Country Guidelines and Technical Speciﬁca ons for Global Mapping of

Salt-Aﬀected Soil (GSSmap)

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Global Soil Partnership

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1. Global Soil Partnership

Pillar Four of the GSP essentially addresses the development of an enduring and authoritative global system to monitor and forecast the condition of the Earth’s soil resources.

This global soil information system has three primary functions:

1. Answering critical questions at the global scale

2. Providing the global context for more local decisions (e.g. transnational aspects of food security and degradation of natural resources)

3. Supplying fundamental soil data for understanding Earth-system processes to enable the management of the major natural resource issues facing the world (e.g. climate change, food security, biodiversity loss). These data need to be comparable with other fundamental data sets including those for weather, climate, net primary productivity, biodiversity, land cover and geology.

Pillar Four of the 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 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 to implement data related activities. The network of International Soil Information Institutions (INSII) forms the backbone of Pillar 4 and is supported by a technical working group of soil information experts nominated by the GSP Regional Soil Partnerships (Pillar 4 Working Group). 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 (Figure 4). The global assessment and the global map of salt affected areas will be based on country submissions and national soil information.

2. Background and Task

Soil salinity/sodicty is a global problem aﬀec ng agricultural produc vity and food security. Quan fying the extent of salt-aﬀected soils on a global level is therefore essen al to support the design of a management plan for the sustainable use of soil resources and to ul mately mi gate this threat. The threat was discussed during the GSP 6th PA and the plenary requested GSP to address the issue (GSPPA-VI/18/Report Item 3) and conduct a global assessment to compile a Global Soil Salinity Map. The main objec ve of the Global Map of Salt-aﬀected Soils (GSSmap) will be to improve na onal capaci es in es ma ng the spa al variability of soil salinity/sodicity. The GSSmap will be created with a bo om-up approach, meaning that each country will provide their na onal maps relying on their own na onal data. Due to heterogeneity and asynchrony of data on soil salinity/sodicity which are available from diﬀerent sources at a global scale, we underline that the ﬁrst ﬁnal GSSmap can be referred to as a baseline map of status salt-aﬀected soils and will highlight the areas where soil is saline/sodic or not. Speciﬁc methodologies will be implemented depending on the available data within each country. The Global Soil Partnership (GSP) will compile and produce several guide documents containing the technical speciﬁca ons. Workshops will be implemented in countries requiring speciﬁc training. Finally, the GSSmap will serve as a baseline to create a global monitoring system of salt-aﬀected soils.

3. Context and Objectives

An important step towards sustainable management of salt-aﬀected soils and control of saliniza on/sodica on in agriculture ﬁelds is the knowledge of occurrence and severity of salt problems in the soil. From the global level up to farmer-ﬁelds, there is a lack of accurate extent and severity of salt problems and trends. Although there are maps portraying occurrence of salt-aﬀected soils, there are scanty literature on global eﬀorts to produce world map of salt-aﬀected soils and trend of the problems. This present document outlines guidelines for suppor ng country-driven global mapping of salt-aﬀected soils and baseline for monitoring.

The main objec ves of the guidelines are to;

● Outline technical speciﬁca ons for country-driven mapping of salt-aﬀected soils

● Guide harmonized global mapping of salt-aﬀected soils

4. Overview of Technical Specifications

GSP will deliver global map of salt-aﬀected soils with contribu ons from individual countries. The map will be for the 0-30 and 30-100 cm depth at a spa al pixel resolu on of 30x30 Arc-Second. Therefore, country-level contribu on towards the global map of salt-aﬀected soils will be expected to be for topsoil (0-30 cm) and Subsoil (30-100 cm) maps depending on data availability. The maps of salt-aﬀected soils will be based on measured/equivalent electrical conduc vity, pH, and ESP values.

Summary Table of the Speciﬁca ons

Table 1: Speciﬁca ons for global map of salt-aﬀected soils

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Data  Product | Depth  (cm) | Mandatory  / Optional  (M/O) | Spatial  Entity | Deliver able Datum | Uncertainty | Validation  Statistics | Delivery  Method | Deadlines |
| Topsoil EC, pH, ESP, and Salinity or Sodicity Maps and uncertainty maps | 0-30 | M | 30x30  Arc-Seco nd Raster Grid | WGS 84, others upon request | Upper and lower  95% Conﬁdence Interval | RMSE[1] ME(bias), (R2) | Online (GSP[2] Data Submissi on Tool) | March  2020 |
| Subsoil EC, pH, ESP, and Salinity or Sodicity Maps and uncertainty maps | 30-100 | M |
| Country  Report | - | M | - | | | |
| Metadata |  | **M** | **-** | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Quality assurance (valida on data or publica on) |  | **M** | **-** |  |  |

5. Technical Product Specifications

5.1 Spatial entity

5.1.1 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.

5.1.2 Spatial Reference

World Geode c System 1984 (WGS84) geographic (lat/lon) projec on will be preferred for all submi ed maps. The ﬁnal global map of salt-aﬀected soils will also be delivered at this coordinate reference system.

5.1.3 Extent

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

5.1.4 Excluded Non-soil Areas

Data providers are expected to provide a con nuous surface for their map predic ons. The 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 a empt will be made to specify the types or propor ons of non-soil materials in a grid cell. Excluded grid cells values of soil proper es should be iden ﬁed as no data in the ﬁnal global product.

5.2 Input data for mapping soil salinity

The current call for global map of salt-aﬀected soils envisages use of exis ng data to produce the country-level map. This sec on provides the speciﬁca ons for exis ng input data requirements for mapping salt-aﬀected soils. The exis ng input data are categorized as: measured soil data, remote sensing data, and proximal sensing data.

(i) **Measured soil data**: Soil salts are preferably determined from measured electrical conduc vity of a saturated soil paste (ECSE). In many laboratories and in the ﬁeld, electrical conduc vity (EC) is o en determined from the soil –water mix. This EC can be

transformed to ECSE depending on the soil texture, organic ma er and clay content. Thus, in general, the minimum measured soil dataset necessary for classifying soil salinity/sodicity is as given in Table (2). This dataset is commonly available in most soil

maps

Table 2: Measured soil data for mapping salinity and sodicity/alkalinity

|  |  |  |
| --- | --- | --- |
| Data type | Descrip on | Remarks |
| 1. pH | (-) | Used for diagnosis of alkaline soils |
| 2. ECSE | Satura on extract (ECSE) (dS/m) | Diagnosis of saline soils |
| 3. ESP | Exchangeable Sodium Percent | Diagnosis of sodic soils |
| 4. SAR | Sodium absorp on ra o(SAR) | Diagnosis of sodic soils using data of the satura on extract |

(ii) **Other measured soil data (alternative):** Although soil salts are customarily determined from electrical conduc vity measurements, there are various methods in the literature using other soil proper es such as electrical conduc vity of soil-water mix (soil solu ons), total soluble salts (TSS), pedo-transfer func ons, etc. It’s recommended that the equivalent ECSE is determined for these methods and the conversion method

clearly explained in the metadata submission. Soil salt ionic composi on is also o en

used to separate saline from sodic and sodic-saline soils. They may be included as well. They include sodium (Na+), Calcium (Ca2+), Magnesium (Mg2+), and some mes Potassium (K+) and anions of Chlorides (Cl-), Carbonates (C0 2-), Sulphates (S0 2-),

3 4

- -

Bicarbonates (HC03 ) and Nitrates (N03 ).

[1] Rusydi AF. 2018. Correla on between conduc vity and total dissolved solids in various types of water: A review. IOP Conf. Ser.: Earth Environ. Sci. 118: 1-6. doi :10.1088/1755-1315/118/1/012019

[2] Corwin, D. L., and K. Yemoto. 2017. Salinity: Electrical conduc vity and total dissolved solids. Methods of soil analysis 2. doi:10.2136/msa2015.0039

(iii) **Remote sensing data** (**Op onal**): Soil salts aﬀects vegeta on growth characteris cs such as ground vegeta on cover and light reﬂectance. At advanced stages of salt accumula on on the land surface, light reﬂectance from the surface also changes. These characteris cs are detectable by remote sensing. In this regard, invasive methods using remote sensing indices of the mul spectral bands can be used to iden fy salt aﬀected areas. Furthermore, with calibra on with ground-truthed data, climate data, and land cover characteris cs, sta s cal correla ons can be established to quan fy soil salinity/sodicity. This approach is more appropriate in areas with limited measured soil data on salinity/sodicity. Table 3 gives the minimum data requirement for classifying salt-aﬀected soils using remote sensing images.

Table 3: Data requirements for salinity classification using remote sensing

|  |  |
| --- | --- |
| Data type | Remark |
| 1. Mul spectral images | For image indices |
| 2. Measured soil electrical conduc vity (dS.m-1) | For calibra on |
| 3. Climate data (mean annual rainfall and mean daily temperature) | For predic on |

(iv) **Electromagne c induc on** (**Op onal**): This method can also be used to determine soil salinity. Here, electromagne c (EM) soil salinity sensor is used to measure salinity in the ﬁeld and the results calibrated with selected ECSE measurements to improve the instrument accuracy. Table 4 gives

data requirements for soil salinity classiﬁca on using EM method.

Table 4: Data requirements for classification using electromagnetic induction

|  |  |
| --- | --- |
| Data | Remark |
| EM Sensor data |  |
| ECSE measured data for calibra on | Limited samples for calibra on |

Summary input data requirements

(a) **Soil data (0-30 cm and 30 -100 cm soil depth):** Electrical conduc vity, pH, Exchangeable Sodium

Percent (ESP), Or salt concentra on (TSS)

1) Electrical conduc vity of saturated soil extract in dS/m (or its equivalent with documented conversion models) or Total Soluble Salts (TSS) (mg/l)

2) pH, ESP (and op onal Sodium Absorp on Ra o)

3) (Op onal) - soluble ion contents (Na+, Cl-, S0 2-, C0 2-, HC0 -) in cmol/Kg

4 3 3

(b) **Spa al/environmental data (predictors)**: climate, relief, land use/cover, parent material

1) Climate: weather sta on or map of mean annual amounts (rainfall and/or temperature)

2) Relief: Eleva on (image or contour map of al tudes)

3) Soil type map (with geology informa on and/or geology map with lithology informa on)

4) Land use/cover map

5) Remote sensing images: Mean annual/season images with visible bands (BGR), near infrared

(IR) bands, and shortwave band 1 and 2.

6) (Op onal) hydrogeology map (with groundwater level/water rest level informa on) (c) **(Op onal) other ancillary informa on**

1) Bulk soil apparent electrical conduc vity (and conversion model to EC of saturated soil paste extract in dS/m)

2) Gamma/microwave/Radar images

5.3 Classification of salt-affected soils

Classiﬁca on of salt-aﬀected soils will be based on measured or equivalent ECSE, pH, pH, and ESP.ESP FAO (2006) salinity classiﬁca on criteria shown in Table 5 will be preferred.

Table 5. Soil salinity/sodicity classiﬁca on

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Types of salt-aﬀected soils** | | | | | |
| **Soil property** | **Unit/ Symbol** | **Threshold** | | | |
| **Non-aﬀected** | **Saline** | **Saline-sodic** | **Sodic** |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Electrical conduc vity | | Ece (dS/m) | | <2 | | > 4 | | > 4 | < 4 |
| Exchangeable sodium | | ESP | | < 15 | | < 15 | | > 15 | > 15 |
| pH | | - | | 0-14 | | < 8.5 | | < 8.5 | > 8.5 |
| **Severity of salt-problems** | | | | | | | | | |
| **Salinity (ECSE dS/m)** | | | | | **Sodicity (ESP)** | | | | |
| Severity level | FAO (2008) | | Richard (1954) | | Severity level | | Abrol et al. (1988) | | |
| None | < 0.75 | | 0 - 2 | | None | | < 15 | | |
| slight | 0.75 - 2 | | 2 - 4 | | Slight | | 15 - 30 | | |
| Moderate | 2 - 4 | | 4 - 8 | | Moderate | | 30 - 50 | | |
| Strong | 4 - 8 | | 8 - 16 | | High/Strong | | 50 - 70 | | |
| Very  Strong | 8 - 15 | | > 16 | | Extreme/V. Strong | | > 70 | | |
| Extreme | > 15 | |  | |  | |  | | |

5.4 Improvement of soil salinity/sodicity map

In the event that there is an opportunity to improve the soil salinity/sodicity maps, then the following steps are recommended to guide the planning and development of the new maps:

1. Use the uncertainty maps developed using secondary data and the country’s preferred sampling strategy to strategize on sample alloca on for the new data

2. Use the GSP Soil salinity/sodicity manual to develop new input maps and new EC map

3. Reclassify the EC map to produce the new and improved salinity/sodicity map

4. Submit the new map of salt-aﬀected soils according to the procedures outlined in this guideline

Suppose the update focus is not necessarily on new data but on the approach and/or predictors, then it’s recommended that:

1. The new approach be iden ﬁed and its requirements evaluated to assess if the exis ng

informa on/data complies with the requirements. Where necessary adjustments should be made targe ng mee ng the approach requirements. If the update is focusing on new predictors, then the assessment and evalua on of the adequacy of the predictors should be done.

2. Use the GSP Soil salinity/sodicity manual to develop new (input maps and) EC map

3. Reclassify the EC map to produce the new and improved salinity /sodicity map

4. Submit the new map of salt-aﬀected soils according to the procedures outlined in this guideline

6. Metadata

All data developed and submi ed for the GSSmap are required to have associated metadata. GSP Secretariat requires metadata to be provided during the 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 will also be provided as a web form which should be ﬁlled-in to accompany each submi ed dataset. Where available, copies of any other documenta on relevant to each dataset may be given during the submission. Examples include:

● Licensing informa on

● Copyright informa on

● Disclaimers

● Metadata statements

● Technical Reports or manuals.

7. Product development and quality assurance

7.1 **Product development**

The GSP preferred input data for soil salinity mapping is measured soil ECSE (Soil Survey Staﬀ, 2014[1]; FAO, 1970[2]). Unless this data is not available, ECSE equivalent obtained by conversion from other

data types may be used. The preferred predic ve mapping method is regression kriging or Random

Forest (ref. GSOC Cookbook; [h p://www.fao.org/3/I8895EN/i8895en.pdf)](http://www.fao.org/3/I8895EN/i8895en.pdf)

[1] Soil Survey Staﬀ. 2014. Soil Survey Field and Laboratory Methods Manual. Soil Survey Inves ga ons Report No. 51, Version 2.0. R. Burt and Soil Survey Staﬀ (ed.). U.S. Department of Agriculture, Natural Resources Conserva on Service ([h ps://www.nrcs.usda.gov/Internet/FSE\_DOCUMENTS/stelprdb1244466.pdf)](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1244466.pdf)

[2] FAO. 1970. Physical and chemical methods of soil and water analysis. Bulle n No. 10. FAO, Rome

([h p://www.fao.org/soils-portal/resources/soils-bulle ns/en/)](http://www.fao.org/soils-portal/resources/soils-bulletins/en/)

7.2 **Product validation**

Countries should validate their maps with measured EC data and present valida on results together with the maps. Valida on result should be supported by suﬃcient data for the GSP to check the quality of the submi ed maps.

Valida on can be done in several ways (detailed descrip on of the valida on techniques will be provided in the technical manual):

a. Valida on with an independent dataset. In this case, the map is validated with a dataset that was not used for mapping. This dataset should be submi ed to the GSP together with valida on results to ensure reproducibility of quality control.

b. Valida on through data spli ng. In this case, the dataset is split before mapping (e.g. 85% and 15% of the data), one part is used for predic on and another part is used for valida on. Part of the data that was used for valida on should be submi ed to the GSP together with valida on results to ensure reproducibility of quality control.

c. Cross-valida on (only DSM modelling). In this case, several model realisa ons are produced with subsets of the data, ensuring valida on of the model at each step. The model object containing predic ons and residuals for each fold should be submi ed to the GSP together with valida on results to ensure reproducibility of quality control.

d. If the country submits an already published map which was quality checked by peer-review process in an interna onally indexed scien ﬁc journal, then such publica on should be provided as a quality assurance of the map (no need to submit valida on data in this case).

8. Product Delivery

The results from the survey on na onal soil informa on systems shared by the GSP secretariat, indicated that for most countries, na onal data on EC are available. Therefore, it is an cipated that the countries will produce the ﬁrst baseline map of soil salinity. The following op ons are proposed to the countries to produce their own na onal soil salinity map:

**8.1 Mandatory Products**

1. **Topsoil (0-30 cm) Soil Electrical Conduc vity (dS/m):** Include country-level topsoil electrical conduc vity and uncertainty maps (0-30 cm) created with digital soil mapping approach based on measured electrical conduc vity (ECSE) and set of environmental covariates. The product format shall be geo ﬀ ﬁles with 30 arc-seconds resolu on (approximately 1 x 1 km). The pixel values should be ECSE (dS/m).

2. **Subsoil (30 – 100) Soil Electrical Conduc vity (dS/m)**: Include na onal subsoil electrical conduc vity and uncertainty maps (30-100cm) created with digital soil mapping based on measured electrical conduc vity (EC). The product format shall be geo ﬀ ﬁles with 30 arc-seconds resolu on (approximately 1 x 1 km). The pixel values should be ECSE (dS/m).

3. **Topsoil (0-30 cm) Soil pH:** Include country-level topsoil pH and uncertainty maps (0-30 cm).

Format: geo ﬀ ﬁles with 30 arc-seconds resolu on (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). Format: geo ﬀ ﬁles with 30 arc-seconds resolu on (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). Format: geo ﬀ ﬁles with 30 arc-seconds resolu on (approximately 1 x 1 km). Pixel values: ESPvalue.

6. **Subsoil (30-100 cm) Exchangeable Sodium Percent (ESP):** Include country-level subsoil SAR and uncertainty maps (30-100 cm). Format: geo ﬀ ﬁles with 30 arc-seconds resolu on (approximately 1 x 1 km). Pixel values: ESP value.

7. **Topsoil (0-30cm) Salinity / salt aﬀected soils:** Include country-level topsoil map of salinity and uncertainty maps (0-30 cm). Format: geo ﬀ ﬁles with 30 arc-seconds resolu on (approximately 1 x 1 km). Pixel values: Soil salinity class

8. **Subsoil (30-100 cm) Salinity / salt aﬀected soils:** Include country-level topsoil map of salinity and uncertainty maps (30-100 cm). Format: geo ﬀ ﬁles with 30 arc-seconds resolu on (approximately 1 x 1 km). Pixel values: Soil salinity class

Supplementary data:

● Metadata (submi ed through the online form or otherwise);

● Country report (electronic document);

● Quality assurance data - one of the following:

○ Valida on dataset (table format or shapeﬁle)

○ Model object with cross-valida on data (R ﬁle);

○ Peer-reviewed publica on 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 EC data and will apply the given technical speciﬁca ons to produce and share their na onal soil salinity and uncertainty maps and associated metadata

b. Countries have EC data but lack adequate technical exper se to produce and share na onal soil salinity map. Training sessions should be organized to support these countries to produce and share their soil salinity maps. Alterna vely, if those 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 EC data but have the technical exper se to produce the soil salinity maps. In this case, the countries are encouraged to mobilize resources necessary for genera ng na onal EC data for producing the salinity maps

d. Countries do not have EC data nor technical exper se to produce soil salinity map. For the foreseeable global soil salinity mapping meline, such countries may have their les gap-ﬁlled by the GSP Secretariat in the interim while awai ng for more accurate date. The countries will be encouraged to mobilize resources for genera ng na onal EC data and for capacity building to produce na onal soil salinity map

e. Countries with EC data but prefer to use their own speciﬁca ons to produce and share na onal soil salinity map. Such countries will be requested to engage GSP Secretariat for further modali es.

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

9. Data Submission Procedure

9.1 File Naming Conventions and Directory Structure

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

Structure is as follows:

**|\_ Maps**

**EC**

**ESP**

**|\_ Na onal Soil EC Map 0-30 cm***(*[*ISO3CountryCode\_Sa*](https://unstats.un.org/unsd/tradekb/knowledgebase/country-code)*linityMap030. ﬀ)*

**|\_ Na onal Soil EC Map 30-100 cm** *(ISO3CountryCode\_SalinityMap30100. f*f)

**|\_ Uncertainty EC Map 0-30 cm** *(ISO3CountryCode\_UncertaintySalinityMap030. ﬀ*)

**|\_ Uncertainty EC Map 30-100 cm** *(ISO3CountryCode\_UncertaintySalinityMap30100. ﬀ)*

**|\_ Na onal Soil ESP Map 0-30 cm** *(*[*ISO3CountryCode\_*](https://unstats.un.org/unsd/tradekb/knowledgebase/country-code)*ESPMap030. ﬀ)*

**|\_ Na onal Soil ESP Map 30-100 cm** *(ISO3CountryCode\_ESPMap30100. f*f)

**|\_ Uncertainty ESP Map 0-30 cm** *(ISO3CountryCode\_UncertaintyESPMap030. ﬀ*)

**|\_ Uncertainty ESP Map 30-100 cm** *(ISO3CountryCode\_UncertaintyESPMap30100. ﬀ)*

pH

**|\_ Na onal Soil pHMap 0-30 cm** *(*[*ISO3CountryCode\_pHMap*](https://unstats.un.org/unsd/tradekb/knowledgebase/country-code)*030. ﬀ)*

**|\_ Na onal Soil pH Map 30-100 cm** *(ISO3CountryCode\_pHMap30100. f*f)

**|\_ Uncertainty PH Map 0-30 cm** *(ISO3CountryCode\_UncertaintyPHMap030. ﬀ*)

**|\_ Uncertainty PH Map 0-30 cm** *(ISO3CountryCode\_UncertaintyPHMap30100. ﬀ)*

*EC*

**|\_ Na onal Soil EC Map 0-30 cm** *(*[*ISO3CountryCode\_*](https://unstats.un.org/unsd/tradekb/knowledgebase/country-code)*ECMap030. ﬀ)*

**|\_ Na onal Soil ECMap 30-100 cm** *(ISO3CountryCode\_ECMap30100. f*f)

**|\_ Uncertainty EC Map 0-30 cm** *(ISO3CountryCode\_UncertaintyECMap030. ﬀ*)

**|\_ Uncertainty EC Map 0-30 cm** *(ISO3CountryCode\_UncertaintyECMap30100. ﬀ)*

Documents

**|\_ Report** (ISO3CountryCode\_Report.doc, docx)

**|\_Quality\_Assurance**

|\_Valida on data or a peer-reviewed publica on

9.2 Formats

The GIS ﬁles will be delivered in GeoTIFF format. GeoTIFF is a standard . f or image ﬁle format that includes addi onal spa al (georeferencing) informa on embedded in the . f ﬁle as tags. These are called embedded tags, f tags. These tags include raster metadata such as spa al extent, coordinate reference system, resolu on, no data values.

10. Quality Assurance/Quality Check

Each country will be responsible for carrying out basic Quality Assurance/Quality Control (QA/QC) of all data prior to supplying it to the GSP Secretariat. Quality Assurance can be described as the process of preven ng errors from entering into datasets; while Quality Control can be described as the process of iden fying and correc ng exis ng errors in datasets.

All datasets should be checked for:

● Spa al errors (extent, projec on)

● Units (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 valida on results with the provided data.

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

11. Process and Timeline

The proposed meline, deadlines for milestone ac vi es and tasks as follow;

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Outputs** | **Ac vi es** | **Contributors** | **Date** | **Clearance** |
| Concept Note | Concept Note | GSP Secretariat, INSII, P4WG, ITPS | Done | ITPS |
| Technical  Speciﬁca ons | Zero Dra | GSP Secretariat, P4WG, SSAG | Done | P4WG, ITPS (out of session) |
| Reviewing, Revising, Finalising | P4WG, ITPS, SSAG | July-August  2019 |
| Launch |  | Done |
| Kick-oﬀ | Na onal Salinity Expert Appointment | INSII, Focal  Points, ICBA | August- September  2019 |  |
| Feedback on  Capaci es | INSII, FP | August  September  2019 |
| Mapping, Modelling | INSII | October 2019 - March 2020 |
| Capacity  Development | Technical Manual | P4WG, SSAG, ICBA | October 2019 (Launch) | ITPS, INSII |
| Training  Materials | P4WG, SSAG | November  2019 | P4WG |
| Training (NENA) | ICBA, SSAG | November  2019 - March  2020 | - |
| Training  Materials | SSAG |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Training (Africa) | ICBA, SSAG |  |  |
| Training (Eurasia) | ICBA, SSAG |
| Training La n  America | SSAG |
| Training (Asia) | SSAG |
| Training (Europe) | SDF |
| Training (Paciﬁc) | CSIRO |
| Data Collec on | Na onal  Submissions | INSII | October 2019 - May 2020 | - |
| Gap Filling  Strategy, Data | GSP Secretariat, SSAG | December  2019 - May  2020 |
| QA/QC of  Na onal  Products | GSP Secretariat, P4WG | March 2020 - May 2020 |
| GSSmap | Harmonisa on and Compila on | GSP Secretariat, P4WG | January 2020 - May 2020 | ITPS |
| QA/QC | ITPS, INSII | May 2020 (INSII  oﬀ-session) |
| Metadata Table | INSII | May 2020 (INSII  oﬀ-session) |
| Launch (v1.0) | GSP Secretariat, ITPS | June 2020 (8th GSPPA) - Side Event |
| Publica ons | Technical Report | GSP Secretariat, P4WG | June 2020 - Public Release | ITPS |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Scien ﬁc Ar cle | GSP Secretariat, P4WG, ITPS, SSAG | May 2020 (Start Wri ng) June - July 2020 (Submission) | Peer Reviewed |
| Policy Brief | GSP Secretariat, ITPS | September  2020 | ITPS |
| Post release Plan | GSP Secretariat, P4WG | May June 2020 |  |
| Dissemina on & Communica on | Leaﬂet, Posters | GSP Secretariat | June 2020 | P4WG,GSP Communica on Team via FAO OCCI |
| Web Services  (GloSIS) | GSP Secretariat, WebGIS Consultant | June July 2020 |

Annex

**ANNEX I. Metadata**

|  |  |
| --- | --- |
| **A ribute** | **Example** |
| Total number of soil proﬁles/sampling loca ons |  |
| 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 collec on) Period | *1980-2008* |
| EC measurement unit | *dS.m-1* |
| EC determina on method | *measured/es mated* |
| (if measured) EC measurement method | *conduc vity meter in a soil paste extract* |
| (if measured) EC soil/water ra o | *`1:5` or 1:2.5 or 1:2, etc* |
| (if es mated) EC es ma on method | *calculated from TSS* |
| (if es mated) EC es ma on formula | *Ec (dS m-1) = TDS(ppm)/640* |
| Mapping method | *Conven onal mapping / Digital Soil Mapping* |
| (if conven onal) Conven onal method | *class-matching / geomatching* |
| (if conven onal) Input maps used | *soil map, land use map* |
| (if conven onal) Soil classiﬁca on of the input map | *WRB* |
| (if conven onal) Soil map scale | *1:1 000 000'* |
| (if DSM) DSM method | *Regression Kriging* |
| (if DSM) Predictors used | *temperature, precipita on, eleva on, soil type* |
| (if DSM) Covariates source(s) | *worldclim, usda, na onal soil map* |
| Valida on method | *cross-v / data spli ng / independent valida on* |
| R2 (Amount of variance explained) | *0.54* |
| mean error (ME) | *-0.05* |
| root mean squared error (RMSE) | *1.2* |
| EC map units | *dS.m-1* |

|  |  |
| --- | --- |
| Uncertainty es ma on method | *standard devia on from regression kriging* |
| Uncertainty map units | *dS.m-1* |
| Map author(s) |  |
| Contribu ng author(s) in case of scien ﬁc/book publica on |  |
| Data provider ins tute(s) |  |
| E-mail(s) |  |
| Address(es) |  |
| Cita on |  |
| Comments/remarks |  |

[1]RMSE: Root Mean Square Error

[2]To be provided by the GSP Secretariat

[3] FAO (2006). Guidelines for Soil Descrip on. FAO, Rome ([h p://www.fao.org/3/a-a0541e.pdf)](http://www.fao.org/3/a-a0541e.pdf)