Gaps and Opportunities Identified

While the verification confirms full achievement of DLI 2.6(a), the assessment identified several areas for future enhancement:

Technical Opportunities:

1. Geospatial AI (GeoAI) Expansion

- Current Status: Deep learning deployed for building footprint extraction
- Opportunity: Expand GeoAI applications to other land-cover classes and spatiotemporal analysis
- Recommendation: Explore advanced deep learning models for crop type classification, agricultural productivity estimation, and temporal change analysis

2. Cloud-Based GIS Integration

- Current Status: Localized geoprocessing workflows in ArcGIS Pro and Model Builder

- Opportunity: Leverage cloud-based GIS platforms (Google Earth Engine, ArcGIS Online) for scalability and automated processing
- Benefit: Enable real-time monitoring, reduce computational bottlenecks, improve accessibility for data users

3. Climate Scenarios and Future Projections

- Current Status: Land-cover mapping based on current/recent conditions
- Opportunity: Integrate climate change projections and downscaled climate scenarios
- Application: Enhance agricultural vulnerability assessments and support climate-smart agriculture planning

4. Enhanced Sampling Error Computation

- Current Status: Basic sampling design with stratification
- Opportunity: Develop sampling error estimation for agricultural statistics
- Benefit: Quantify precision of survey estimates and enhance transparency for data users

5. Sector-Specific Data Integration

- Current Status: Agricultural focus through SAS
- Opportunity: Extend methodology to other sectors (environment, urban planning, health)
- Potential: Develop integrated geospatial information system supporting multi-sectoral evidence-based policymaking

Institutional Opportunities:

1. Inter-Agency Data Coordination

- Challenge: Data-sharing protocols among government agencies
- Opportunity: Formalize data-sharing agreements and establish automated data exchange pipelines
- Benefit: Reduce duplication, improve consistency, enhance data quality

2. Capacity Development

- Current Status: NISR team demonstrated proficiency in advanced geospatial techniques
- Opportunity: Expand training programs to other statistical agencies and government ministries
- Application: Broader adoption of geospatial innovations across the National Statistical System

3. International Collaboration

- Current Status: Support from World Bank and regional partners
- Opportunity: Strengthen South-South cooperation with other African countries implementing similar innovations

- Platform: EARSP-for-R provides institutional mechanism for knowledge sharing and capacity strengthening

3.5 Compliance with International Standards and Best Practices

The verification confirmed that Rwanda's geospatial initiative aligns with international best practices:

1. **UN Statistical Standards:** Adherence to international classification systems (ISIC for economic activities, CPC for agricultural products)
2. **Data Quality Framework:** Implementation of prerequisites for quality (legal framework, professional ethics, statistical confidentiality)
3. **Methodological Soundness:** Rigorous design and validation of sampling frame, comprehensive documentation
4. **Accessibility:** Publication of technical documentation and data through official channels
5. **Innovation Leadership:** Adoption of advanced technologies (deep learning, cloud computing) within the African regional context

4. Outstanding Issues and Documentation

The Independent Verification Team of UNECA confirms that there are **no outstanding issues or missing documents** required to facilitate the verification process. All necessary documentation has been provided, reviewed, and validated. The technical report is complete, published, and publicly accessible.

5. Conclusion

The verification exercise conducted by UNECA as the Independent Verification Agency confirms that Rwanda has **fully achieved** DLI 2.6(a) on the use and analysis of remote sensor data to improve production of agricultural statistics.

The National Institute of Statistics of Rwanda (NISR) has demonstrated exceptional progress and technical sophistication in implementing the 2023 upgrade of the Seasonal Agricultural Survey (SAS) sampling frame. This initiative showcases:

- **Advanced Technology Integration:** Sophisticated application of satellite imagery, deep learning, machine learning, and automated geoprocessing
- **Methodological Rigor:** Comprehensive validation, field-based verification, and quality assurance procedures
- **Institutional Commitment:** Sustained investment in geospatial innovation as a core statistical activity
- **Regional Leadership:** Positioning Rwanda as a leader in the application of Big Data and geospatial technologies for official statistics in East Africa

The comprehensive technical report documenting the 2023 SAS frame upgrade meets and exceeds verification criteria. The documented approach is reproducible, transparent, and designed for long-term sustainability. By leveraging satellite imagery, deep learning, and automated geoprocessing, NISR has strengthened the precision, reproducibility, and efficiency of agricultural statistics production.

The integration of remote sensing technologies has yielded tangible improvements in:

- **Accuracy:** Automated building detection and land-cover classification with validated accuracy metrics

- **Efficiency:** Reduced manual workload through automated workflows and standardized procedures
- **Sustainability:** Development of reproducible methodologies enabling consistent updates every three years
- **Accessibility:** Public dissemination of reports and datasets through dedicated geospatial platforms

However, to consolidate these gains and maximize the potential of geospatial innovation, continued investments are recommended in:

- **Capacity Development:** Strengthening technical skills across the National Statistical System
- **Infrastructure:** Cloud-based GIS platforms and enhanced computational capacity
- **Inter-Institutional Coordination:** Formal data-sharing agreements and coordinated geospatial information systems
- **Innovation Expansion:** Extension of proven methodologies to additional statistical domains

Overall, the verification concludes that Rwanda is well-positioned to advance further toward fully institutionalizing Big Data and geospatial technologies as standard practice across its national statistical system, with potential for becoming a regional model for the application of innovation in official statistics.

6. Recommendations

Based on the verification assessment and opportunities identified, the Independent Verification Team provides the following recommendations for consideration by NISR and the Government of Rwanda:

Strategic Recommendations

1. Institutionalize Geospatial Innovation

- **Action:** Establish a dedicated Geospatial Statistics Unit within NISR with clear governance structure, staffing, and budget allocations
 - **Rationale:** Ensure long-term sustainability and institutional continuity of geospatial initiatives
 - **Timeline:** Within 6-12 months
 - **Indicators:** Unit established, staffed, and operational; work plans and budget allocations finalized

2. Develop a Geospatial Statistics Strategy

- **Action:** Formulate a comprehensive National Geospatial Statistics Strategy aligned with broader statistical development priorities
- **Components:**
 - Scope of geospatial applications across statistical domains
 - Technology roadmap (platforms, tools, infrastructure)
 - Capacity development and training programs
 - Data governance and inter-agency coordination frameworks

- Resource requirements and financing mechanisms
- Monitoring and evaluation frameworks
- **Timeline:** 12-18 months
- **Stakeholders:** NISR, sectoral ministries, academic institutions, development partners

3. Formalize Inter-Agency Data Coordination

- **Action:** Establish formal data-sharing protocols and technical coordination mechanisms with government agencies producing geospatial data
- **Agencies:** Ministry of Infrastructure, Rwanda Environmental Management Authority (REMA), National Land Board, district administrations
- **Mechanism:** Steering committee, technical working groups, memoranda of understanding
- **Benefit:** Reduce duplication, improve data consistency, enhance data quality
- **Timeline:** 3-6 months

Technical Recommendations

4. Expand Deep Learning Applications

- **Opportunity:** Apply deep learning beyond building detection to:
 - Crop type classification and identification
 - Agricultural land productivity estimation
 - Urban growth monitoring and informal settlement mapping
 - Land degradation and soil erosion detection
- **Implementation:**
 - Procure additional computing resources (GPU capacity)
 - Develop datasets with labelled training examples
 - Partner with academic institutions for model development and validation
- **Timeline:** 12-24 months

5. Transition to Cloud-Based GIS Platforms

- **Current:** Local geoprocessing workflows in ArcGIS Pro
- **Recommended:** Migrate to cloud-based platforms for scalability and efficiency
- **Options:**
 - Google Earth Engine for large-scale Earth observation processing
 - ArcGIS Online for collaborative web-based GIS
 - Open-source alternatives (QGIS Server, Geoserver) for cost-efficiency

- **Benefits:**
 - Reduced computational bottlenecks
 - Automatic updates with latest satellite imagery
 - Enhanced data accessibility
 - Reduced infrastructure maintenance burden
- **Timeline:** 12-18 months

6. Integrate Climate Projections and Future Scenarios

- **Current:** Land-cover mapping based on historical and current conditions
- **Enhancement:** Integrate downscaled climate scenarios and future climate projections
- **Application:**
 - Agricultural vulnerability assessments
 - Climate-smart agriculture planning
 - Disaster risk reduction
 - Water resource management
- **Partnerships:** Collaborate with climate modelling institutions (regional and global)
- **Timeline:** 12-24 months

7. Develop Sampling Error Estimation Methodology

- **Current Status:** SAS sampling design with stratification but without formal sampling error computation
- **Recommendation:** Develop and implement sampling error estimation for key agricultural indicators
- **Components:**
 - Standard errors for national and subnational estimates
 - Confidence intervals around key statistics
 - Coefficients of variation for precision assessment
 - Transparent reporting of data quality indicators
- **Benefit:** Enhanced credibility and transparency; international alignment with statistical standards
- **Timeline:** 6-12 months

8. Extend Methodology to Additional Statistical Domains

- **Current:** Focus on agricultural statistics through SAS
- **Opportunities:** Apply proven geospatial methodologies to:
 - Environmental statistics (land use/land cover, forest coverage, water resources)
 - Demographic statistics (urban-rural classification, population settlement patterns)

- Business statistics (enterprise location mapping, economic activity zones)
- Health statistics (health facility mapping, population proximity analysis)
- **Implementation:** Pilot projects in 1-2 domains, followed by scaling
- **Timeline:** 18-36 months

Capacity Development Recommendations

9. Strengthen Technical Capacity Across the National Statistical System

- **Current:** NISR team has demonstrated proficiency in advanced geospatial techniques
- **Expansion:** Build capacity across government agencies and statistics community
- **Programs:**
 - Formal training courses in GIS, remote sensing, and machine learning
 - Certification programs for geospatial analysts
 - Knowledge-sharing workshops and webinars
 - Internship and mentorship programs
 - International study visits to regional and global centers of excellence
- **Partners:** UNECA, World Bank, academic institutions, international statistical organizations
- **Budget:** Allocate resources for training materials, trainer development, and participant support
- **Timeline:** Ongoing, with structured program rollout over 24-36 months

10. Foster International Collaboration and Knowledge Sharing

- **EARSP-for-R Platform:** Leverage regional program as mechanism for South-South cooperation
- **Activities:**
 - Regular technical working group meetings on geospatial innovation
 - Peer learning exchanges between Rwanda, Tanzania, and Kenya
 - Joint development of standardized methodologies and tools
 - Documentation and dissemination of best practices
- **Benefits:** Accelerate regional adoption of innovations, improve cost-efficiency, strengthen institutional networks
- **Timeline:** Ongoing

Sustainability and Monitoring Recommendations

11. Establish Monitoring and Evaluation Framework

- **Metrics:**
 - Percentage of sampling frames updated using automated workflows
 - Accuracy of machine learning-based land-cover classification

- Timeliness of SAS data release
- Number of data users accessing geospatial statistics
- Adoption of geospatial methodologies across statistical domains
- Capacity indicators (trained personnel, specialized equipment)
- **Mechanism:** Annual reviews aligned with statistical cycle
- **Reporting:** Inclusion in NISR annual reports and EARSP-for-R progress reporting

12. Ensure Financial Sustainability

- **Challenge:** Geospatial initiatives require sustained investment in technology, capacity, and operations
- **Recommendation:**
 - Secure multi-year budget allocations within NISR
 - Explore external financing (World Bank, bilateral donors, development partners)
 - Consider cost-recovery mechanisms (data services, consulting, training)
 - Leverage cost-efficiency gains from automation to offset investment costs
- **Timeline:** Immediate and ongoing

Overall Conclusion

The verification exercise undertaken by the United Nations Economic Commission for Africa (UNECA) as the Independent Verification Agency confirms that the Republic of Rwanda has **fully achieved** Disbursement Linked Indicator 2.6(a) under the Eastern Africa Regional Statistics Program for Results (EARSP-for-R).

The National Institute of Statistics of Rwanda (NISR) has demonstrated exceptional technical competence, institutional commitment, and strategic vision in integrating geospatial data and advanced remote sensing technologies into its agricultural statistics system. The 2023 upgrade of the Seasonal Agricultural Survey sampling frame represents a landmark achievement in the application of innovation to official statistics production.

By leveraging satellite imagery, machine learning, and automated geoprocessing, NISR has strengthened the precision, reproducibility, and long-term sustainability of the SAS. The initiative positions Rwanda as a regional leader in the application of Big Data and geospatial innovation for evidence-based policymaking.

To consolidate and expand upon these achievements, Rwanda should:

1. Institutionalize geospatial innovation through formal governance and capacity structures
2. Transition to cloud-based GIS platforms for enhanced scalability and efficiency
3. Expand geospatial methodologies to additional statistical and sectoral domains
4. Strengthen inter-agency data coordination and information sharing
5. Invest in capacity development across the National Statistical System
6. Foster regional and international collaboration on geospatial innovation

With continued strategic investment and institutional commitment, Rwanda has the potential to become a continental model for the integration of Big Data and geospatial technologies in the production of high-quality, accessible, and policy-relevant statistics.

Overall Verification Assessment: ACHIEVED

Verification Team

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End of Final Verification Report: Use and Analysis of Remote Sensor Data to Improve Production of Agricultural Statistics, Rwanda

Submitted by the United Nations Economic Commission for Africa (UNECA) as the Independent Verification Agency (IVA) for the Eastern Africa Regional Statistics Program for Results (EARSP-for-R), January 2026 Verification Window.