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TECHNICAL SUPPORT FOR THE ESTABLISHMENT OF THE LESOTHO SOILS INFORMATION SYSTEM (LESIS)

March 2020

SDGs:	
Countries:	Lesotho
Project Codes:	TCP/LES/3602
FAO Contribution	USD 475 000
Duration:	1 February 2017 – 31 December 2019
Contact Info:	FAO Representation in Lesotho FAO-LS@fao.org

Implementing Partners

Ministry of Forestry, Range and Soil Conservation (MFRSC).

Beneficiaries

The farming community, Department of Soil Conservation, Ministry of Agriculture and Food Security, National University of Lesotho (NUL).

Country Programming Framework (CPF) Outputs

CPF Outcome 3: By 2017, natural resources are sustainably managed by local authorities and community groups.


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Background

Lesotho is a landlocked country completely surrounded by the Republic of South Africa. More than 76 percent of the country's population lives in rural areas, where the main source of income is subsistence rain-fed agriculture. Land-use patterns in Lesotho have been mainly determined by historical circumstances and agro-ecological conditions. In the past, hilltops and mountain sides were used as fortresses and many settlements were confined to these strategic locations, while flat plains and fertile valleys were used for crop farming and remote mountains for grazing. This has largely remained the pattern of land-use in the country although population pressure and urbanization have forced widespread encroachment of settlements in areas traditionally reserved for agriculture. The shortage of arable agricultural land has also tended to concentrate cultivation on mountain slopes, with devastating results for slope and soil stability, a decrease in the quality of rangelands and reduced agricultural productivity. The country's soils are thus under severe pressure as a result of natural conditions and human activities, triggering soil erosion, land degradation and depletion of soil organic matter. Soil data in Lesotho are limited and the lack of systematic and organized soil information impedes the management and monitoring of soil properties.

A basic prerequisite for sustainable soil and land management is systematic soil data collection through field surveys and the continuous monitoring of soil properties organized into a database and soil information system (SIS). Agricultural decision-making also relies on accurate soil data and information in order to guide the sustainable management of soils. Given the existing pressures on soils, there is a need to establish an SIS with accurate and up-to-date soil information, based on state of the art methods and digital soil mapping tools. This will enable sustainable land management and will allow for the efficient monitoring of land degradation processes. The Lesotho SIS (LESIS) will also enable applications for food security, climate change mitigation and adaptation, the provision of ecosystem services, land suitability analysis, land degradation assessment, etc. It will store data and information about the spatial variability of soil types and soil properties integrated with such variables as climate, vegetation, geology, relief conditions and hydrology. Once in place, the system can be periodically upgraded and updated with new information and can serve as a baseline tool for monitoring soil conditions.

Impact

Although the project was small in size it will have a far reaching influence on the country's ability to achieve SDG targets. It has provided important baseline information for SDGs 13 and 15. More importantly, it has provided valuable investment decision support tools for improving agriculture and agribusiness. The information provided should help farmers and other decision-makers to invest better in the sector by applying appropriate soil enrichment inputs and understanding which crops are suitable for which land.

Achievement of results

The main output was the establishment of the Lesotho Soil Information System, containing national quantitative soil property maps, soil type maps and various applications, including soil suitability maps. Technical capacities for soil survey and digital soil mapping were also developed in all participating ministries and departments, as well as the National University of Lesotho. The results of the project were communicated to all key stakeholders through workshops and policy briefs. The country now has a well-functioning soil information system that is easily accessible to the general public, farming community and other interest groups via a web-based portal. The system allows government advisory services to supply farming communities with credible information and data for better decision-making.

Implementation of work plan

Project activities were successfully conducted in line with the work plan until the collection and analysis of supplementary data, which were constrained by two critical variables: the timely procurement and delivery of critical field and laboratory equipment, and the profiling of soil and collection of soil samples from farmers' fields. The latter was delayed by about five months to allow farmers to harvest their crops, while critical laboratory equipment and supplies had to be procured from abroad. These unforeseen delays necessitated a ten-month project extension.

All project activities were implemented well within the available budget.

The risks envisaged in the Project Document included limited technical expertise and a lack of commitment among key stakeholders, institutional conflicts over project ownership and a failure to maintain the established SIS. The most significant of these was the failure by key government institutions to collaborate and provide the required information and personnel. This was mitigated by the decision to anchor the project within the soil science community, which understands the need for easily accessible and comprehensive soil information. One unforeseen risk related to the fact that all servers at line ministries and departments had to be linked to the Ministry of Information. This control measure obscures the visibility of the information system and restricts traffic. To ensure unimpeded access to LESIS, MFRSC will have to engage the Ministry of Information to explore ways of exercising control and oversight without compromising access to information.

Follow-up for government attention

It is recommended that MFRSC and the Ministry of Information collaborate in order to find a way of ensuring unimpeded access to LESIS, without running the risk of compromising security or limiting access to information.

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Sustainability

1. Capacity development

Although current policies and legal frameworks may not be sufficient to support the long-term sustainability of the project, several programme-level initiatives indicate that the project outcome will be sustained. Pipeline projects are already using the results of the project to improve their design. They will continue to build and update the available soil information database, using and improving the existing technical and operational capacities within the sector.

The project operated within existing government structures and technical, functional and operational capacity gaps were addressed, enabling these structures to perform as expected. Critical infrastructure was provided and key operatives in the relevant government institutions are now proficient in its use. In addition, the project delivered software and soil assessment tools with free access to online support. This should enable government personnel and institutions to operate and maintain the soil information system for years to come

The project successfully built effective alliances, not only with MFRSC but also with soil scientists and Global Information System (GIS) experts from several line ministries and institutions of higher learning, including NUL, the Department of Agricultural Research (DAR), the Department of Soil and Water Conservation, the Department of Meteorology, the Department of Crops and the Department of Geology. These institutions are aware of their respective capabilities and will continue to collaborate and complement one another after the project.

During the design the project had planned to use proprietary (closed source) software. However, it became clear that the host department would not be in a position to sustain this investment after the project and the decision was made to use open source software. This has made it easier for government institutions to maintain and update the information system with no external support.

2. Gender equality

The activities implemented under the project were largely gender neutral and the participation of different genders reflected the demographics of the respective technical departments. Project input into follow-up policy dialogue and associated policy decision-making should benefit all genders equally.

Beyond the institutional capacities developed, the most tangible project result is the existence of a well-functioning SIS. This will be accessible to all people, regardless of gender.

3. Environmental sustainability

The project outcomes will have a profound influence on managing the environment and related natural resources. It provides important base information for decision-making in these areas and promotes sustainable soil management, which is key to attaining the sustainable use of natural resources and protection of the environment.

4. Human Rights-based Approach (HRBA) – in particular Right to Food and Decent Work

Human rights were fully observed during project implementation. Proper protocols were followed in engaging communities and seeking their concurrence for digging pits on private and communal land.

5. Technological sustainability

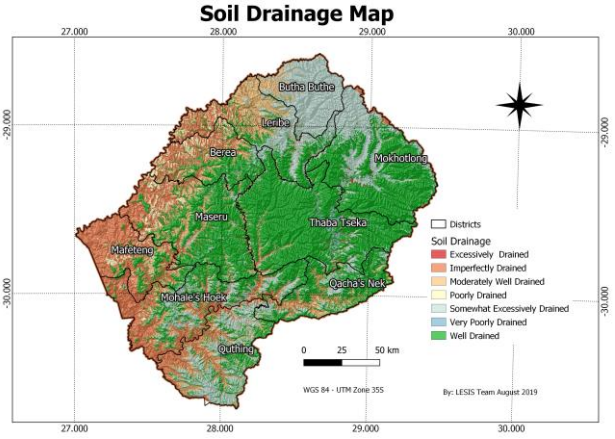
The technology introduced was highly appropriate to Lesotho. The method of collecting soil data embraced new technology in place of pen and paper. For the development of the SIS, open source software was preferred to closed source software as it was more affordable and offered longer-term sustainability.

The project was instrumental in developing the knowledge and capacities of key government personnel and institutions. The relevant departments and units are now able to apply their advanced GIS skills as a result of the training and provision of GIS equipment and accessories. The capacity of DAR was similarly boosted by the acquisition of laboratory equipment and supplies. The project also enhanced collaboration across different ministries, facilitating access to information and technical knowledge.

Key stakeholders and beneficiaries should be able to sustain the momentum generated by the project with relative ease. All products delivered under the project were created by them with minimum guidance from the lead technical unit. Most technical support was provided virtually and those channels of communication will continue to be open within the established professional networks. The professional networks and rapport developed during implementation will facilitate easy access to technical advice.

6. Economic sustainability

The results of the project have informed the design of major investment projects and its products will continue to be used by farmers and other decision-makers for years to come. The key products of the project are accessible free of charge to beneficiaries and stakeholders on the web-based portal.



Documents and outreach products

- LESIS Soil Survey Manual. Mobile applications in soil survey 2018. Mapeshoane et al. Maseru, July 2018. 41 pp.
- Lesotho Soil Information System Laboratory Protocols. Mapeshoane et al. Maseru, September 2018. 36 pp.
- Soil profile catalogue.
- Key Policy Issues for Sustainable Soil Management and Food Security in Lesotho. Mapeshoane. Maseru, December 2019. 18 pp.
- Soil Atlas.

ACHIEVEMENT OF RESULTS - LOGICAL FRAMEWORK

Expected Impact	**Attainment of sustainable agricultural growth for improved national and household food security and poverty reduction**	
Outcome	Improved capacities of national stakeholders on digital soil mapping and a fully functional and easily accessible national SIS	
	Indicator	1. Existence of soils data base. 2. A robust web-based national SIS created and functional. 3. Availability of soil suitability and fertility maps.
	Baseline	1. Patches of rudimentary soil information scattered across different institutions. 2. National SIS non-existent. 3. Land cover maps and maps of other environmental variables recently developed with FAO support.
	End Target	1. All available soil data assembled into one database and the identified data gaps filled. 2. Functioning and easily accessible system up and running by the end of the project. 3. Soil information and environmental covariates (including land cover, climatic data, etc.) collated.
	Comments and follow-up action to be taken	1. Both operational and technical capacities of key stakeholders were developed under the project. Advanced GIS equipment and associated accessories were procured for the GIS unit of MFRSC while DAR's soil laboratory received state of the art equipment and supplies for analysis of soil samples. In addition, the project procured and installed a dedicated server for LESIS. These critical acquisitions combined with technical training in GIS, soil survey, laboratory analysis, digital soil mapping and database management strengthened existing national capacities, in order to deliver digital soil maps for the entire country and establish a well-functioning and easily accessible national SIS. The soil information database, which combines legacy data and newly collected data, is now accessible at https://lesis.gov.ls. 2. A fully functional SIS was developed. Hosted by MFRSC, it will be updated continually by the soil science community of Lesotho through the established institutional arrangements and professional networks. It should be easy to maintain as it has largely used open source software. The plan to use proprietary (closed source) software was dropped when it was realised that the government would not be able to meet the start-up costs and annual fees. 3. All the required variables for developing soil suitability maps for various crops have been collected and are easily accessible through the established web-based portal. Fertility maps have also been generated and made accessible for use by farmers and other decision-makers. These provide general guidance on soil properties for different areas. Farmers are, however, advised to continue to take their soils for testing as different fields may have different chemical properties depending on the level of adulteration through different use and application of fertilizers and other productivity-enhancing products.

Output 1	Lesotho National Soils Map developed (digital soil maps, overlaying of digital soil map with existing topographic data set and land cover maps)		
	Indicators	Target	Achieved
	Lesotho National Soils Map developed.	One National Soils Map developed.	Yes
Baseline	0		
Comments	The national soil maps (digital) were developed and are accessible via the web-based portal. They show key soil physical properties such as soil types, texture and bulk density, and chemical properties such as organic carbon stock, exchangeable sodium percentage, nitrogen, phosphorus and potassium. They also describe soil conditions in terms of pH, fertility, erosion, salinity, and depth. Predominant soil management practices and associated threats are clearly articulated in these maps.		
Activity 1.1	Inception workshop		
	Achieved	Yes	
	Comments	Inception workshop conducted.	
Activity 1.2	Compilation and digitalization of all existing cartographic and thematic soil data		
	Achieved	Yes	
	Comments	This activity was completed during the first six months of project implementation. Initial consultative meetings between players were instrumental in convincing holders of soil legacy data to release it as a starting base for developing a national soil information database. The benefits of the new SIS to the broader soil science community and other users were highlighted and stakeholders known for hoarding legacy data were convinced to release it to the project.	
Activity 1.3	Development of a work plan and methodology for complementary soil survey		
	Achieved	Yes	
	Comments	A work plan and methodology for a complementary soil survey were developed with the guidance of the international consultant and his local counterpart. Protocols for collecting soil samples were emphasized during the training and were further supported by written Soil Survey Standard Operating Procedures. This helped to ensure consistency in the collection of critical data by different teams.	
Activity 1.4	Soil survey on preselected areas		
	Achieved	Yes	
	Comments	This activity was completed as per the work plan. It involved the use of a Digital Soil Mapping model for randomly generating points for soil surveys. In total, 238 survey points were generated using this model. Of these points, 169 area and soil profile descriptions were done, which surpassed the set threshold of 150 points.	
Activity 1.5	Preparation of soil legacy profile database		
	Achieved	Yes	
	Comments	The profiling of the soil legacy data was the first activity to be done under this project. The outcome of this profiling formed the core structure of the Lesotho Soil Information System. It provided building blocks for the primary soil data that was collected and analysed later.	
Activity 1.6	Laboratory analysis of collected soils		
	Achieved	Yes	
	Comments	All soil sampled analysis to determine their chemical and bio-physical properties	
Activity 1.7	Selection and utilization of appropriate methods and approaches for preparation of digital soil maps		
	Achieved	Yes	
	Comments	Appropriate methods and approaches were employed during the preparation of digital soil maps. The guidance of the international consultant and lead technical unit was key in this process. More importantly, the dedication of the national project core team comprising soil science and GIS experts was instrumental in accomplishing this task.	

Output 2	Technical capacities for soil survey and digital mapping developed (GIS, soil survey and laboratory analysis)		
	Indicators	Target	Achieved
	Technical staff enabled to conduct soil surveys and digital mapping.	Equipment provided and capacity built in relevant technical skills.	Yes
Baseline	0		
Comments	The project contributed immensely to the development of technical capacities of government institutions for soil survey and digital soil mapping. At institutional level, the technical capacities of both GIS and soil laboratory units were enhanced through acquisition of critical equipment and supplies. Technical capacities and skills of individuals working in these units and other related departments and ministries were developed through face-to-face training and virtual mentoring by the FAO lead technical unit and consultants. It is through the use of these collective capacities that Lesotho has a fully functional SIS, which is fully owned by the Government and the soil science community of Lesotho.		
Activity 2.1	Procurement of equipment and supplies		
	Achieved	Yes	
	Comments	Critical GIS equipment and accessories were procured for the GIS unit of MFRSC. The project also procured laboratory equipment, including the maintenance (replacement of missing parts and recalibration) of old equipment. Supplies in the form of reagents and other consumables were procured to facilitate analysis of large soil samples by the soil science laboratories of DAR and NUL. Most of the equipment and supplies could not be found in the country and had to be imported from South Africa and beyond. Some deliveries were late, delaying the soil analysis.	
Activity 2.2	Upgrade technical capacities and skills of GIS staff		
	Achieved	Yes	
	Comments	GIS staff from all participating ministries and the project core team were trained and given hands-on practical training in critical GIS skills and digital soil mapping.	
Activity 2.3	Training in soil survey and laboratory analysis		
	Achieved	Yes	
	Comments	Training for all staff involved in collection and analysis of soil samples was undertaken under the leadership of the national consultant and her government counterparts in agricultural research.	
Activity 2.4	Training in database management and in web-based soil information system		
	Achieved	Yes	
	Comments	This was the first training that was provided by the lead consultant. It helped project stakeholders to digitize and make all soil legacy data accessible through a web-based portal	
Activity 2.5	Installation of a web-based GIS server		
	Achieved	Partially done	
	Comments	The process of setting up the server is not yet completed. The GIS unit of the Ministry of Forestry, Range and Soil Conservation is currently being supported by Global Soil Partnership secretariat (FAO) to complete the set-up/installation. Currently, access to Lesotho Soil Information Services is through the cloud services	
Activity 2.6	Training in digital soil mapping techniques and data analysis		
	Achieved	Yes	
	Comments	This task was fully accomplished, the skills acquired were used and fine-tuned during the actual development of the digital soli maps. The core team is well equipped to maintain and update these digital soil maps.	

Output 3	Digital soil property maps and soil suitability applications developed (soil suitability maps for selected crops)		
	Indicators	Target	Achieved
	Digital soil property maps and soil suitability maps for selected crops developed.	Digital soil maps developed. Soil suitability maps developed for selected crops.	Yes
Baseline	0		
Comments			
Activity 3.1	Selection of suitable approaches for digital soil mapping		
	Achieved	Yes	
	Comments	With the guidance of the FAO technical unit and the lead consultant, the project selected and implemented suitable approaches for digital soil mapping that facilitated the delivery of high-quality soil maps.	
Activity 3.2	Development of digital soil maps		
	Achieved	Yes	
	Comments	Digital soil maps were developed. They have since been uploaded in the soil information system and are accessible through this web portal: https://lesis.gov.ls	
Activity 3.3	Validation of soil property maps with field measurement data		
	Achieved	Yes	
	Comments	Field data systematically collected, analysed and validated	
Activity 3.4	Preparation of soil suitability maps for selected crops and land use		
	Achieved	Yes	
	Comments	The necessary information (bio-physical soil properties) for preparing suitability maps was collected across the country. Farmers and other decision-makers can use this information to decide what crops to grow in different areas and what soil enrichment inputs they will require for that particular area with regard to the crop of their choice and whether such an investment makes technical and business sense.	
Activity 3.5	Preparation of metadata for all produced GIS layers and digital soil maps		
	Achieved	Yes	
	Comments	All generated maps have metadata	
Activity 3.6	Training in the application of digital soil maps for production of soil property maps (texture, pH, soil organic matter, CIC, N, P, K, etc.) and land suitability maps		
	Achieved	Yes	
	Comments	Training and mentorship of government technical officers was done by the lead consultant with the support of his national counterpart. It involved the broader soil science community including GIS experts and technicians from different technical departments of government.	

Output 4	Dissemination of results and information		
	Indicators	Target	Achieved
	Web-based and tangible information.	Results and information disseminated.	Yes
Baseline	Limited and outdated soil information.		
Comments	Information and knowledge generated through this project was disseminated through regular meetings with key stakeholders, progress reports and media briefs. The first platform for information dissemination was the project launch workshop. This workshop generated a lot of interest from different stakeholders and paved a way for meaningful collaboration between different players including holders of critical legacy data. The project wrap-up workshop presented very interesting products of this project and stakeholder were very impressed with what the project had achieved and appreciated the level of efforts and dedication shown by the project team in delivering those products under such difficult circumstances.		
Activity 4.1	Stakeholder meetings		
	Achieved	Yes	
	Comments	Strategic stakeholder meetings were held to share information on progress and key products of the project.	
Activity 4.2	Produce biannual progress reports		
	Achieved	Yes	
	Comments	The National Project Coordinator provided regular project reporting including submission of mandatory biannual reports	
Activity 4.3	Information and product dissemination for different uses		
	Achieved	Yes	
	Comments	Information and product dissemination has been achieved through several platforms, including workshops and stakeholder meetings. More importantly, key products are accessible through a web-based portal. What still needs to be done is to translate some of the products into the local language for the benefit of the non-English speaking farming community.	
Activity 4.4	Validation or end of project workshop		
	Achieved	Yes	
	Comments	End of project workshop was held and presentations of project progress and related products made. Stakeholders were highly impressed with what the project was able to deliver within two years. Some indicated that they would use the results and information from this project to influence the design and implementation of their land based projects.	
Activity 4.5	Final report		
	Achieved	Yes	
	Comments	Terminal report serves as the final report.	

Partnerships and Outreach
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