



The significance of surface water harvesting structure in Mongolia

EXECUTIVE SUMMARY

Climate change is directly affecting water resources, moisture circulation, land degradation, and desertification in Mongolia. Key drivers include rising temperatures, increased evaporation, shift in rainfall frequency and intensity, and altered seasonal transitions. Over the past 80 years, Mongolia's average air temperature has risen by 2.46 degree Celsius, while total precipitation has declined by 10-30% (Mongolia, 2025). These conditions have strained water availability and, in turn, sustainable livelihood.

As part of the *Scaling up Climate Ambition on Land Use and Agriculture through NDCs and NAPs (SCALA)* project, jointly implemented by UNDP and FAO, to support the advancement of the Nationally Determined Contribution (NDC) and National Adaptation Plan (NAP) goals in the agriculture and land use sector, a system level assessment (SLA) was conducted. The SLA assessed “**Options for surface water collection systems for livestock husbandry and arable farming including suitable construction designs for water reservoirs and selection of suitable locations based on regional climate vulnerabilities**”, to help implement transformative climate action aligned with Mongolia's NDC. Given climate risk and vulnerability profiles, the SLA focused on Uvurkhangai, Gobi-Altai, Zavkhan, and Uvs provinces which locates in mainly Western part of Mongolia.

Key findings

- **Needs of Solutions:** Establishing Surface Water Harvesting Structures (SWHS) offers a viable solution for Mongolia to capture and store water that is otherwise lost during spring snowmelt floods and seasonal rains in grassland areas, while maintaining the ecological river flows. Such structures can play a critical role in climate change adaptation and resilience in the livestock and agricultural sectors nationwide.
- **Limited Integration Among Plans:** Although some policy documents set quantitative targets and locations for building SWHS or ponds, these efforts are often insufficiently coordinated with other relevant policies and plans. Without clear linkages between projects and actions, there is a risk of duplicative tasks and inefficient resource use, which can hinder successful implementation.
- **Absence of Integrated Data Platform:** There is no unified platform to track progress, exchange ideas, and share information among stakeholders. As a result, stakeholders cannot rely on validated data on SWHS construction or easily identify areas requiring additional resources and support. This reduces transparency and impedes collaborative problem-solving.
- **Accountability and Implementation Gaps:** In the absence of a shared platform, it is difficult to implement initiatives effectively, evaluate progress, ensure accountability, or adapt strategies based on real-time feedback. Establishing such a platform would enable efficient data collection, support inter-agency collaboration, and provide valuable insights for resolving on-the-ground challenges at the local level.

Recommendations

The following recommendations, derived from the SLA, aim to strengthen suitability analysis and site selection for SWHS and improve the cost-effectiveness of their development and implementation.

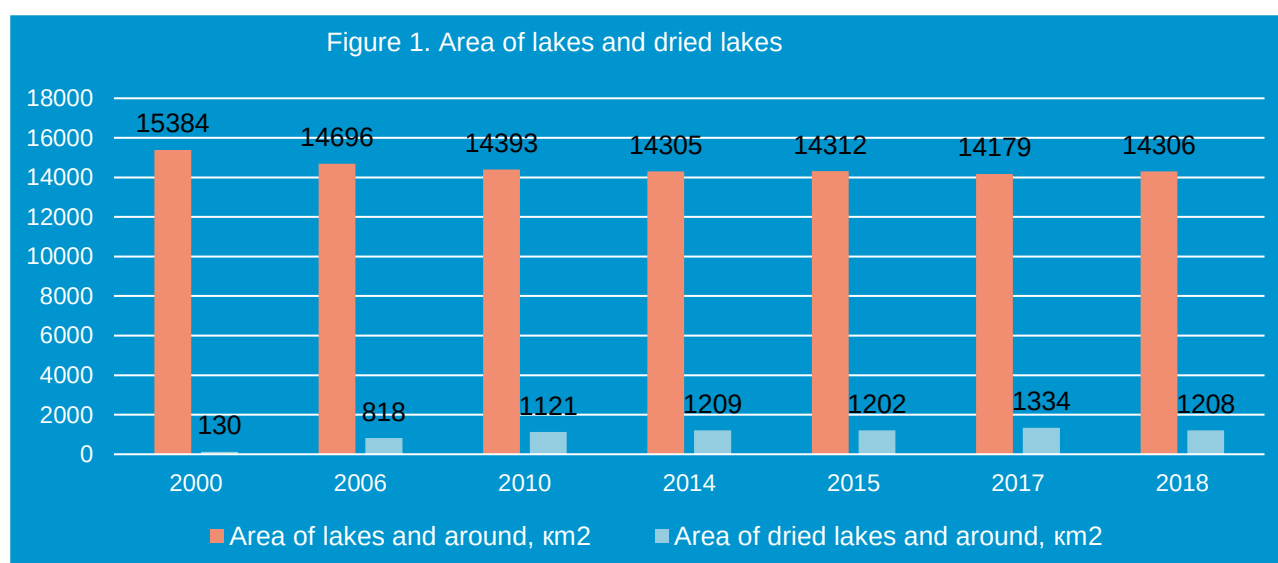
1. **Leverage Existing Experience:** Mongolia has used surface water collecting structures for agriculture and livestock since the 1980s, with some record suggests earlier use. The focus should be on expanding these practices by improving template designs, enhancing monitoring systems, ensuring maintenance, and sharing knowledge.
2. **Site Selection Technology and Database:** Geographical Information System (GIS) and Remote Sensing Technology, including drones, are essential for identifying suitable SWHS locations in each of the 330 soums (administrative unit). By developing Digital Elevation Models (DEMs) and Digital Terrain Models (DTMs) (e.g., slope, elevation, and aspect) using high-resolution satellite and aerial imagery, and overlaying climate, land use, and water data, the most suitable sites can be identified. An integrated, intersectoral database should consolidate all relevant information to support this process.
3. **Standardized Template Design and Classification:** Introduce standard template designs to enhance SWHS durability and maintenance efficiency. Classify SWHS by catchment size, storage volume, and intended usage (agricultural or livestock). This classification will help determine appropriate investment levels, funding needs, and financial sources.
4. **Integrated Management and Funding:** Establish a comprehensive management framework involving relevant ministries, agencies, and local authorities to ensure that SWHS are planned, constructed, maintained, and monitored effectively. Funding strategies should consider multiple sources, including state and local budgets, international grants, and public-private partnerships, to ensure financial sustainability.

BACKGROUND

In recent years, summer rainfall has become less frequent but more intense. Rainfall has also shifted from early spring to late summer months¹, with precipitation increasingly occurring after the natural growth period of plants and crops; this shift accelerates evapotranspiration. At the same time, precipitation during colder seasons, especially winter snowfall, has increased. Heavy snowfall in autumn and winter creates thicker snow cover, imposing significant challenges on pastoral animal husbandry, transportation, and the broader economy (Zamba, 2017).

An estimated 76.9% of Mongolia's territory is affected by desertification and land degradation to varying degrees: 4.7% extremely severe, 18.6% severe, 22.1% moderate, and 31.5% weak (MET, Report on the State of the Environment of Mongolia, 2019-2020).

Satellite data (LANDSAT ETM, TM2, L8) from 2000 to 2018 show that the number of lakes and ponds with an area larger than 0.003 km² have consistently decreased across Mongolia, while the area of dried lakes have generally increased (Figure 1).



Source: Report on the State of the Environment of Mongolia, Ministry of Environment and Tourism, 2015-2016 and 2019-2020

Permafrost areas are also been shrinking: total area decrease by 12.1% from 1940 to 1990, 4% in 1990 to 2000, 13.7% in 2000-2011, a cumulative decline of 29.9% over 70 years. These changes underscore the importance of collecting surface water from the spring snowmelt and summer rainfall, without exceeding ecological river flows, by constructing SWHS and ponds (Tsokhio, 2017). Such measures have significant implications for climate adaptation that most affect the livestock and agriculture sectors.

The legal framework governing the establishment, protection and possess/use of SWHS is defined in the Law on Water. Constructing SWHS using surface water is also reflected in key national policy documents approved by the Parliament of Mongolia and the Government (e.g. Vision 2050, 2024-2028 Action Plan of the Government of Mongolia, NDC Action Plan and NAP). Moreover, the State General Land Use and Management Plan designates, based on land-suitability assessments, 160 locations larger than 5,000 hectares and 619 locations ranging from 2,000 to 5,000 hectares across 18 provinces as state special-use land for constructing SWHS.

However, detailed research is still needed for these areas. SCALA has identified the SWHS assessment as an SLA that can contribute to the transformative climate change action.

¹ Usually, rainfall begins in May or June; however, it has now shifted to occur mainly between June and August.

² The Enhanced Thematic Mapper Plus (ETM+) and Thematic Mapper (TM) is the main instrument on board Landsat-7.

SYSTEM LEVEL ASSESSMENT

According to the SLA work plan “to assess options for surface water collection systems for livestock husbandry and arable farming including suitable construction designs for water reservoirs and selection of suitable locations based on regional climate vulnerabilities”, an assessment was completed in Zavkhan province basin. The assessment combined community feedback using modern technology to develop comprehensive and sustainable approaches for SHWS suitable for local environmental conditions in livestock and agriculture.

The Geographical Information System (GIS) and Remote Sensing Method were used to analyze terrain and climate vulnerability to identify potential SWHS locations. This approach is particularly effective in water-scarce areas. The study covered 10 soums in Zavkhan Province, located in steppe and desert areas with limited water supply. Fourteen suitable locations were identified in Shiluustei soum; of these, three were prioritized (Figure 2) because of the need for more constant water supply for animal husbandry in spring and autumn. After an initial technical evaluation, the selected locations were reviewed with local government and community. This participatory approach ensured that the sites meet both technical criteria and local needs, the options were further narrowed based on community inputs (Figure 3).

Figure 2. Location of 3 SWHS determined in Shiluustei soum, Zavkhan province

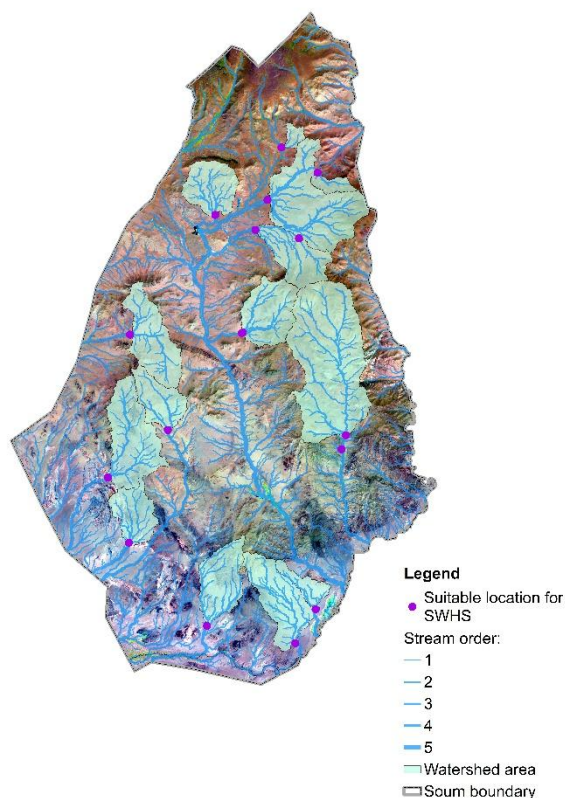
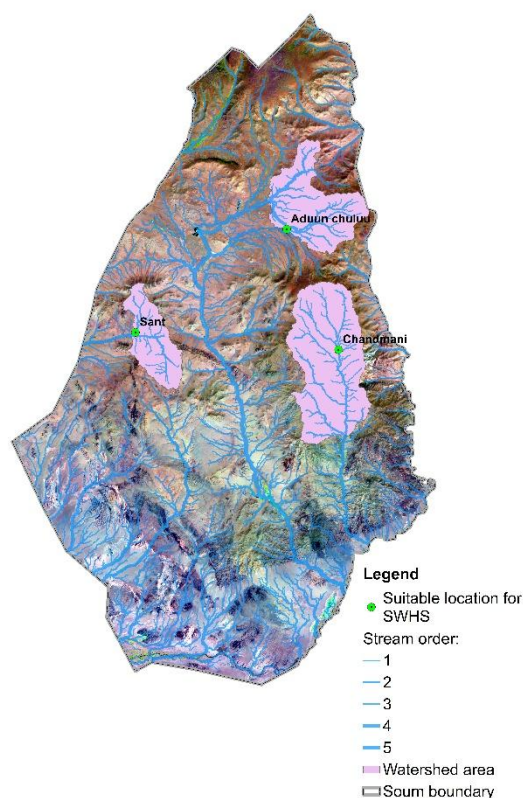


Figure 3. Locations of 3 SWHS determined by local community inputs in Shiluustei soum, Zavkhan province



According to the Water Agency, there were 304 SWHS across the country as of 2024. As part of the SLA, on-site surveys were conducted in Uvurkhangai, Gobi-Altai, Zavkhan, and Uvs provinces in the Western Region of Mongolia. The survey team visited several SWHS to assess their status and siting, including an SWHS built by local government in Shiluustei soum in 2022 (Figure 4).

Under Article 4.1.1 of the Law on Construction, SWHS are classified as "Buildings and Constructions" and , per Article 10.1.2 and 10.1.3, fall within the categories of "low and medium difficulty". Article 39.1 requires that design, technical feasibility studies, engineering calculations, and cost estimates for projects funded by foreign loans or by national and local budgets be developed by authorized individuals or entities under contract with the relevant state administrative organization (e.g., the Construction Development Center).



Figure 4. SWHS built by local government in Shiluustei soum of Zavkhan province in 2022.

Photo credit to: R. Gankhuyag, SCALA consultant

Article 21.1 of the Law on Water states that "water-related activities, including exploration, well drilling, reconstruction, development of water facility design, construction, equipping, installation of water-saving technologies, water examination, and quality audits, must be conducted by a qualified water organization to ensure compliance with safety standards, environmental sustainability, and operational efficiency. A qualified organization will have the technical expertise, appropriate certifications, and experience to manage these tasks effectively, ensuring the delivery of high-quality water services and infrastructure. In practical terms, SWHS designs must be developed by authorized organizations and approved by the relevant state administrative body following a feasibility review, and construction must be carried out by qualified organization.

These regulatory requirements pose challenges for SWHS construction, particularly in the absence of general template designs. When projects are funded by state or local sources, each SWHS, regardless of size or complexity, requires a detailed geological study and design, which must be reviewed and approved by the Construction Development Center in Ulaanbaatar. These steps make the approval process both costly and time-consuming.

RECOMMENDATIONS

Mongolia has traditional practices related to the construction and using SWHS, and several local government initiatives are already in place. However, greater attention is needed to proper use and maintenance. The recommendations below could also contribute to enhancing NDC adaptation targets:

1. **Legal and Budgetary Frameworks:** Amend the Law on Water and Law on Construction to assign responsibilities for designing, budgeting, and constructing low-cost, small-scale SWHS to local governors of the soums. This change would formalize accountability and maintain local initiatives and fundings for SWHS.
2. **Terminology and Classification:** Establish a common terminology and a classification system for SWHS to underpin policy development, research, and project implementation.
3. **Intersectoral Working Group:** Establish an “Inter-sectoral Working Group”, including representatives of ministries and agencies responsible for land, water, climate, and agriculture, to develop a joint database and conduct assessments of SWHS needs for each soum. Classify and rank sites by size and cost, based on local needs and community inputs.
4. **GIS and RS Methods for Site Assessment:** Use Geographic Information System (GIS) and Remote Sensing (RS) technologies to assess and identify suitable locations for SWHS in every soum. Create a unified, intersectoral database by integrating data from Ministry of Food, Agriculture and Light Industry (MOFALI), Ministry of Environment and Climate Change (MECC), Agency for Land Administration and Management, Geodesy and Cartography (ALAMGAC), Institute on Geography, Geo-ecology and National Agency Meteorology and Environmental Monitoring (NAMEM), among others.
5. **Funding Solutions:** Define and rank required SWHS locations in each soum based on need and significance. Potential funding sources include:
 - a. State and local budget;
 - b. International donor funding;
 - c. Private sector, entities and citizens’ initiatives and their funding
 - d. Blended finance.
6. **Template Design for Low-Cost SWHS:** Evaluate the current use of the country’s 304 SWHS, update the six proposed template designs (Figures 6.a-6.f) and approve and publish final versions.
7. **Feasibility Studies for Large SWHS:** Conduct feasibility studies for large SWHS and identify investment sources, including the state and local budget, international donors and blended financing modalities.
8. **Common Database and Knowledge Platform:** Establish and maintain an integrated platform to share data and experience on SWHS management, technological solutions, materials, achievements, and challenges.
9. **Increase Flood Resilience:** In areas prone to flooding, adapt SWHS designs to withstand seasonal floods, potentially incorporating stronger materials or overflow mechanisms.
10. **Support Community Initiatives in High-Demand Areas:** Expanding SWHS in regions such as Shiluustei and Sagil soums where community demand is high, to maximize resource availability and support agricultural growth.
11. **Protection and Maintenance:** Engage local communities in routine maintenance and establish safeguards against misuse (e.g., dumping), to enhance longevity and utility.
12. **Cabinet Resolution:** In line with regulatory procedures, MECC or MOFALI could prepare a Cabinet Resolution to implement the actions above for SWHS development.

To simplify approval by authorized organizations and the relevant state bodies, six nationwide “template designs” for SWHS have been developed under the SLA, reflecting Mongolia’s varied landscapes and natural conditions (Figures 6.a – 6.f);

- 6 a. Template Design of Conventional SWHS;
- 6 b. Template Design of Cliff SWHS in rocky terrain;
- 6 c. Template Design of Gully crossing SWHS;
- 6 d. Template Design of Cascade style SWHS;
- 6 e. Template Design of SWHS to collect surface runoff from spring;
- 6 f. Template Design of SWHS to collect water from dry riverbeds in Gobi region.

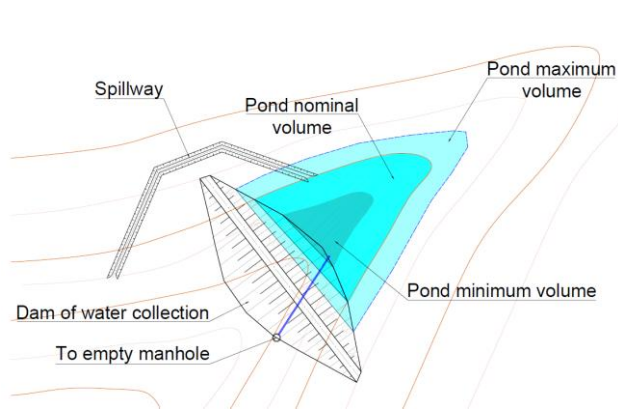


Figure 6 a: Template Design of Conventional SWHS

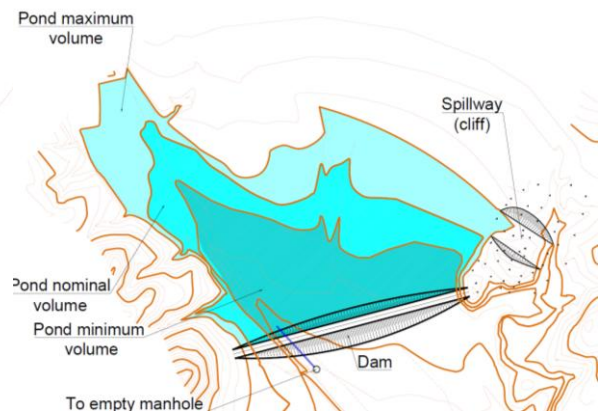


Figure 6 b: Template Design of Cliff SWHS

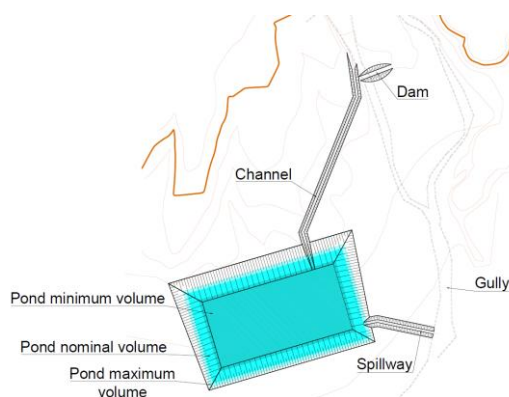


Figure 6 c: T Template Design of Gully crossing SWHS

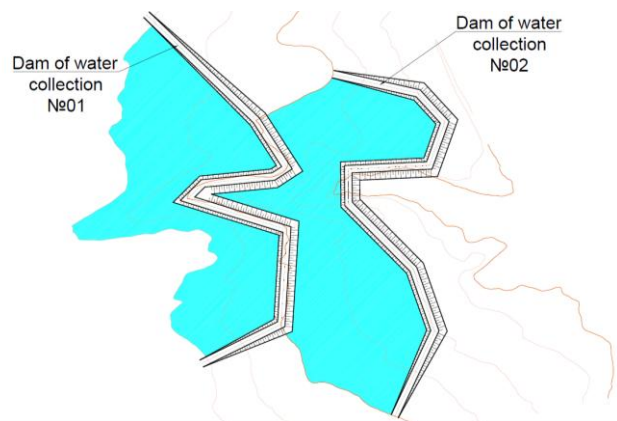


Figure 6 d: Template Design a Cascade SWHS

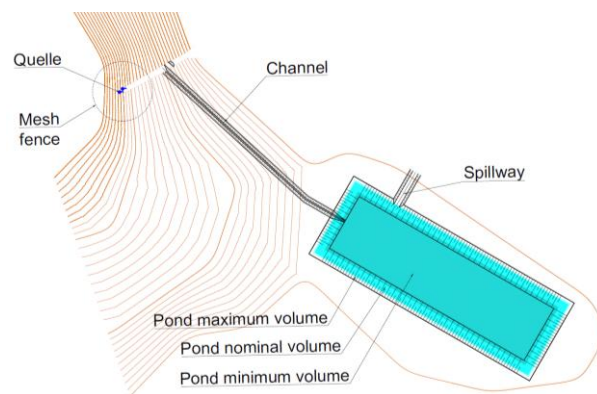


Figure 6 e: Template Design a SWHS to collect surface runoff from spring

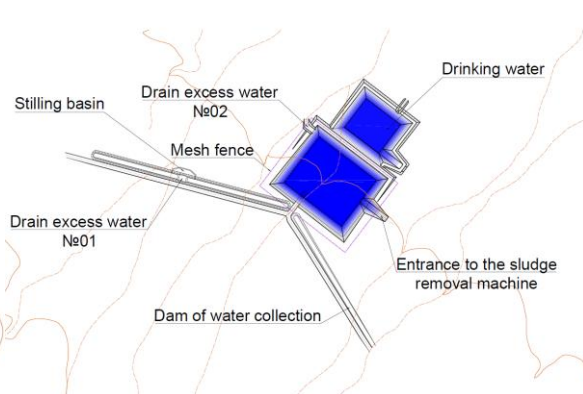


Figure 6 f: Template Design a SWHS to collect water from dry riverbeds in Gobi region

These designs enable more efficient SWHS construction in compliance with Mongolia's Construction and Water laws. The six templates serve as cost-reducing models that can be further refined by evaluating the 304 existing SWHS. Using templates is expected to lower expenses, as adjustments to drawings and engineering requirements would be needed for different pond sizes. Pre-approved designs and streamlined workflows would further reduce costs. In addition, most labor, materials, transport, and equipment can be sourced locally using simple, low-cost technologies. Overall adopting SWHS template designs will reduce design complexity and costs while providing practical, efficient, and resource-appropriate solutions for construction.

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AUTHOR

Gankhuyag Radnaabazar, SCALA programme consultant

EDITORS

Krib Sitathani, Regional Coordinator for Asia Pacific Climate Promise and SCALA, UNDP
Saruul Dolgorsuren, National Project Coordinator, Climate projects, UNDP
Zolzaya Sambuunjam, SCALA project Technical Officer, UNDP

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Scaling up Climate Ambition on Land Use and Agriculture through Nationally Determined Contributions and National Adaptation Plans (SCALA), funded by the German Ministry of Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN) through its International Climate Initiative (IKI). SCALA responds to the urgent need for increased action to cope with climate change impacts in the agriculture and land use sectors. The twenty million euro programme will support at least twelve countries in Africa, Asia and Latin America to build adaptive capacity and to implement low emission priorities.

Country support includes strengthening policies, adopting innovative approaches to climate change adaptation and removing barriers related to information gaps, governance, finance, gender mainstreaming and integrated monitoring and reporting. To achieve this shift, the programme will engage the private sector and key national institutions.

SCALA supports countries to develop the capacity to own and lead the process to meet targets set out in their National Adaptation Plans and Nationally Determined Contributions under the Paris Agreement, and to achieve the Sustainable Development Goals. The SCALA initiative builds on another FAO-UNDP led programme, Integrating Agriculture in National Adaptation Plans (2015-2020) which is currently phasing out.

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