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Global Partnership for Sustainable Development Data

Initiative Prospective Agricole et Rurale

IsDB البنك الإسلامي للتنمية Islamic Development Bank

Timely data for the Sustainable Development Goals:

SENEGAL

A collaboration between the Islamic Development Bank, the Global Partnership for Sustainable Development Data, and the Government of Senegal.

ABBREVIATIONS AND ACRONYMS

ARDC	Africa Regional Data Cube
DPVE	Direction de la Planification et de la Veille Environnementale of the Ministry of Environment and Sustainable Development
EO	Earth observation
IPAR	Initiative Prospective Agricole et Rural
IsDB	Islamic Development Bank
NASA	National Aeronautics and Space Administration
SDGs	Sustainable Development Goals

EXECUTIVE SUMMARY

The right data, at the right time, is key to successful policymaking. With only 10 years left to achieve the Sustainable Development Goals (SDGs), it is imperative that we rapidly increase the access and use of timely data in decision-making. The Global Partnership for Sustainable Development Data (the Global Partnership), the Islamic Development Bank (IsDB), and the Government of Senegal partnered in 2019 and 2020 to test the use of satellite imagery to provide timely data that can inform environmental protection policies and that can support agricultural productivity. In Senegal, leadership came from the Direction de la Planification et de la Veille Environnementale (DPVE) of the Ministry of Environment and Sustainable Development, and the think tank Initiative Prospective Agricole et Rural (IPAR).

The impacts of this partnership between IsDB, the Global Partnership, and the Government of Senegal, include:

Agriculture

Satellite data from the Africa Regional Data Cube[1] (ARDC) was analyzed to identify the characteristics of areas being used for agricultural activity across all 45 departments in Senegal. This decreased the time taken to collect key data from five months to two months, which allowed farmers to start selling crops earlier, reducing post-harvest losses. It also helped the government improve the distribution of drought-resistant crops to where they are most needed.

Deforestation

Satellite imagery, accessed through the ARDC, was also deployed to understand deforestation, focusing on areas that have been affected by illegal logging, bush fires, and the clearing of land for agriculture. It identified locations where deforestation was particularly high over a much larger geography and far quicker than it would have taken through manual mapping, field surveys, and administrative records. This is helping to improve the understanding of the scope and drivers of deforestation and is supporting a more efficient targeting of resources to tackle it.

Water quality

Satellite data was used to provide insights into the water extent and quality of Lake Guiers, which provides about 40 percent of the water consumed in Senegal's capital. Processed data from the ARDC allowed a rapid calculation of the rate of decline of water extent over the last four years, helping to reduce the time needed to assess water quality from more than two days to half a day, and enabling rapid response to protect Dakar's drinking water supplies.

[1] The Africa Regional Data Cube is a technological innovation that layers 17+ years of satellite imagery and Earth observation data and makes it available through both an online user interface and Jupyter notebooks, in analysis-ready formats. It is available in five countries across Africa through a partnership between the Global Partnership, NASA, Amazon Web Services, and country governments, and is currently being scaled up into a fully regional infrastructure, Digital Earth Africa, with support from Geoscience Australia and the Helmsley Trust.

This partnership also unearthed valuable lessons:

- This partnership highlighted the importance of cooperation between institutions and involving multiple stakeholders when piloting a new data source and method. It also stressed the importance of tailoring training and capacity support to the needs of different institutions and stakeholders to ensure sustained engagement.

- Critically, these case studies showed that no single data source can answer all problems, and that data interoperability and the creation of an integrated data system are key to enabling different solutions and data sources to work well together.

- This partnership also demonstrated that using new data sources can reduce costs and improve the quality of the information that is used for policymaking, and ultimately can help to achieve the SDGs by 2030.

This partnership has clearly demonstrated the value of satellite imagery and how using it in decision-making can have huge gains for development. However, it has also revealed that there is more work to be done to cement the progress made in Senegal and scale this work across sectors and geographies.

INTRODUCTION

The right data, at the right time, is key to successful policymaking. Without timely data, making and adapting policy to accelerate progress on the Sustainable Development Goals (SDGs) will be harder and less successful. With only 10 years left to achieve the SDGs, the world cannot afford to wait.

Motivated by this sense of urgency, and the opportunity of new technologies, the Global Partnership for Sustainable Development Data (the Global Partnership), and the Islamic Development Bank (IsDB) have partnered with the Government of Senegal to test the use of satellite imagery to provide timely data for environmental protection and to support agricultural productivity. This work was carried out within the framework of the national platform of actors monitoring the SDGs, institutionalized by order N°031547 on December 31, 2019. In Senegal, leadership came from the Direction de la Planification et de la Veille Environnementale (DPVE) of the Ministry of Environment and Sustainable Development, and the think tank Initiative Prospective Agricole et Rural (IPAR). Here we set out what we have achieved, what we have learned, and an agenda for the future.

PROGRESS AND LESSONS LEARNED

Agricultural Productivity

Agricultural productivity was identified as a key priority and an area where timely data could improve government policy and its impact. The work was structured around SDG indicator 2.4.1, Proportion of agricultural area under productive agriculture.

Satellite data from the Africa Regional Data Cube[2] (ARDC) was used in combination with other data sources to identify the characteristics of areas being used for agricultural activity across all 45 departments in the country. This data was used to:

- **Improve the conduct of agricultural surveys.**

  Satellite data allowed government technicians to remotely identify agriculturally productive areas. This enabled more accurate sampling for the agriculture survey and ensured that enumerators were not deployed to areas that were no longer agriculturally productive. Using only traditional data collection methods, the agriculture survey data collection process took about five months. The use of the ARDC and Earth observation (EO) data reduced this to two months, making the survey much more time and cost-efficient.

- **Enable faster commercialization.**

  A more efficient survey process enabled more rapid processing of productivity estimates and price-setting. This in turn allowed the commercialization of groundnuts, Senegal's most important cash crop, to begin just one month after harvest, instead of the usual four months. This likely reduces post-harvest losses for farmers and enables them to see profits earlier.

- **Distribute appropriate crops.**

  Climate change has had severe impacts in Senegal including low, delayed, or no rainfall. Satellite imagery was used to identify regions that were at high risk for low or no agricultural productivity, and enabled the Senegalese government and international organizations to provide climate-resistant crops, such as sorghum, to farmers in the identified areas in a timely manner.

[2] The Africa Regional Data Cube is a technological innovation that layers 17+ years of satellite imagery and Earth observation data and makes it available through both an online user interface and Jupyter notebooks, in analysis-ready formats. It is available in five countries across Africa through a partnership between the Global Partnership, NASA, Amazon Web Services, and country governments, and is currently being scaled up into a fully regional infrastructure, Digital Earth Africa, with support from Geoscience Australia and the Helmsley Trust.

The use of new data sources, in combination with existing survey data, have helped to improve decision-making and resource allocation for agricultural development in Senegal. We expect that farmers will in turn benefit from more rapid commercialization and more effective distribution of climate-resistant crops.

Deforestation

Deforestation is a serious challenge in Senegal, with some regions losing nearly 20 percent of their forests over the last 20 years. Collecting data on the extent of forest loss is highly time and resource-intensive, and the last forest inventory was conducted in 2004. Satellite imagery was deployed to fill in some of the data gaps.

This work was designed to contribute to the measurement of SDG indicator 15.1.1, 'Forest area as a percentage of total land area', and 15.2.1, 'Progress towards sustainable forest management'.

The ARDC provides data at the local level, and the initial study focused on areas that have been affected by illegal logging, bush fires, and the clearing of land for agriculture.

Comparison of satellite images over time allowed the rapid identification of areas where deforestation was particularly high. Without access to this data, it would have taken at least three months to obtain the results and analysis presented below, which was produced in a matter of days. Additionally, it would have required using a combination of manual mapping, field surveys, and administrative records of charges brought against illegal loggers. Furthermore, without EO data, such methods can only cover a small sample of the total area due to resource constraints.

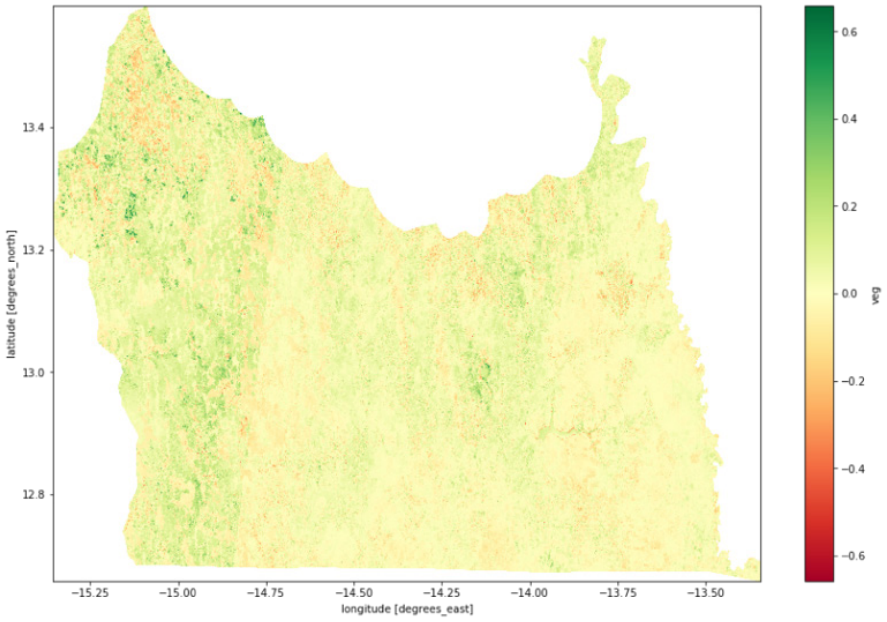

Figure 1: Deforestation in Kolda Region. Areas in RED have experienced deforestation

This data helps illuminate the drivers of deforestation in specific contexts and will be used to inform forest management. It will feed into the next Forest Risk Assessment Report, which will begin soon.

Water extent and quality

Lake Guiers, located in northern Senegal, is the primary source of fresh water for Dakar's 1 million people, providing about 40 percent of the city's water. Satellite data was used to provide insights into water extent and quality for this crucial resource.

This effort provided data to support SDG indicator 6.6.1, 'Change in the extent of water-related ecosystems over time' and 6.3.2, 'Proportion of bodies of water with good ambient water quality'.

The lake is surrounded by fertile shores. The north shore is primarily used for growing sugar cane irrigated by water from the lake. The cane is grown in close proximity to other supply chain actors in the sugar industry such as refineries. Given the strategic importance of the lake, it was identified as a good use case to test how satellite data can provide information on water quality and water extent.

Comparing satellite images over time shows how the availability of water in the lake has changed over the last four years: water extent has declined by approximately one percent.

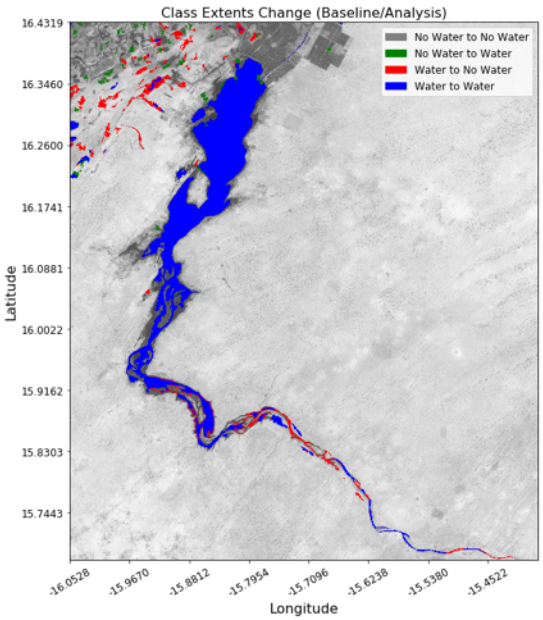

Figure 2: Combined Water extent in Lake Guiers from 2014 (baseline) to 2018 (analysis)

Using the processed data from the ARDC allowed this calculation to happen in half a day, compared to the several days it takes through manual collection. The coverage is also better, as some areas of the lake are hard to reach with ground collection methods. This information is useful in assessing the amount of water available for the year and informing the need for mitigation strategies if there are indications of water shortage.

Satellite imagery was also used to indicate areas with water quality issues, by identifying the presence of particles (total suspended matter) and chlorophyll in the water. Routine and timely water quality insights can help identify contamination hotspots, efficiently investigate causes, and rapidly undertake mitigation strategies.

Emerging areas where the ARDC can provide further value: Marine protected areas and urbanization

An assessment of the value of satellite imagery for providing insights relating to marine protected areas and urbanization indicated promise, though more work is needed.

Imagery provided through the ARDC is not sufficiently detailed to differentiate between marine water and inland water. However, it may have value in detecting water pollution in marine protected areas in the sea and interior water bodies in coastal regions. This will be critical to monitor the impact of increased petroleum production off the coast of Senegal.

Furthermore, land change analysis for the Point of Sangomar highlighted the extent of loss in vegetation or deforestation between 2000 and 2017 at 690,300 m^2. This is shown in red in the figure below and indicates coastal erosion due to oil exploration in the Point of Sangomar. Again, this is crucial for informing marine protection policies.

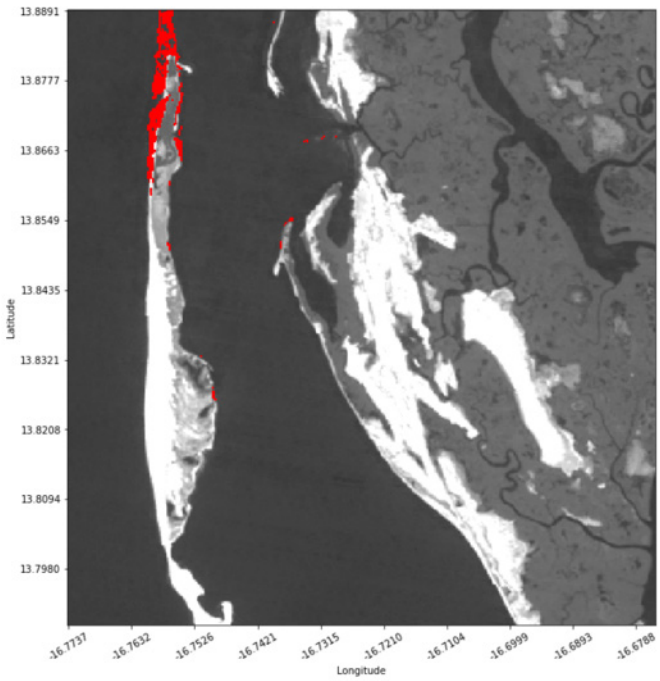

Figure 3: Vegetation loss in the Point of Sangomar

Similarly, in the case of urbanization, analysis indicated limitations in the ARDC data's ability to differentiate between bare soil, vegetation, and buildings - the proxy for land consumption - in rural areas. It is possible that this limitation can be addressed through higher resolution data or improvements in the algorithm.This will be explored further, and lessons will be shared as they become available.

These methodological issues however, were not an issue in urban areas, and therefore could be used to calculate population growth over time in towns and cities, improving population estimations and census activities. This can help to reduce pressure on statisticians where resources are limited: while there are 17,000 districts across Senegal, only three people within the Office of Statistics focus on population growth estimations. Through traditional data collection methods, it takes a minimum of one month to collect and process population estimation data within a sample urban area. The same insights could be derived using the ARDC within one day, given good Internet connectivity.

USING NEW DATA SOURCES:
institutional and capacity considerations

It is critical that the use of new data sources, such as EO data, is embedded within institutional frameworks to ensure leadership and sustained commitment. In the case of Senegal, leadership came from the Direction de la Planification et de la Veille Environnementale (DPVE) of the Ministry of Environment and Sustainable Development, and the think tank Initiative Prospective Agricole et Rural (IPAR). They developed a national coordination and collaboration mechanism to guide work on data for environmental management, linked to the national stakeholders' platform for monitoring the SDGs.

The Global Partnership, with support from the Islamic Development Bank, worked within this framework to prioritize needs and understand capacities.

With the focus areas agreed, the team worked within the Senegalese government structures to develop capacity building activities and provide ongoing support. Capacity building involved a series of four in-person trainings between April and September 2019, bringing in regional and international partners from the National Aeronautics and Space Administration (NASA). Ninety-four percent of respondents in post-training evaluations rated their experience as good, very good, or excellent. Outside of the trainings, support was provided by the technical manager, and through peer learning with colleagues involved in similar work in other countries.

The focus on institutional engagement and collaboration ensured that all relevant stakeholders agreed on the tools and methodologies used, enabling harmonization and the collective agreement on results. This approach also supports data sharing across government agencies and facilitates the coordination of actions.

KEY LESSONS FOR FUTURE WORK

This initial partnership between IsDB, the Global Partnership, and the Government of Senegal demonstrated that satellite imagery, in combination with other data sources, can provide insights at a higher speed and lower cost than other methods alone. Decision-making can thus be more timely and more effective. In addition to the specific insights from the sectors studied, the work has lessons for the use of new data sources for other countries and the SDGs more broadly.

1. Cooperation matters.

These experiences highlight the benefit of using a multi-stakeholder approach to piloting a new data source and method. Collaborating across multiple stakeholders from different agencies on the same use case improved coordination and increased the feasibility of standardizing methodologies, enabling greater consensus on problem definition and appropriate policy response.

2. Build capacity across the system.

The ability to use a new tool and data source relies critically on building technical capacity. Given the varying skill levels among users, training was a key feature of exploring the value of new methods. On average, across all three trainings conducted as part of this work in Senegal, the majority of respondents (67 percent) reported that more than 60 percent of the material covered during the training was new to them. Thirty-one percent of trainees reported that less than half (40 percent) of the material was new, and 3 percent reported that only a small percentage (20 percent) of it was new. These figures demonstrate the diversity of familiarity with the materials and the value of continued and tailored technical support.

It was also important to extend the trainings to multiple relevant staff members within a given office or agency. This increases human resources and helps mitigate the impact of personnel turnover: if one person leaves, the institutional knowledge is not lost.

3. The right data for the right problem.

The data infrastructure used for these pilots – the ARDC – was more appropriate for some challenges than for others. Increased capacity is needed to enable decision-makers to select and use the right data source for the problem at hand. Data interoperability here is also key to enable different solutions to work well together and support the creation of a single data system across the country.

This work, and these lessons, are helping improve the ARDC infrastructure and its ability to support other national governments in their efforts to fill SDG data gaps to monitor and acheive the goals.

NEXT STEPS

The case studies undertaken through this partnership between IsDB, the Global Partnership, and the Government of Senegal highlighted key areas for further work and collaboration:

- **Validation and increasing confidence in the data:**
  Within Senegal, the next step for most of the use cases will be to validate ARDC-generated results with ground data to ensure consistency and accuracy. This will then allow users to apply the methods and algorithms with greater confidence to analyze larger or different areas and on a more routine basis. The validation process includes ground validation as well as technical and political validation using existing governance mechanisms. In addition, the technical committee has highlighted social validation as an important component to ensure that citizen groups are incorporated in the process to build awareness and trust.

- **Strengthening sustainability and institutionalization:**
  Sustained training will also be needed to ensure continuity within the country and discussions are underway to ascertain how best to institutionalize training. In order to leverage the existing technical capacity, future plans include the implementation of a training-of-trainers model, which will ensure that more individuals can be trained and that there will be on-site technical support that is consistently accessible.

- **Scaling-up across sectors and geographies and branching out to include new data sources:**
  The Senegal experience has shown the value of using new data sources, combined with other data, in a variety of policy areas. It has shown the importance of matching the solution to the problem, and the level of input and effort needed to create sustained change in terms of institutional frameworks, capacity development and routine use of data for policymaking. The insights will help strengthen the work in Senegal across sectors, enhance support to other countries, and develop partnerships that go beyond satellite imagery to bring in other data sources.

More work is needed, but the rewards are great. Using new data sources can reduce costs and improve the quality of the information that is used for policymaking, and ultimately help to achieve the SDGs by 2030.

PHOTO CREDITS

Cover: Aerial view of the Pink Lake Retba or Lac Rose in Senegal. Photo made by drone from above. Africa Natural Landscape. Lake Retba, Senegal. Photo: Curioso.Photography
https://www.shutterstock.com/image-photo/aerial-view-pink-lake-retba-lac-1570960909

Page 2: Préparation de riz étuvé pour les diabétiques et certains autres plats comme la bouillie etc.... Transformation du riz de la vallée de l' Anambé.Vallée de l'Anambé.Travail sur la filière riz au Sénégal. Vredeseilanden/VECO.Anambé , SENEGAL.23 Ju https://flic.kr/p/g8tN7h

Page 3: This particular emergency West African Agricultural Productivity Program (WAAP) subsidizes almost 2,000 tons of certified maize, millet, and sorghum seeds. Photo: Daniella Van Leggelo-Padilla / World Bank https://flic.kr/p/oPXBAW

Page 7: Lake Guiers and the Senegal River NASA Johnson https://flic.kr/p/2i4jxxi

Page 9: A beachside fish market in Dakar, Senegal © 2013 Gwendolyn Stansbury/ IFPRI https://flic.kr/p/ihn8eb


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