NENALAB-III/22/Report

Food and Agriculture Organization of the United Nations

GLOBAL SOIL PARTNERSHIP

Report of the Third meeting of the Near East and North African Soil Laboratory Network (NENALAB)

Virtual meeting, 12 - 13 October 2022

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 2022

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Introduction

The third meeting of the Near East and North African Soil Laboratory Network (NENALAB) was held online on 12 and 13 October 2022. The meeting was attended by about one 61 laboratory staff members from 17 NENA countries. The list of participants is available in Annex I.

The meeting was opened by Mr Abdelmjid Zouahri, NENALAB Chair, and Mr Rachid Moussadek, NENA Soil Partnership Chair, who recalled the importance of good quality, harmonized data in decision-making and the link between the Global Soil Laboratory Network (GLOSOLAN) and global soil mapping activities. Mr Zouahri finally recalled the objectives of the meeting: (i) to inform NENA laboratories on GLOSOLAN progress and the way forward, (ii) to bring soil laboratories issues and challenges to the attention of national governments by bridging the gap between soil laboratories and national focal points to the Global Soil Partnership (GSP), (iii) to discuss the results of the GLOSOLAN proficiency test (PT) 2022, (iv) to identify the standard operating procedure for GLOSOLAN and NENA to harmonize, (v) to open the discussion on the interpretation of laboratory results and the provision of recommendations to farmers, and (vi) to review the NENALAB governance.

In order to meet these objectives, national focal points to the GSP were invited to attend the first day of the meeting (see agenda in Annex II).

Highlights and conclusions

Ms Lucrezia Caon (GLOSOLAN coordinator) opened the meeting by introducing national focal points to the GSP and new NENALAB members to GLOSOLAN, recalling that uncertainty in soil data is currently too large to monitor changes in soil properties, to make scientific conclusions or to pay for ecosystem services. By improving the performance of soil laboratories and reducing uncertainty in the measurement, GLOSOLAN plays a key role in providing better soil data for better soil management and decision-making. At present, GLOSOLAN is composed of almost 1 000 member laboratories organized into Regional Soil Laboratory Networks (RESOLANs). Since 2021, GLOSOLAN supports countries in establishing their National Soil Laboratory Networks (NASOLANs).

Thereafter, the discussion focused on the following topics:

- National Soil Laboratory Networks (NASOLANs).

During the meeting, representatives from the Islamic Republic of Iran, Iraq, Morocco and the Syrian Arab Republic shared their experience with the establishment of their NASOLANs, focusing on the main obstacles that they faced during the process and the support they eventually received from the government and other institutions operating in their countries.

During the discussion, private laboratories from the Islamic Republic of Iran reported about their financial struggle, stating that it is difficult to improve their performance if they do not have enough money to even pay salaries. Participants from other countries shared their experience on getting financial support from

the government and suggested Iranian labs to (i) get involved in government activities like mapping and/or to (ii) talk to the national focal point for the Islamic Republic of Iran in order to propose that the government to subsidize soil analysis for farmers. This would increase the number of soil samples sent to the laboratories, thus increasing laboratories' income. However, the national reference laboratory for the country pointed out that at present, the economic condition of the Islamic Republic of Iran does not allow the government to provide any subsidy. The GLOSOLAN coordinator will ultimately organize a meeting with the national focal point and the national reference laboratory for the Islamic Republic of Iran to discuss these possibilities and to propose a review of the national legislation on soil analysis, since this was also identified as a limitation of soil laboratories' work in general.

Sharing experience was useful to many other laboratories that are facing issues in establishing their own national network, who benefitted from hearing successful stories from similar contexts. The main benefits obtained from an established, well-functioning NASOLAN were identified as the implementation of several activities, according to laboratories' main needs. These include the translation of GLOSOLAN standard operating procedures (SOPs) and other technical material into local languages, and the organization of national inter-laboratory comparisons and other initiatives on quality control.

Countries were invited to provide information on the status of establishment of their NASOLAN or their NASOLAN activities to the GLOSOLAN coordinators. Information will be used by the GLOSOLAN coordinators to create or update NASOLAN webpages.

- Bridging the gap between soil laboratories and national governments

Polls to enquire about the interaction between soil laboratories and national focal points were launched.

When asked about the type of support they receive from the government, the majority of laboratories (62 percent) reported not to receive any type of support. However, it should be considered that polls were answered also by private laboratories that usually do not receive any type of support from the government. 15 percent of respondents declared to receive moral support or support in terms of recognition and visibility at the national level. Still, 15 percent of respondents declared to receive support in terms of more staff or extra budget. Only eight percent of respondents declared to have a preferential communication channel with the government.

The majority of laboratories (56 percent) do not receive any support from sponsors or donors other than the government. Four of the laboratories that answered the survey are the main and unique data providers to their government for national soil assessment and mapping activities, four are not involved in national soil assessment and mapping activities at all, three provide data to other organizations following the signature of a written agreement and two act as main data providers to their government together with other institutions.

- NENALAB performance in the GLOSOLAN PT 2022

Mr Filippo Benedetti presented an overview of the performance of the NENALAB members that participated to the GLOSOLAN Proficiency Test (PT) 2022, on behalf of Mr Christian Hartmann (IRD, France). Twenty-four soil laboratories from 13 Near East and North African countries received a parcel containing a set of ten soil samples. Each sample contained 10 g of homogenized soil material that had been dried, sterilized and packed in double-layered plastic bags. Each sample was labelled in progression using the suffix "GLO-" (i.e. GLO-1, GLO-2, etc.). Laboratories were asked to determine a few basic chemical parameters for each sample, namely: soil carbon, total nitrogen and soil available phosphorus. While total nitrogen and available phosphorus were not mandatory parameters to analyze, PT participants were asked to deliver results on carbon as a mandatory condition to join the PT. This condition was decided due to the global need to have precise data on the organic carbon content of the soil, given its role in fighting climate change.
The PT instructions delivered to each participant specified that the Standard Operating Procedures (SOPs) harmonized by GLOSOLAN should have been used to analyze each soil parameter. These were:

SOPs on carbon:

- Total carbon by Dumas dry combustion method available in English, Spanish and Russian (EN | ES | RU);
- Organic carbon by Walkley and Black method – titration and colorimetric method available in English, Spanish and Russian (EN | ES | RU);
- Organic matter by loss of ignition. Please note that GLOSOLAN does not have a SOP for measuring organic matter by loss of ignition at 450-550 °C yet.

SOPs on phosphorus:

- Soil available phosphorus by Olsen method available in English only (EN);
- Soil available phosphorus by Bray I method available in English only (EN);
- Soil available phosphorus by Bray II method available in English only (EN).

SOPs on nitrogen:

- Soil total nitrogen by Dumas dry combustion method available in English only (EN);
- Soil total nitrogen by Kjeldahl method available in English only (EN).

The low amount of soil needed to carry out the analysis using the methodologies reported above allowed participants to perform more than one procedure for the same parameter, given the quantity of each sample.

Each laboratory was provided with a unique pin code to be used to upload the analysis results on an online platform that was developed by GLOSOLAN with the purpose of facilitating the collections of data from PT participants and guarantee anonymity. Mr Benedetti informed the attendees that in a few cases major issues were faced with the shipment of samples. More specifically, the parcels addressed to Palestinian laboratories failed to reach the destination due to customs issues. Moreover, the presented results were based on the data that were successfully submitted by 23 laboratories only and thus used for the statistical analysis. Therefore, one laboratory did not submit the results in time to be included in the analysis and their performance will be not assessed, despite they having received the samples for the GLOSOLAN PT. Mr Benedetti remarked the importance of ensuring a clear overview of the countries' regulations prior to proceeding in shipping the soil samples and the great opportunity given to the labs to participate to the exercise for free, as the preparation and delivery of PT samples is a time-consuming and expensive operation. This information should also be made available on the GLOSOLAN's soil import legislation (SIMPLE) database.

Mr Benedetti shared some outcomes on the performance of NENA laboratories for the carbon analysis only. The overall results (on both regional and world scales) will be described in detail in the PT global report, which is under preparation. Moreover, all PT participants received an individual report of their performance.

The analysis of the PT results allowed for insight on the most adopted methodologies. For instance, it seems that most NENALAB laboratories use the Walkley and Black method to measure soil organic carbon (SOC), as 20 out of 23 participants (which correctly uploaded data on the PT platform) of the GLOSOLAN PT submitted results following this procedure. In addition to that, eight laboratories reported SOC values using loss of ignition method. As explained above, laboratories could perform more than one methodology to determine the same parameter (e.g. both Walkley and Black and loss of ignition), as long as there was sufficient sample quantity. No submission was received using the Dumas method, probably because of the high cost of the apparatus needed to implement this methodology.

Regional results obtained using Walkley and Black method are reported in figure 1. The boxplots show that uncertainty (i.e. dispersion of the results around the consensus value) was rather acceptable for all samples (uncertainity was the lowest with sample A which had the lowest carbon content), while data submitted for sample F (highest carbon content) revealed the highest uncertainty. Furthermore, Mr Benedetti explained that within the ten-sample set received by laboratories, five samples were actually replicas of the same soil. This was done to test laboratories' precision in blindly measuring the same soil material multiple times. Overall, results suggested that NENALAB members determined similar consensus values but the distribution of results around such values was quite different between replicates, revealing issues with precision. Moreover, the distribution of results is not balanced, as there is a larger dispersion of values below the median (especially for sample F). Furthermore, the boxplots reported in figure 1 highlight that few outliers were present, which were somehow repeated. Further analysis is needed to assess whether the outliers are referring to the same laboratories or if that is caused by problems in providing similar results when analyzing the same samples.

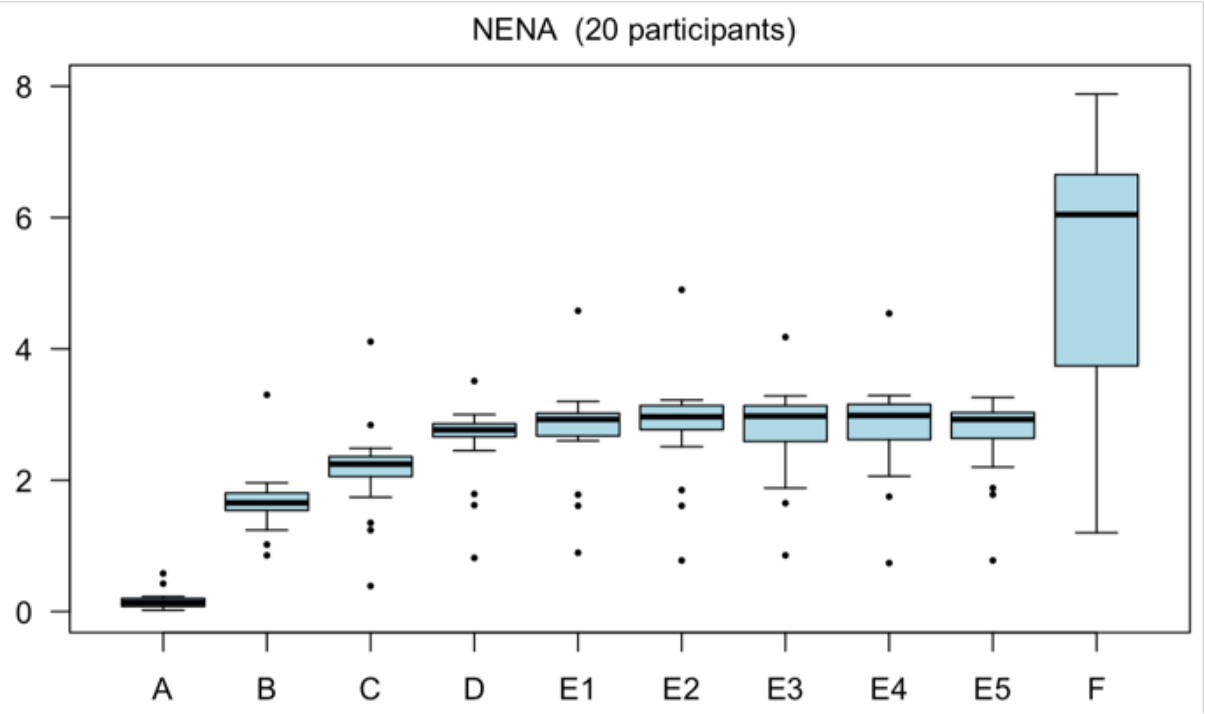

Figure 1 – Boxplots reporting the results collected from the NENALAB participants to the GLOSOLAN PT 2022 for soil organic carbon using the GLOSOLAN SOP for Walkley and Black method. Letters A-F correspond to the samples delivered to laboratories ordered from the lowest to the highest carbon content. Please note that the A-F order does not coincide with the order of samples' labelling (GLO-1, GLO-2, etc.). The y-axis report carbon content (percentage).

The boxplots of figure 2 report the data collected from those NENALAB members who submitted results for carbon using the loss of ignition method. Overall, submissions obtained with this method gave higher dispersion compared with Walkley and Black, even if differences among replicates were observed in loss of ignition as well. Mr Benedetti remarked that only one outlier was observed, due to the large dispersion and low number of laboratories.

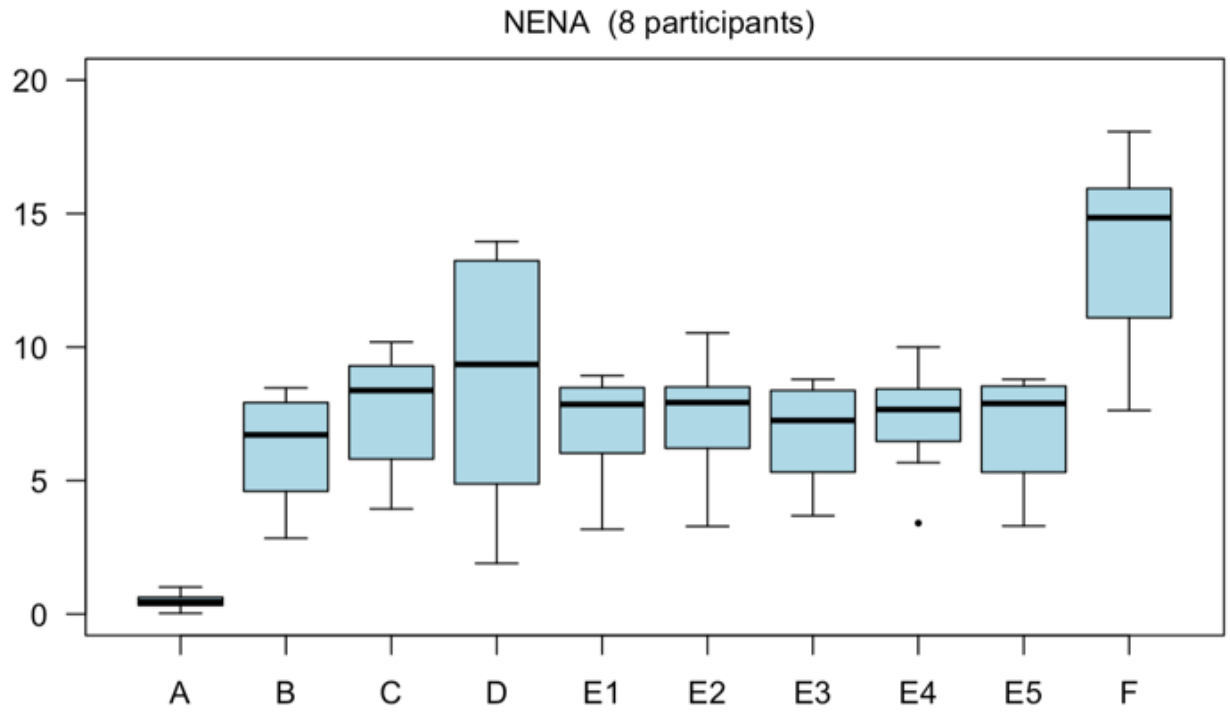

Figure 2 – Boxplots reporting the results collected from the NENALAB participants to the GLOSOLAN PT 2022 for soil organic matter by loss of ignition. Letters A-F correspond to the samples delivered to laboratories ordered from the lowest to the highest carbon content. Please note that the A-F order does not coincide with the order of samples' labelling (GLO-1, GLO-2, etc.). The y-axis report carbon content (percentage).

During the discussion, the willingness to organize regional and national PTs was shared. However, despite participants acknowledging the guidelines prepared by GLOSOLAN on how to produce a soil sample for proficiency testing, it was pointed out that further training should be organized to build the capacity of laboratories in organizing regional and national PTs. For this reason, the GLOSOLAN Technical Committee is currently preparing a training video to provide systematic guidance on PT organization. Moreover, Mr Benedetti informed participants that GLOSOLAN is trying to organize a regional PT opened to laboratories operating in the both the African and the NENA regions, to be implemented in 2023.

- Standard Operating Procedures (SOPs)

Ms Caon recalled how GLOSOLAN Standard Operating Procedures (SOPs) are harmonized, stressing that a modified procedure is followed when there are few experts on a topic in the working groups or when there are only few laboratories using a given method. In this regard, harmonization matrices are used as a reference within the working group and are not sent to the GLOSOLAN network for completion.

In order to open the discussion on the SOPs that NENALAB recommends GLOSOLAN to harmonize in 2022, Ms Caon summarized the SOPs that the network harmonized already. See table 1. To note that since GLOSOLAN already harmonized the majority of methods widely used worldwide, in 2023, RESOLANs will focus on harmonizing SOPs of regional relevance.

Table 1. SOPs harmonized by GLOSOLAN in 2019 - 2022

	2019	2020	2021	2022
Chemical	OC Walkley and Black, TC Dumas, Calcium carbonate eq. (titrimetric and volumetric calcimeter methods)	Phosphorus (Bray I, Bray II, Olsen, Mehlich I), pH, electrical conductivity (in water and in saturated paste), nitrogen (Dumas, Kjeldah), carbon (Tyurin)	Particulate organic carbon (physical fractionation), Quasi-total elements (digestion using aqua regia and EPA), Exchangeable bases and CEC (ammonium acetate), available micronutrients (extraction using DTPA), Boron (hot water extraction), Mehlich III for macro and micronutrients (including S and B)	Organic matter (loss of ignition), Available phosphorus (KCl), Exchangeable acidity + Exchangeable Al (KCl), Soil buffer capacity (KOH), Fe and Al oxides (ammonium oxalate)
Physical			Particle size-distribution (hydrometer, pipette), bulk density, moisture content (gravimetric method)	Water retention (pF) curve, Particle density (pycnometer)
Biological			Microbial biomass C and N by chloroform fumigation-extraction, soil respiration	Microbial Enzyme Activities (B-Glucosidase, Arylsulfatase, Dehydrogenase), N Mineralization (incubation method), Nematodes trophic groups (wet extraction), QBSar, ISO-TSBF

Ultimately, NENALAB will propose GLOSOLAN to harmonize the following SOPs:

- *Chemical parameters:*
  - Soluble anions (sulphate, chloride, carbonate, bi-carbonate) by titration method
  - Soluble cations (calcium and magnesium) by titration method and sodium and potassium using flamephotometer

  These SOPs should include standards on the interpretation of results.

- *Physical parameters:*
  - Field capacity by cylinder method
  - Aggregate stability

  An SOP on undisturbed soil samples collection, transportation and storage was required.

  NENALAB pointed out that texture determination by laser diffraction requires expensive equipment and it is a method mostly used for research purposes. By not using this method, they do not support the harmonization of this method.

- *Biological parameters:*
  - DNA extraction
  - Earthworm sampling and identification

- Interpretation of laboratory results and provision of recommendations to farmers

Mr Nujod Awatleh, agricultural extension agent from the Soil Fertility Department in General Directorate of Agricultural Land (Palestine) shared with participants his experience concerning the relations between famers and soil laboratories, highlighting that a stronger collaboration is needed, as farmers are the end-users of soil data. Mr Awatleh mentioned that governments should encourage farmers to sample and analyse their soils.

In the case of Palestine soil experts, farmers, and even laboratory technicians are normally in charge of collecting soil samples and, eventually, plant samples from the field. Guidelines on how to interpret results are provided when the customers (i.e. farmers) visit the laboratories to retrieve the analysis results. However, it was pointed out that larger farm companies normally have agricultural engineers among their staff that are in charge of developing proper soil management practices based on soil laboratory data. During the open discussion, it was underlined that laboratories should focus mainly on soil analysis and not much on the interpretation of results, as this is mostly a work to be done by extension agents. Still, meeting participants welcomed the proposal to provide general reference tables for each soil parameter, trying to take into consideration local and regional soil types.

Mr Benedetti closed the meeting by introducing participants to the new GLOSOLAN website and by inviting them to participate in the 6th GLOSOLAN meeting from 22 to 24 November 2022. Laboratories were also invited to send video messages wishing happy birthday to GLOSOLAN in their local languages. Videos will be displayed at the *Five years of GLOSOLAN* celebration on November 10.

NENALAB governance

NENALAB thanked Mr Abdelmjid Zouahri (Morocco), Ms Riham Zahalan (Syrian Arab Republic) and Ms Hana Nabil (Morocco) for representing the region and the network from 2020 to 2022. Ultimately, participants elected their representatives for the period 2023-2025:

- Chair: Ms Riham Zahalan (Syrian Arab Republic)
- Vice-Chair for the Near East: Ms Yara Khairallah (Lebanon)
- Vice-Chair for North Africa: Mr Abdelmjid Zouahri (Morocco)

The members of the Steering Committee will be reviewed/identified by the NENALAB governance at their first, available meeting.

Venue and time of the next meeting

The fourth NENALAB meeting will take place online between September and October 2023.

Annex I. List of participants

Ms Lucrezia Caon, Global Soil Partnership Secretariat, FAO HQ

Mr Filippo Benedetti, Global Soil Partnership Secretariat, FAO HQ

Ms Miriam Ostinelli, GLOSOLAN Chair, Argentina

Name	Laboratory	Country
Asma Belouanas	Rendement Plus	Algeria
Saddek Medjahed	Regional Laboratory of Soil and Water Analysis	Algeria
Jameela Hassan	Soil lab	Bahrain
Ahmed El Baroudy	Soil, water and plant laboratory analysis	Egypt
Karim Shahbazi	SWRI-Lab	Iran (Islamic Republic of)
Mojgan Yeganeh	Soil and Water Research Institute	Iran (Islamic Republic of)
Seyed Hashem Khadem	Khakazma pars soil science laboratory	Iran (Islamic Republic of)
Taher Ahmadzadeh	KIMIA AB environmental and agricultural consulting laboratory	Iran (Islamic Republic of)
Alaa Ati	Soil physics/A5	Iraq
Iman Sahib Salman	Ministry of Agriculture	Iraq
Sadeq Dwenee	Soil Chemical Analysis Lab, Soil and Water Resources Center, Agricultural Researches Directorate, Ministry of Science and Technology.	Iraq
Abdallah Obaidat	Water Lab - Royal Scientific Society	Jordan
Emad Al-Qudah	NARC	Jordan
Isra Kharabsheh	Soil and water	Jordan
Nabeel Bani Hani	Soil Lab, NARC	Jordan
Hanaa Adel Burezq	Soil Laboratories	Kuwait
Shabbir Ahmad Shahid	Soil lab KISR	Kuwait
Abdel Kader El Ha2jj	LARI - Lebaa	Lebanon
Beshr Sukkariyah	Lebanese university	Lebanon
Dany Romanos	LARI	Lebanon
Nidale El Hachem	Lebanese Agricultural Research Institute/Kleiat	Lebanon
Razan Dbaibo	Soil characterization lab	Lebanon
Valérie Azzi	Soil & Soilless unit (LARI)	Lebanon
Yara Khairallah		Lebanon
Yolla Ghorra Chamoun	Laboratoire du sol de l'ESIAM-USJ	Lebanon
Zeinab Fahs	Samaha Plants	Lebanon
Ali Madi	ARC Libya	Libya
Hana Nabil	Soil pedology	Morocco
Abdelmjid Zouahri	Laboratory of Soil, Water and Plant Analyses (Lab-URECRN) INRA, Rabat	Morocco
Khalid Ben Zhir	INRA	Morocco

Laila Tajeddine	CESFRA SSL	Morocco
NA	Soil spectroscopy and CHOS, Center for Soil and Fertilizer Research in Africa, Mohammed VI Polytechnic Univ	Morocco
Rachid Moussadek	Institut National de la Recherche Agronomique	Morocco
Tarik Elmoatassem	CESFRA	Morocco
Zhor Abail	Laboratory of Soil Fertility	Morocco
Belal Amous	TLC	Palestine
Imad Ghanma	MoA	Palestine
Nojoud Awatleh	MoA	Palestine
Intisar Arabi	Land Use protction and conservation	Sudan
Nuha Khamis	SALU	Sudan
Hamed Al Dhuhli	Oman Agri Lab	Oman
Ali Issa	Central Lab	Syrian Arab Republic
Raounak Jabour	Central laboratories in ministry of local administratio. And Environment	Syrian Arab Republic
Riham Zahalan	ANRR-lab1	Syrian Arab Republic
Solaf Halloum	Lattakia laboratory	Syrian Arab Republic
Attia Rafla	LCAS	Tunisia
Dalel Melki	CTAB	Tunisia
Mohamed Hachicha	INRGREF	Tunisia
Sonia Mbarki	INRGREF	Tunisia
Bayan Athamneh	EAD	United Arab Emirates
Habiba Al Yafei	Central laboratory, Abudhabi Quality and Confirmity Council	United Arab Emirates
Noura Salem Amer Ameri		United Arab Emirates
Rahma Almehrazi	Rahma Khlfan Saeed Almehrazi	United Arab Emirates
Roudha Alghaithi	Roudha AlGhaithi	United Arab Emirates
Anoop Mony	Al Hoty Stanger	United Arab Emirates
Mohammed Al-Mashreki	Soil, Warer and Plant	Yemen

Annex II: Agenda

Day 1 – October 12	
10:00 – 10.15	**Opening, endorsement of the agenda and group picture** *Mr Abdelmjid Zouahri NENALAB Chair* *Mr Rachid Moussadek, NENA Soil Partnership Chair*
10:15 - 10:50	**Item 1. Quick updates (global, regional)** • What is GLOSOLAN • Main achievements at global and regional levels • Regional capacities needs • NASOLANs: establishment and activities (stories from the region: Islamic Republic of Iran, Syrian Arab Republic) *Ms Lucrezia Caon, GSP Secretariat - FAO*
10.50 - 11:50	**Item 2. Soil laboratories and national government: bridging the gap** • NRLs survey outcomes • National Soil Laboratory Networks • Open discussion on how to strengthen the collaboration and communication between laboratories and national Focal Points (governments) • Resource mobilization • Improvement of national soil legislation systems (soil import, waste management and disposal, drainage system, etc.) *Mr Giacomo Rocchegiani, GSP Secretariat - FAO* • Presentation of the projects implemented/under implementation in the region (both by GSP and other organizations) • Discussion on country-specific project proposals *Moderator: Ms Riham Zahalan, NENALAB Vice-Chair*
11:50 - 12:00	**Item 3. Announcements** • New GLOSOLAN website • GLOSOLAN 5th anniversary celebrations • 6th GLOSOLAN meeting *Mr Filippo Benedetti, GSP Secretariat - FAO*
12:00	**Closure of the meeting**
Day 2 – October 13	

10:00 - 10:30	**Item 4. Proficiency testing** • GLOSOLAN proficiency test (PT) 2021: regional outcomes • Regional and national PTs • Contribution to GLOSOLAN PT organization and implementation (link to video, NRLs survey) *Moderator: Mr Christian Hartmann, GLOSOLAN Steering Committee*
10:30 - 11:00	**Item 5. Standard Operating Procedures (SOPs)** • GLOSOLAN harmonization process (updates, introductory session organization) • Regional harmonization of methods not used worldwide • Prioritize GLOSOLAN documents to be translated Moderator: *Ms Lucrezia Caon, GSP Secretariat – FAO and Mr Fassil Kebede, NENALAB Steering Committee*
11:00 – 11:20	**Item 6. Capacity building** • GLOSOLAN video trainings (need for more subtitles, launch a call for new videos) • GLOSOLAN webinars: call for trainers • In-person training (resource mobilization) *Mr Filippo Benedetti, GSP Secretariat – FAO*
11:20 – 11.50	**Item 7. Interpretation of laboratory results and provision of recommendations to farmers** • Develop regional-based interpretation guidelines • The experience of extension agents *Ms Nujod Awatleh, Soil Fertility Department in General Directorate of Agricultural Land, Palestine* *Moderator: Ms Yara Khairallah, NENALAB Steering Committee*
11:50 – 12:00	**Item 8. Governance renewal** • Presentation of candidates for the role of RESOLAN Chair • Presentation of candidates for the role of Vice-Chairs • Election of the new governance (online poll)
12:00	**Closure of the meeting**