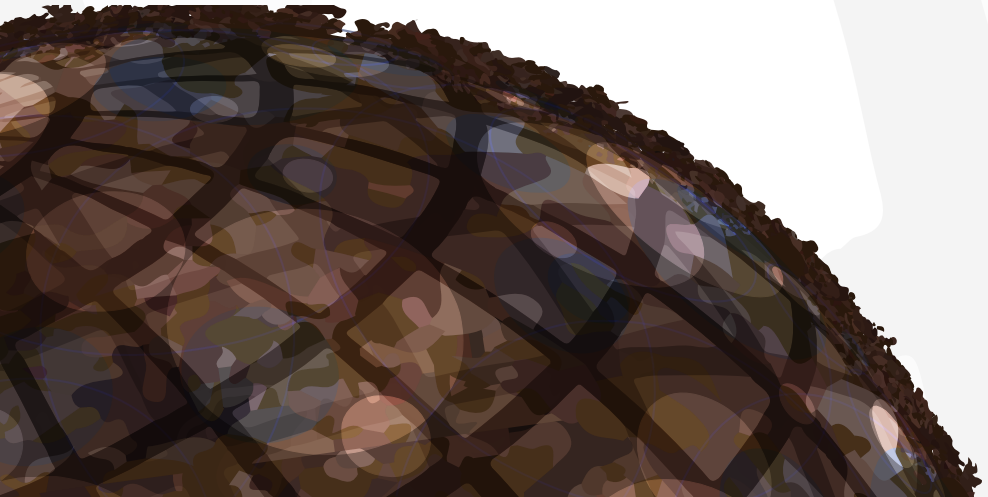
Food and Agriculture Organization of the United Nations

SOIL SALINITY MAPPING

Country Guidelines and Technical Specifications for Global Mapping of Salt-Affected Soil (GSSmap)



GLOBAL SOIL PARTNERSHIP

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Summary

This guideline is intended to support countries to prepare data for updating their national soil information of salt-affected soils. Salt-affected soils are groups of soils with high content of neutral salts and/or high amounts of sodium ions. Currently, there is no consistent recent update of their global distribution. GSP is therefore mobilizing countries to update their national soil information and contribute to updated global distribution of salt-affected soils. This document is instrumental in the mobilization and harmonization of data and procedures. It outlines data requirements, approaches, and procedures for contributing to update of the global map of salt-affected soils

Approach for mapping salt-affected soils			
Approach	Classification of salt-affected soils using measured soil indicators		
	Harmonization of soil indicators and classification method		
	Spatial modelling of soil indicators		
Input data requirements			
Data	Data type	Variables	Units
Soil data	Georeferenced soil profile data (between 0-100 cm of soil depth)	EC	dS/m
		pH (H_20)	-
		ESP	%
		Soluble ions[*]	*cmol/kg*
		TSS[*]	*g/l*
Soil forming factors	Climate (Mean annual)	Rainfall	mm
		Min Temperature	°C
		Max Temperature	°C
	Land use/cover	cover/use types	-
	soil map	soil types	-
	DEM	Elevation	m
	Remote sensing land surface reflectance	Visible (RGB) reflectance	-
		IR reflectance	-
		SWIR reflectance	-
	Geology	Lithology types	-
Other data	Hydrogeology[*]	Groundwater level	m
	Degradation[*]	Degradation types	-
	Distance to the coastline	Distance	m
Output product specification			
Products (Maps)	Electrical Conductivity (dS/m), pH(water), Exchangeable Sodium Percent		
	Salt-affected soils and uncertainty (EC, pH, ESP, salt-affected soils)		
Depth	Topsoil (0-30 cm)	Subsoil (30-100 cm)	
Extent	National level raster maps (spatial resolution of 1 km or 30 Arc-Second)		
Projection	WGS 84 (Decimal Degrees Geographic)		
Uncertainty	Width of prediction interval at 95% confidence interval		
Validation	Validation Statistics (RMSE, ME, R^2/Kappa Index)		
Documentation	Metadata (Metafile)		
Delivery	Online (GSP Data Submission Tool) on or before 30 April 2020		

[*]Optional

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List of abbreviation

CSIRO	-	Commonwealth Scientific and Industrial Research Organization
DEM	-	Digital Elevation Model
DSM	-	Digital Soil Mapping
EC	-	Electrical conductivity
ESP	-	Exchangeable Sodium Percent
FAO	-	Food and Agriculture Organization
FP	-	Focal Point
GloSIS	-	Global Soil Information Service
GSOC	-	Global Soil Organic Carbon
GSP	-	Global Soil Partnership
GSSmap	-	Global Map of Salt-Affected Soils
ICBA	-	International Center for Biosaline Agriculture
IIASA	-	International Institute for Applied Systems Analysis
INSII	-	International Soil Information Institutions
ISRIC	-	International Soil Reference and Information Centre
ITPS	-	Intergovernmental Technical Panel on Soils
JRC	-	Joint Research Centre
ME	-	Mean Error
MODIS	-	Moderate Resolution Imaging Spectroradiometer
NIR	-	Near Infrared
OLI	-	Operational Land Imager
PA	-	Plenary Assembly
P4WG	-	Pillar Four Working Group
QA	-	Quality Assurance
QC	-	Quality Control
RMSE	-	Root Mean Square Error
SDF	-	Soil Data Facility
SAR	-	Sodium Absorption Ratio
SWIR	-	Shortwave Infrared

1 Introduction

1.1 Background

Salt-affected soils are groups of soils with high content of soluble salts and/or high amounts of sodium ions. They cause high osmotic potential in the soil, which limit easy exchange of water and nutrients with plant roots. Consequently, mostly salt-tolerant plants are the dominant vegetation types in these soils. Despite their negative impacts, they have numerous economic potential especially if well managed (Wicke et al., 2011[1]). One of the challenges affecting full exploitation of their potential and sustainable management is the inadequate update of their spatial distribution. Although they occur in all continents at different levels of salt concentration, there is no recent update of their global distribution. Current available reports were those that were collected in the early 1970s, which portrayed the global distribution of affected areas to be about 1 billion hectares (Abrol et al., 1988[2]; (FAO/IIASA/ISRIC/ISS-CAS/JRC, 2008[3]; Wicke et al., 2011). GSP 6th Plenary Assembly (PA) discussed this gap and the need to address sustainable management of salt-affected soils. Subsequently, the Assembly requested GSP to conduct a global assessment and compile a Global Soil Salinity Map (GSPPA-VI/18/Report Item 3.4).

Global Map of Salt-affected Soils (GSSmap) is focused on updating the global and country-level information of salt-affected soils and lay ground for future periodic monitoring of these soils. The global map will be an integration of the country-level maps, which implies that the country-level maps will first need to be updated. Therefore, prominence is given to country-level activities to produce updated status of salt-effected soils at this level. Due to heterogeneity and asynchrony of input data for mapping salt-affected soils, this guideline seeks to harmonize the required data, processing steps, and product specification in order to reduce potential uncertainties that come with diversities in data and methods.

1.2 Global soil partnership

The Global Soil Partnership was established in December 2012 as a mechanism to develop a strong interactive partnership and enhanced collaboration and synergy of efforts between all stakeholders. From land users through to policy makers, one of the key objectives of GSP is to improve the

[1]Wicke, B., Smeets, E., Dornburg, V., Vashev, B., Gaiser, T., Turkenburg, W., Faaij, A., 2011. The global technical and economic potential of bioenergy from salt-affected soils. Energy and Environmental Science 4, 2669-2681

[2]Abrol, I.P., Yadav, J.S.P., Massoud, F.I., 1988. Salt-affected soils and their management. FAO Soils Bulletin 39. FAO, Rome

[3]FAO/IIASA/ISRIC/ISS-CAS/JRC, 2008. Harmonized world soil database (version 1.0). Rome: FAO

governance and promote sustainable management of soils. Since its creation, GSP has become an important partnership where global soil issues are discussed and addressed by multiple stakeholders.

The mandate of GSP is to improve governance of the limited soil resources of the planet in order to guarantee agriculturally productive soils for a food secure world. In addition, it also supports other essential ecosystem services in accordance with the sovereign right of each Member State over its natural resources. In order to achieve its mandate, GSP addresses five pillars of action to be implemented in collaboration with its regional soil partnerships (Figure 1.1).

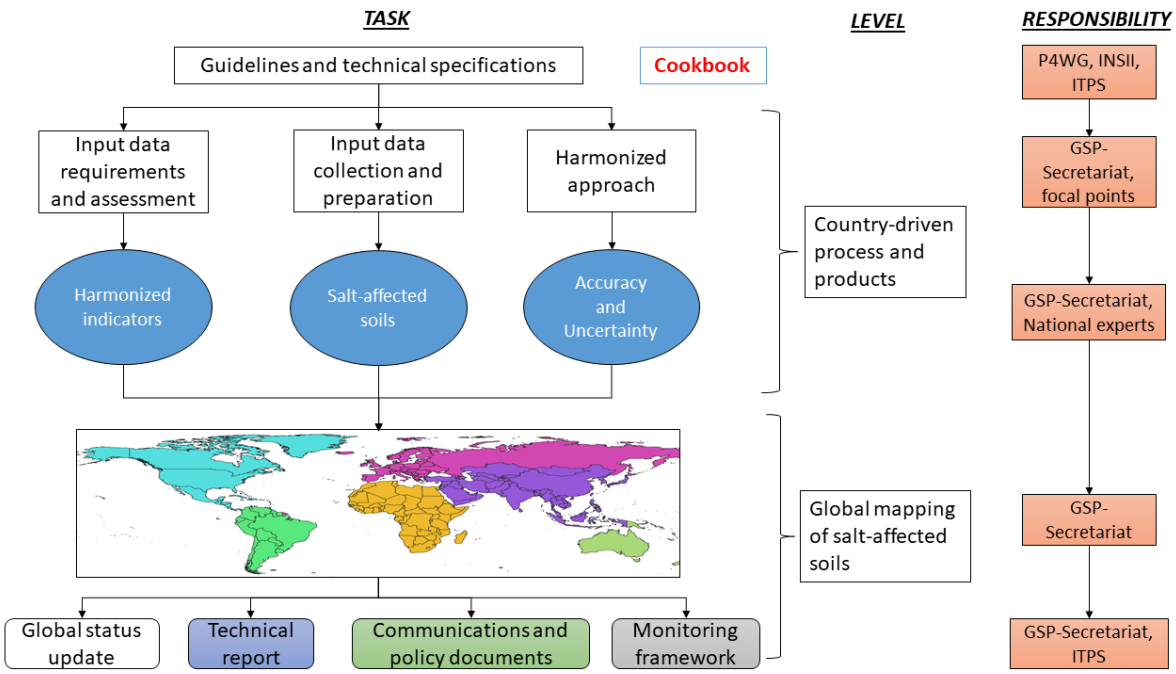
1.2.1.1 Figure 1.1: GSP Pillars (source: http://www.fao.org/global-soil-partnership/pillars-action/en/)

Pillar Four of GSP builds an enduring and authoritative global system (GloSIS) to monitor and forecast the condition of the Earth's soil resources and produce map products at the global level. The secretariat is working with an international network of soil data providers (INSII - International Network of Soil Information Institutions) and the Pillar 4 Working Group (P4WG) to implement data related activities. INSII forms the backbone of Pillar 4 and is supported by a technical working group

of soil information experts nominated by GSP Regional Soil Partnerships (P4WG). Among other tasks, this working group elaborates additional guidance for developing soil data products, which build on existing and new national and other local soil information, and for which extracts of such data fit the product scheme of the global soil information system. Technical documentation including product specifications and technical manual for soil salinity mapping will be prepared through INSII and Pillar 4 Working Group with the technical support of the ITPS (Intergovernmental Technical Panel on Soils), ICBA (International Center for Biosaline Agriculture) and GSP Soil Data Facility.

1.3 Country-driven approach and tasks

GSP has developed and successfully tested the country-driven approach for global soil information products. This approach places emphasis on country-level activities and soil information ownership. The countries contribute soil information to GSP for global integration. Global mapping of salt-affected soils will follow this approach (Figure 1.2).



1.3.1.1 Figure 1.2: Country-driven framework for global mapping of salt-affected soils

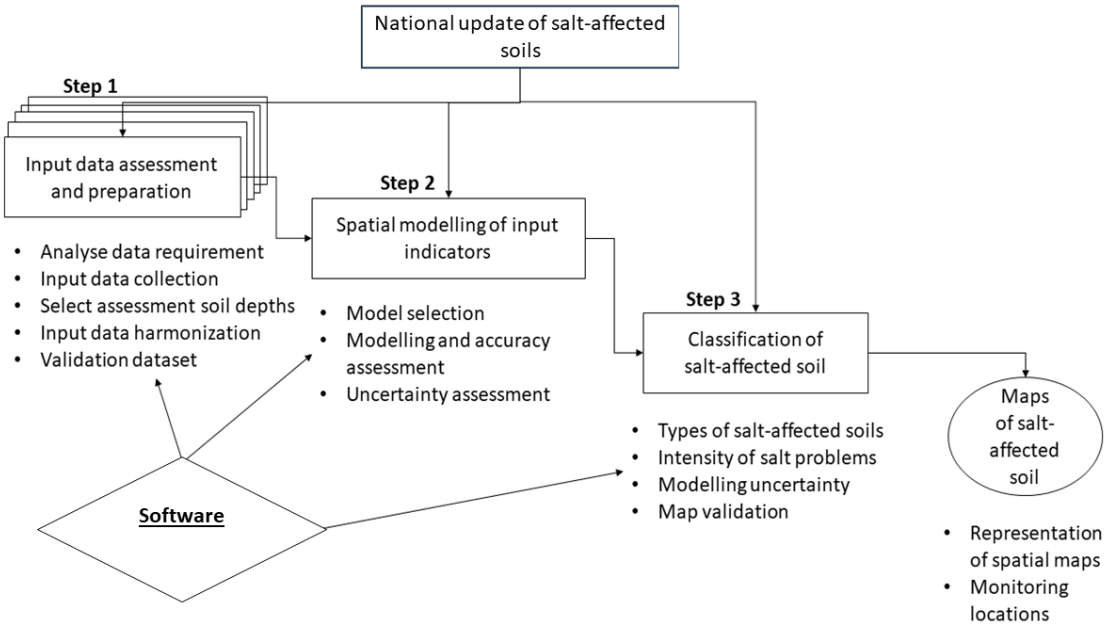
This guideline outlines the input data requirements, data preparation, and specification of the expected soil information products to contribute to the global update of salt-affected soils. P4WG, INSII and ITPS developed the guideline. The guideline is expected to guide the countries in input data and personnel mobilization under the coordination of country focal persons (FP) and GSP-Secretariat. It also gives a roadmap and responsibilities towards development of updated soil information of salt-

affected soils (Figure 1.1). P4WG, INSII, ITPS will also produce a technical manual and cookbook to support harmonization of data and procedures during update of salt-affected soil information.

2 Approach for updating soil information on salt-affected and input data requirements

2.1 Approach

The country-driven approach for mapping salt-affected soils is a three-step approach anchored on input data harmonization, spatial modelling of input soil indicators using spatial predictors, and classification of salt-affected soils (Figure 2.1).



2.1.1.1 Figure 2.1: Approach for national mapping salt-affected soils

The approach puts emphasis on measured soil data (EC, pH, and ESP) as the primary soil indicators for classifying salt-affected soils. These input soil data are spatially modelled to produce maps of soil indicators of salt-affected soils. The maps feed into schemes for classifying salt-affected soils (Figure 2.1).

2.2 Input data

2.2.1 Soil data

Input soil data for mapping salt-affected soils are measured Electrical conductivity (EC dS/m), pH, Exchangeable Sodium Percent (ESP) or Sodium Absorption Ratio (SAR) (Table 2.1). The extract of saturated soil paste is the preferred soil solution for the measurement of these soil indicators.

2.2.1.1.1 Table 2.1: Summary minimum data requirements for mapping salinity

Data	Data type	Variables	Units
Soil data	Georeferenced soil data (between 0-100 cm of soil depth)	EC	dS/m
		pH (H_20)	-
		ESP	%
		Soluble ions[*]	*cmol/kg*
		TSS[*]	*g/l*
Soil forming factors	Climate (Mean annual)	Rainfall	mm
		Min Temperature	^oC
		Max Temperature	^oC
	Land use/cover	cover/use types	-
	soil map	soil types	-
	DEM	Elevation	m
	Remote sensing land surface reflectance	Visible (RGB) reflectance	-
		IR reflectance	-
		SWIR reflectance	-
	Geology	Lithology types	-
Other data	Hydrogeology[*]	Groundwater level	m
	Degradation[*]	Degradation types	-
	Distance to the coastline	Distance	m

[*]Optional

The required soil indicators (EC, pH, and ESP) are also often measured using other methods in the literature. Such datasets can also be used provided that:

- Their methods of determination/measurements are adequately described
- There are conversion models to harmonize them with the required method
- They are harmonized using the conversion models

In case available soil data (EC, pH, and ESP) were determined by methods other than the soil paste-extract method, then conversion models are recommended to derive the equivalent values of the paste-extract method. These measurement methods and their conversion models should be clearly explained in the metadata submission. General models in the literature can also be used where own-conversion models are lacking. Alternatively, an independent sample dataset is prepared to develop the conversion models. In addition to the primary soil data (EC, pH, and ESP), the following soluble

ions are recommended should their data be available: sodium (Na^{+}), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), and sometimes Potassium (K^{+}) and anions of Chlorides (Cl^{-}), Carbonates ($C0_3^{2-}$), Sulphates ($S0_4^{2-}$), Bicarbonates ($HC0_3^{-}$) and Nitrates ($N0_3^{-}$).

Data from other proximal sensors: Examples of proximal sensors are electromagnetic induction (EMI), geophysical sounding, and reflectometers. Their application also need conversion models to derive equivalent soil paste-extract values. This data may be included if available.

2.2.2 Data on soil forming factors

Remote sensing data: The literature has elaborated various applications of multispectral remote sensing in mapping salt-affected soils (see for example, Gorji et al., 2019[4] and references). The majority of these applications use images with the visible band (with wavelength between 0.40 – 0.70 micrometre (µm)), near infrared band (0.75 - 0.88 µm), and shortwave infrared band (1.55 – 2.30 µm). Table 2.2 lists popularly used images for consideration in national-level assessment of salt-affected soils.

2.2.2.1.1 Table 2.1: Multispectral remote sensing data for mapping salt-affected soils

Image	Spatial resolution	Bands
Landsat Operational Land Imager (OLI)	30 m	Band 1 (Blue); Band 2(Green) Band 3(Red); Band 5(NIR); Band 6(SWIR1); Band 7(SWIR2)
Sentinel 2A	10 m	Band 2(Blue); Band 3(Green); Band 4 (Red) Band 8(NIR)
	20 m	Band 11 (SWIR 1); Band 12 (SWIR 2)
MODIS (MOD09GA V6)	500 m	Band 3(Blue); Band 4(Green); Band 1(Red) Band 2 (NIR); Band 6(SWIR 1); Band 7(SWIR 2)

Other remote sensing data are gamma rays, microwave, Radar etc. They can be used if relevant data is available.

Data of other soil forming factors: Soil forming factors such as land use/cover (including irrigation command areas and vegetation types), climate, relief (DEM), soil type map, and geology are important predictors of salt-affected soils. They are necessary for mapping salt-affected soils (Table 2.1).

[4]Gorji, T., Yildirim, A., Sertel, E., Tanik, A,. 2019. Remote sensing approaches and mapping methods for monitoring soil salinity under different climate regimes. International Journal of Environment and Geoinformatics, 6(1), 33-49

2.2.3 Other datasets

Salt-affected soils are influenced by groundwater level, seawater intrusion, or land degradation such as wind erosion, water erosion, etc. Information about these factors my provide clue on the occurrence of salt-affected soils. Therefore, spatial data (map) of these factors may be used if they are available (Table 2.1).

3 Product specification

3.1 Expected products

Global update of soil information on salt-affected soils is expected to focus on 0-30 cm and 30-100 cm soil depth at a spatial resolution of 1 km (30 Arc-second). Therefore, country-level contribution towards the global map of salt-affected soils is expected to deliver topsoil (0-30 cm) and Subsoil (30-100 cm) maps of soil indicators of salt problems and classified map of salt-affected soils. Table 2.2 gives a summary of expected products from country-level contribution towards global update of soil information on salt-affected soils.

3.1.1.1.1 Table 2.2: Expected country-level contribution to global map of salt-affected soils

Item	Description	
Data product (Maps)	Electrical Conductivity (dS/m), pH(water), Exchangeable Sodium Percent)	
	Salt-affected soils and uncertainty (EC, pH, ESP, salt-affected soils)	
Soil depth designation	Topsoil	Subsoil
Depth (cm)	0-30	30 -100
Spatial Entity	National level raster maps (spatial resolution of 1 km or 30 Arc-Second)	
Deliverable Datum	WGS 84 (decimal degrees/geographic)	
Uncertainty	Width of prediction interval at 95% confidence interval	
Validation Statistics	RMSE, ME(bias), (R^2)	
Delivery Method	Online (GSP Data Submission Tool)	
Deadlines	30 April 2020	

1.1 Product specification

3.1.2 Spatial entity

Horizontal and Vertical Resolution

The first product of global map of salt-affected soils will be given in two depths (0-30 cm and 30-100 cm) at regular fixed horizontal dimensions of 30 by 30 arc-seconds grid (approximately only 1x1km at the equator).

Spatial Reference

All submitted maps should have World Geodetic System 1984 (WGS84) geographic (decimal degrees) projection. The final global map of salt-affected soils will also be delivered at this coordinate reference system.

Extent

A generic, empty, global 30 arc-second grid will be prepared and shared with all participating countries. Countries will be expected to deliver their datasets using these standard grids.

Excluded Non-soil Areas

Data providers are expected to provide a continuous surface for their map predictions. GSP secretariat will mask out non-soil areas occupied by non-soil materials, including permanent water and ice, bare rock and sealed surfaces (urban). No attempt will be made to specify the types or proportions of non-soil materials in a grid cell. Excluded grid cells values of soil properties should be identified as no data in the final global product.

3.2 Metadata

All data developed and submitted for the GSSmap should have associated metadata. Metadata contains documentation of type of map, the methods used in map production, input data, units, projection, validation accuracy, spatial extent and resolution, input data age and date of map creation, and contact address. The metadata should be provided during data submission. It is important to understand that deliverables are not considered complete without metadata. A completed metadata form is known as a metadata record. The metadata form is given in Annex I and is also available as a web form, which should be completed for every submitted dataset. Where available, copies of any other documentation relevant to each dataset may be given during the submission. They include:

- Licensing information
- Copyright information
- Disclaimers
- Metadata statements
- Technical Reports or manuals.

4 Product development and quality assurance

4.1 Product development

Preferred input data for mapping salt-affected soil are georeferenced profile data of measured soil indicators (EC, pH, ESP) (Soil Survey Staff, 2014[5]; FAO, 1970[6]). These indicators should have been determined on extracts of saturated soil paste. Unless this data is not available, equivalent values obtained by conversion models should be used. A three-step approach given in Figure 2.1 is preferred for national level product development. A technical manual and cookbook to guide product development can be obtained from GSP-Secretariat@fao.org.

4.2 Product validation

Countries should validate their maps with measured data and present validation results together with the maps. Validation result should be supported by a sample data to GSP to crosscheck the reported results.

Validation can be done in several ways (detailed description of the validation techniques will be provided in the technical manual):

a. Validation with an independent dataset. In this case, the map is validated with an independently sampled dataset focused on validation. Part of this dataset should be submitted to GSP together with validation results to ensure reproducibility of quality control.
b. Validation through data splitting. In this case, the dataset is split before mapping (e.g. 85% and 15% of the data), one part is used for prediction and another part is used for validation. Part of the data that is used for validation should be submitted to GSP together with validation results to ensure reproducibility of quality control.
c. If a country submits published map which was quality-checked by a peer-review process in internationally indexed scientific journal, then such publication should be shared with GSP as a quality assurance of the map. In this case, there will be no need to submit validation data.

[5] Soil Survey Staff. 2014. Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 51, Version 2.0. R. Burt and Soil Survey Staff (ed.). U.S. Department of Agriculture, Natural Resources Conservation Service (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1244466.pdf)

[6] FAO. 1970. Physical and chemical methods of soil and water analysis. Bulletin No. 10. FAO, Rome (http://www.fao.org/soils-portal/resources/soils-bulletins/en/)

5 Product Delivery

5.1 Mandatory Products

The following products are expected: soil maps (EC, pH, ESP, salt-affected soil), uncertainty maps (EC, pH, ESP, salt-affected soils), and validation (sample set and statistics). All together there will be 16 maps (4 soil maps and 4 uncertainty maps each for 0-30 cm and 30-100 cm soil depth) and validation.

1. **Topsoil (0-30 cm) Soil Electrical Conductivity (dS/m):** Include country-level topsoil electrical conductivity and uncertainty maps (0-30 cm) created with digital soil mapping approach based on measured electrical conductivity (EC_{SE}) and set of spatial predictors (Table 2.1). The product format shall be geotiff files with 30 arc-seconds resolution (approximately 1 x 1 km). The pixel values should be EC_{SE} (dS/m).

2. **Subsoil (30 – 100) Soil Electrical Conductivity (dS/m)**: Include country-level subsoil electrical conductivity and uncertainty maps (30-100cm) created with digital soil mapping approach based on measured electrical conductivity (EC_{SE}) and set of spatial predictors (Table 2.1). The product format shall be geotiff files with 30 arc-seconds resolution (approximately 1 x 1 km). The pixel values should be EC_{SE} (dS/m).

3. **Topsoil (0-30 cm) Soil pH:** Include country-level topsoil pH and uncertainty maps (0-30 cm) created with digital soil mapping approach based on soil pH(water) and set of spatial predictors (Table 2.1). The product format shall be geotiff files with 30 arc-seconds resolution (approximately 1 x 1 km). Pixel values: pH value.

4. **Subsoil (30-100 cm) Soil pH:** Include country-level subsoil pH and uncertainty maps (30-100 cm) created with digital soil mapping approach based on soil pH(water) and set of spatial predictors (Table 2.1). The product format shall be geotiff files with 30 arc-seconds resolution (approximately 1 x 1 km). Pixel values: pH value.

5. **Topsoil (0-30 cm) Exchangeable Sodium Percent (ESP):** Include country-level topsoil ESP and uncertainty maps (0-30 cm) created with digital soil mapping approach based on soil pH(water) and set of spatial predictors (Table 2.1). The product format shall be geotiff files with 30 arc-seconds resolution (approximately 1 x 1 km). Pixel values: ESP value.

6. **Subsoil (30-100 cm) Exchangeable Sodium Percent (ESP):** Include country-level subsoil ESP and uncertainty maps (30-100 cm) created with digital soil mapping approach based on soil

pH(water) and set of spatial predictors (Table 2.1). The product format shall be geotiff files with 30 arc-seconds resolution (approximately 1 x 1 km). Pixel values: ESP value.

7. **Topsoil (0-30cm) salt affected soils:** Include country-level topsoil (0-30 cm) map of salt-affected soils and uncertainty maps (0-30 cm) created by classification of maps of soil indicators (EC, pH, ESP). The product format shall be geotiff files with 30 arc-seconds resolution (approximately 1 x 1 km). Pixel value: Class of intensity of salt problems in the salt-affected soils
8. **Subsoil (30-100 cm) salt affected soils:** Include country-level subsoil (30-100 cm) map of salt-affected soils and uncertainty maps (0-30 cm) created by classification of maps of soil indicators (EC, pH, ESP). The product format shall be geotiff files with 30 arc-seconds resolution (approximately 1 x 1 km). Pixel value: Class of intensity of salt problems in the salt-affected soils

Supplementary data:

- Metadata (submitted through the online form or otherwise);
- Country report (electronic document);
- Quality assurance data –(any of the following):
    - Validation dataset (table format or shapefile)
    - Model object with cross-validation data (R file);
    - Peer-reviewed publication of the results (electronic document or link to online access).

The following flow is foreseen in country-level mapping of salt-affected soils and final submission for producing global soil salinity map:

a. Countries have measured data and will apply the given technical specifications to produce and share their national soil salinity and uncertainty maps and associated metadata

b. Countries have measured data but lack adequate technical expertise to produce and share national soil salinity map. Capacity building sessions will be organized to support these countries to produce and share their soil salinity maps. Alternatively, if these countries elect to authorize GSP to produce the maps on their behalf then GSP secretariat will arrange to facilitate the data exchange and mapping.

c. Countries do not have measured data but have the technical expertise to produce the soil salinity maps. In this case, the countries are encouraged to mobilize resources necessary for generating national data for producing the salinity maps

d. Countries do not have measured data nor technical expertise to produce soil salinity map. For the foreseeable timeline for global mapping of salt-affected soils, such countries may have their tiles gap-filled by GSP Secretariat while waiting for more accurate date. These countries will be encouraged to mobilize resources for generating national data and for capacity building to produce national soil salinity map

e. Countries with measured data but prefer to use their own specifications to produce and share national soil salinity map. Such countries will be requested to engage GSP Secretariat for further modalities.

GSP Secretariat will also develop a gap-filling strategy for the countries who will not be able to provide data during the required time span.

5.2 Data Submission Procedure

5.2.1 File Naming Conventions and Directory Structure

GSP Secretariat will provide countries with an online data submission facility. The deliverables will be uploaded as individual files or as compressed archives of files (.zip, .rar, 7z). Structure is as follows:

|_ Maps

EC

|_ National Soil EC Map 0-30 cm*(ISO3CountryCode_SalinityMap030.tiff)*

|_ National Soil EC Map 30-100 cm *(ISO3CountryCode_SalinityMap30100.tif*f)

|_ Uncertainty EC Map 0-30 cm *(ISO3CountryCode_UncertaintySalinityMap030.tiff*)

|_ Uncertainty EC Map 30-100 cm *(ISO3CountryCode_UncertaintySalinityMap30100.tiff)*

ESP

|_ National Soil ESP Map 0-30 cm *(ISO3CountryCode_ESPMap030.tiff)*

|_ National Soil ESP Map 30-100 cm *(ISO3CountryCode_ESPMap30100.tif*f)

|_ Uncertainty ESP Map 0-30 cm *(ISO3CountryCode_UncertaintyESPMap030.tiff*)

|_ Uncertainty ESP Map 30-100 cm *(ISO3CountryCode_UncertaintyESPMap30100.tiff)*

pH

|_ National Soil pH Map 0-30 cm *(ISO3CountryCode_pHMap030.tiff)*

|_ National Soil pH Map 30-100 cm *(ISO3CountryCode_pHMap30100.tif*f)

|_ Uncertainty PH Map 0-30 cm *(ISO3CountryCode_UncertaintyPHMap030.tiff*)

|_ Uncertainty PH Map 30-100 cm *(ISO3CountryCode_UncertaintyPHMap30100.tiff)*

Salt-affected

|_ National Soil Salt-affected Map 0-30 cm *(ISO3CountryCode_SaltMap030.tiff)*

|_ National Soil Salt-affected Map 30-100 cm *(ISO3CountryCode_SaltMap30100.tiff*)

|_ Uncertainty Salt-affected Map 0-30 cm *(ISO3CountryCode_UncertaintySaltMap030.tiff*)

|_ Uncertainty Salt-affected Map 30-100 cm *(ISO3CountryCode_UncertaintySaltMap30100.tiff)*

Documents

|_ Report (ISO3CountryCode_Report.doc, docx)

|_Quality_Assurance

|_Validation data or a peer-reviewed publication

5.2.2 Formats

The GIS files will be delivered in GeoTIFF format. GeoTIFF is a standard .tif or image file format that includes additional spatial (georeferencing) information embedded in the .tif file as tags. These are called embedded tags, tif tags. These tags include raster metadata such as spatial extent, coordinate reference system, resolution, no data values.

6 Quality Assurance/Quality Check

Each country will be responsible for carrying out basic Quality Assurance/Quality Control (QA/QC) of all data prior to submitting it to the GSP Secretariat. Quality Assurance can be described as the process of preventing errors from entering datasets while Quality Control can be described as the process of identifying and correcting existing errors in datasets.

All datasets should be checked for:

- Spatial errors (extent, projection)
- Units (e.g. EC dS.m-1)
- Completeness of data and metadata (are all mandatory datasets present and documented?)
- Consistency with data shown in any accompanying documents (such as reports or drawings),
- Compliance with the Data Standards described in this document.
- Consistency of the reported validation results with the provided data.

The final QA/QC for the national and global datasets will be facilitated by the GSP Secretariat through its technical networks (INSII, P4WG, and Intergovernmental Technical Panel on Soils (ITPS)) who will give the final clearance to the global dataset before release to the public.

7 Process and Timeline

The proposed timeline, deadlines for milestone activities and tasks are as follows:

7.1.1.1.1 Table 7.1: Timelines

Outputs	Activities	Date	Clearance
Concept Note	Concept Note	Done	ITPS
Technical Specifications	Zero Draft	Done	
	Reviewing	Done	P4WG, ITPS (out of session)
	Launch	Done	
Capacity Development	Technical Manual	Done	ITPS, INSII
	Training Materials	Done	P4WG
	Training (NENA)	November 2019 - March 2020	-
	Training Materials		
	Training (Africa)		
	Training (Eurasia)		
	Training Latin America		
	Training (Asia)		
	Training (Europe)		
	Training (Pacific)		
Data Collection	National Submissions	March-April 2020	-
	Gap Filling Strategy, Data	May 2020	
	QA/QC of National Products	May 2020	
GSSmap	Harmonization and Compilation	March- May 2020	ITPS
	QA/QC	May 2020 (INSII)	
	Metadata Table	May 2020 (INSII off-session)	
	Launch (v1.0)	June 2020 (8th GSPPA) - Side Event	
Publications	Technical Report	June 2020 - Public Release	ITPS
	Scientific Article	May 2020 June - July 2020 (Submission)	Peer Reviewed
	Policy Brief	September 2020	ITPS
	Post release Plan	May June 2020	
Dissemination & Communication	Leaflet, Posters	June 2020	P4WG,GSP Communication Team via FAO OCCI
	Web Services (GloSIS)	June July 2020	

8 Annex

8.1 ANNEX I. Metadata

Attribute	**Example**
Total number of soil sampling locations	
Number of soil profiles	
Number of topsoil samples	
Number of subsoil samples	
Number of auger samples	
Sampling Depth	*soil horizons, topsoil: 0-30; subsoil: 30-100*
Georeferencing method	*GPS coordinates / legacy maps*
Sampling (data collection) Period	*1980-2008*
Soil indicator measurement unit	*dS.m-1*
Soil indicator determination method	*measured/estimated*
(if measured) soil indicator measurement method	*conductivity meter in a soil paste extract*
(if measured) solution or soil/water ratio	*`1:5` or 1:2.5 or 1:2, etc*
(if estimated) soil indicator estimation method	*calculated from TSS*
(if estimated) soil indicator estimation formula	*Ec (dS m-1) = TDS(ppm)/640*
Mapping method	*Conventional mapping / Digital Soil Mapping*
(if conventional) Conventional method	*class-matching / geomatching*
(if conventional) Input maps used	*soil map, land use map*
(if conventional) Soil classification of the input map	*WRB*
(if conventional) Soil map scale	*1:1 000 000'*
(if DSM) DSM method	*Random Forest*
(if DSM) Predictors used	*temperature, precipitation, elevation, soil type*
(if DSM) Predictor source(s)	*worldclim, usda, national soil map*
Validation method	*cross-v / data splitting / independent validation*
R^2 (Amount of variance explained)	*0.54*
mean error (ME)	*-0.05*

root mean squared error (RMSE)	*1.2*
Soil indicator map units	*dS.m-1*
Uncertainty estimation method	*standard deviation from regression kriging*
Uncertainty map units	*dS.m-1*
Map author(s)	
Contributing author(s) in case of scientific/book publication	
Data provider institute(s)	
E-mail(s)	
Address(es)	
Citation	
Comments/remarks	

SOIL SALINITY MAPPING

GLOBAL SOIL PARTNERSHIP

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