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FARMERS WELFARE
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Soil Sampling & Testing Manual for Class XI-XII Students

About the document

Soil is a crucial and necessary foundation for plant growth and is a supremely important resource for our country. More than 54% of our workforce either directly depends on agriculture for their livelihood, or through allied activities. Therefore, the health of soil affects more than 54% of our workforce! Soil health is fundamental to the food system in the country. It forms the bedrock of agriculture and serves as the vital medium for the growth of food-producing plants. When soils are healthy, they yield higher productivity of nutritious crops that provide nourishment for both humans and animals. It's important to recognize that the quality and quantity of our food are directly connected to the quality of our soils. Therefore, prioritising soil health is essential for ensuring the availability of high-quality and abundant food for all and reducing dependency on other countries for agricultural produce.

The Honourable Prime Minister Narendra Modi has emphasised on teaching students the importance of soil and its health. He has also called for senior secondary students to be trained and involved in doing soil tests to support farmers. This would be done by utilising school laboratories during school vacation times.

In light of this, the Ministry of Agriculture and Farmers Welfare, the Ministry of Education, and the Central Board of Secondary Education have partnered to create this resource for students and teachers to be apprised of the importance of soil health and testing.

The document is supposed to act as a guide for students of classes XI and XII how to sample and test soil in their local areas. The document also provides a standard operating procedure guideline for students about the soil health card programme and Soil Health Card mobile App.

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Chapter 1: How to do Soil Sampling & Processing of Sample for Testing

When to Sample?

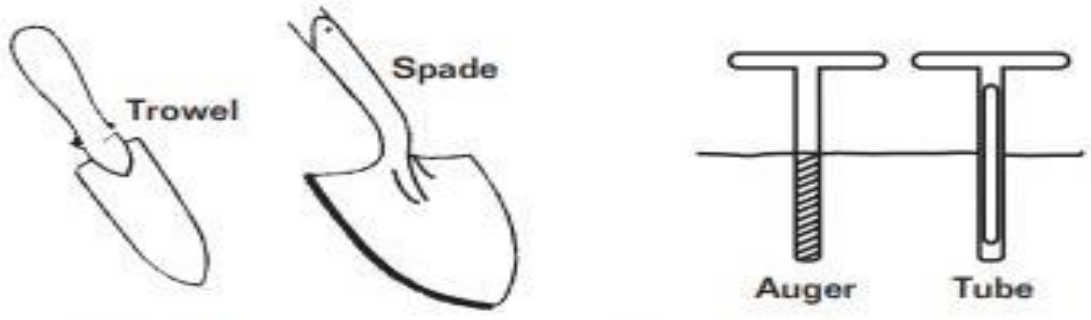
Timing of sampling is important because soil properties vary depending on the time of year and type of management practices used, such as tillage or nutrient application just prior to testing. The best time of year to sample is when the climate is most stable and there have been no recent disturbances, such as after harvesting or at the end of the growing season.

Where to Sample?

1. For sampling of micronutrient analysis, always use auger made up of stainless steel instead of rusted iron khurpi or spade.
2. Store soil samples in clean cloth or polythene bags.
3. Use glass or polythene jars for storage of soil samples for a longer duration.
4. Recently fertilized plots, bunds, channels, marshy tracts, area near trees, farm ways, buildings, wells, compost piles or other non-representative locations must be avoided during sampling.

Basic soil sampling tools

Soil sampling tools are required to collect a uniform amount of soil at any given depth. Various kinds of soil sampling tools are used/ recommended for the soil to be sampled in different environments. Some of the basic soil sampling tools used are as shown below :

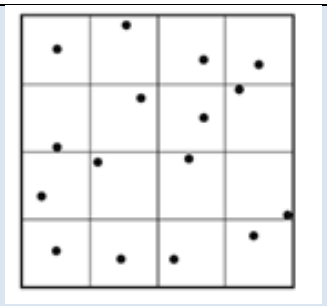
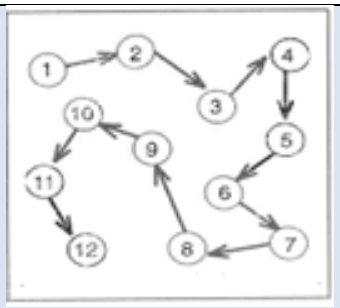


Depth of soil sampling

S. No.	Type of situation/ crop	Depth of sampling
1.	Cereals, vegetables, seasonal crops etc. (Shallow rooted crops) All soil types under cultivation	0-15 cm Furrow slice layer
2.	Deep rooted crops with longer duration (Cotton, sugarcane, banana, tapioca, vegetables etc.) Plantation or fruit crops	Samples should be collected from different depth depending on situation

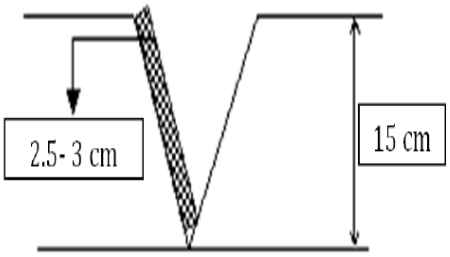
Collection of soil samples

There are methods/ technique for collection of soil samples which vary according to the purpose of sampling and a number of approaches may be employed. The two techniques, i.e. Grid sampling & Zig-zag sampling are shown below –

	
Grid sampling allows for a systematic, non-random, approach to soil sampling which can be applied on a whole or for sampling relatively smaller areas. It allows for a higher degree of precision where repeat samples are collected over time.	Zig-zag sampling provides the best coverage of an area if care is taken with the sample collection. This is often the best strategy for collecting samples to diagnose nutrient deficiencies.

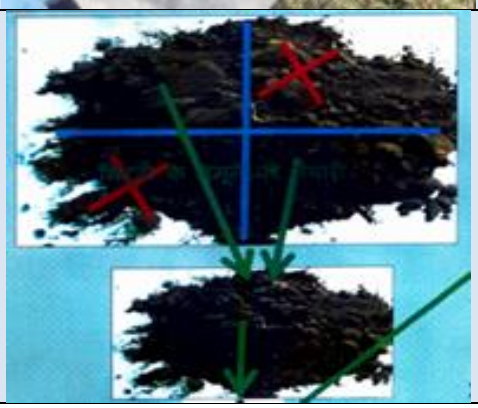
V-shaped soil sampling (15 cm soil sampling depth)

	Procedure of V shaped method of soil sampling: 1.Remove the surface litter, grass, debris, etc., from the sampling point 2.Drive the auger to a plough depth of 15 cm and draw the soil sample

	3.Collect at least 10 to 15 samples from each sampling unit and place in a bucket or tray 4.If auger is not available, make a 'V' shaped cut to a depth of 15 cm in the sampling spot using spade 5. Remove thick slice of soil from top to bottom of exposed face (2.5-3 cm) of the 'V' shaped cut and place in a clean container.

Preparation of composite soil sample

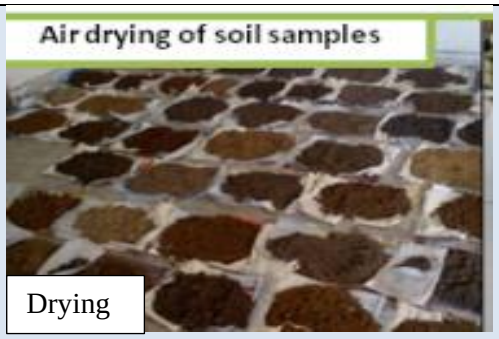
1. Mix the collected soil samples thoroughly on a clean sheet.
2. Entire soil mass is spread
3. Divide into four quarters
4. Two opposite samples are discarded and remaining two are remixed. Repeat till 500 g sample is left.
5. Storage & Labelling of soil samples

1. 	**2.** 
3. 	**4.** 

5.

Processing of soil samples for analysis

- Drying- The soil samples are dried in shade.
- Grinding- The sample is grinded using mortar to prepare it for sieving.
- Sieving- Grinded soil sample is sieved through 2 mm stainless steel sieve and for specific analyis like Organic Carbon use 0.2 – 0.5 mm sieve. Remove plant residues, gravels, etc by retaining them on the sieve.



Drying

Grinding

Sieving

Chapter 2: Do's and Don'ts for soil sampling, processing & testing in Indian conditions

Do's:

1. Use a representative sampling method: Take multiple soil samples from different locations within the field to account for soil variability. Use a zigzag or W-pattern sampling approach to obtain a representative soil sample.

2. Sample at the right time: Soil sampling should ideally be done before the planting season or during the fallow period.

3. Take samples at the appropriate depth: The depth of soil sampling depends on the crop and its root zone. For most crops, a depth of 0-15 cm is suitable. However, for deeper-rooted crops like sugarcane or tree plantations, sample up to 30-60 cm depth or as recommended.

4. Use clean sampling tools: Ensure that sampling tools such as a soil probe, auger, or shovel are clean and free from contaminants to prevent cross-contamination

5. Label samples properly: Clearly label each soil sample with unique identifiers, including location, date, depth, and crop information. This helps in maintaining proper records and ensures correct interpretation of test results.

6. Store and handle samples correctly: Store soil samples in clean, labelled sample bags or containers to avoid mixing or contamination. Keep samples in a cool, dry place until they are sent for testing.

Don'ts:

1. Don't sample from atypical areas: Avoid sampling from areas with known soil variability, such as eroded spots, waterlogged areas, or areas near boundaries where different management practices may have been followed.

2. Don't sample immediately after fertilizer application: Wait for a sufficient period after fertilization to allow nutrients to mix uniformly in the soil. Sampling immediately after fertilization may result in inaccurate nutrient readings.

3. Don't use non-representative sampling tools: Avoid using galvanized or rusty tools. These can affect the accuracy of the test results.

4. Don't sample from surface residues: Do not collect samples from areas with high surface residues. Remove surface residues from sample.

5. Don't rely solely on visual assessment: Visual soil assessments may provide some indications of soil health, but they cannot accurately determine nutrient deficiencies or imbalances. Soil testing is essential to obtain precise information for making nutrient management decisions.
By adhering to these do's and don'ts, farmers, agronomists, and researchers can obtain reliable soil test results.

Chapter 3: Soil Testing & Analysis

Soil testing is a set of various chemical processes that determine the amount of available plant nutrients in the soil. It is important because it determines the exact amount of available crop nutrients in the soil and provides a visible snapshot of soil properties (chemical/ physical/ biological).

The results of soil testing will supply soil nutrients interpretation, which includes an indication of whether that particular soil is low, medium or high/ deficient or sufficient in that nutrient. Accordingly, fertilizer recommendations based on the analysis can be made.

Digital Soil Testing Mini Lab/ PUSA STFR machine

PUSA STFR METER KIT (PUSA Soil Test and Fertiliser Recommendation Meter Kit) is an advanced Soil Testing Kit authorised under the Government of India's Soil Health Card mission. This Digital Soil Testing Mini Lab is a low cost, user friendly digital embedded system instrument which can quantitatively estimate available nutrients in soil.

It is a Soil Doctor that tests parameters of soil where the available nutrient in a soil is extracted with an extractant and a color is developed in the extract with another reagent. The colour intensity which is proportional to the amount of nutrient extracted is measured by this Soil Testing Meter. It recommends fertiliser dose from soil test values of for over 100 crops, prints Soil Health Card through in-built thermal printer, sends Soil Testing Report to mobile via Bluetooth and computer via USB.

Significance of Digital Soil Testing Mini Lab/ PUSA SFTR machine

About 1244 soil testing laboratories (STLs) are available throughout the country, which are not sufficient to cater the soil testing needs of the farming community. There was long-felt need of a quantitative soil test kit to support the soil testing service. Digital Soil Testing Mini Labs would increase farmers‟ access to soil testing, and thus help them to achieve higher yields owing to soil test-based fertilizer application.

SOP for use of Soil Testing kit (Do's and don'ts for soil testing using a soil testing kit)

When conducting soil testing in a laboratory using a soil testing kit, it's important to follow certain guidelines to ensure accurate and reliable results. Here are some do's and don'ts for soil testing in a laboratory using a soil testing kit:

Do's:

1. Read and follow the instructions: Carefully read the instructions provided with the soil testing kit and follow them step by step. Each kit may have specific guidelines for sample preparation, reagent usage, and result interpretation.

2. Use clean equipment: Ensure that all equipment used for testing, including containers, scoops, pipettes, and measuring devices, are clean and free from any residues that could contaminate the samples.

3. Mix and homogenize the soil sample: Thoroughly mix the soil sample to ensure a consistent representation of the field. Break up any clumps and remove stones or debris that could interfere with the testing process.

4. Measure accurately: Follow the provided guidelines for accurately measuring the soil and reagents. Use precise measuring devices, such as graduated cylinders or syringes, to ensure correct volumes are added.

5. Perform controls and calibration: Many soil testing kits include control samples or calibration standards. Use these samples to verify the accuracy of the kit and ensure that the test results fall within the expected range.

Don'ts:

1. Don't contaminate the samples: Avoid cross-contamination between samples. Clean the equipment thoroughly between each sample to prevent carryover of reagents or residues that could impact the accuracy of subsequent tests.

2. Don't rush the process: Take your time to perform each step carefully and allow sufficient reaction times for accurate results. Rushing through the process can lead to errors and inaccurate readings.

3. Don't extrapolate beyond the kit's capabilities: Soil testing kits have specific limitations and are designed to provide a basic assessment of certain soil parameters. Avoid extrapolating the results beyond the kit's intended use and consult a professional laboratory for comprehensive soil analysis if needed.

4. Don't neglect safety precautions: Some soil testing kits may involve the use of potentially hazardous reagents or chemicals. Follow safety precautions, such as wearing appropriate personal protective equipment (PPE), working in a well-ventilated area, and disposing of chemicals properly.

5. Don't rely solely on the kit for complex analysis: While soil testing kits can provide valuable insights into certain soil parameters, they may not be suitable for complex analysis or comprehensive nutrient management recommendations.

Remember that soil testing kits provide a convenient and cost-effective option for basic soil analysis. However, it is advisable to consult a professional laboratory that specializes in soil testing.

Chapter 4: Data analysis and interpretation for Soil Samples Analysis Using Digital Soil Testing Mini Lab/ PUSA SFTR machine

Experiment I - Estimation of Soil pH

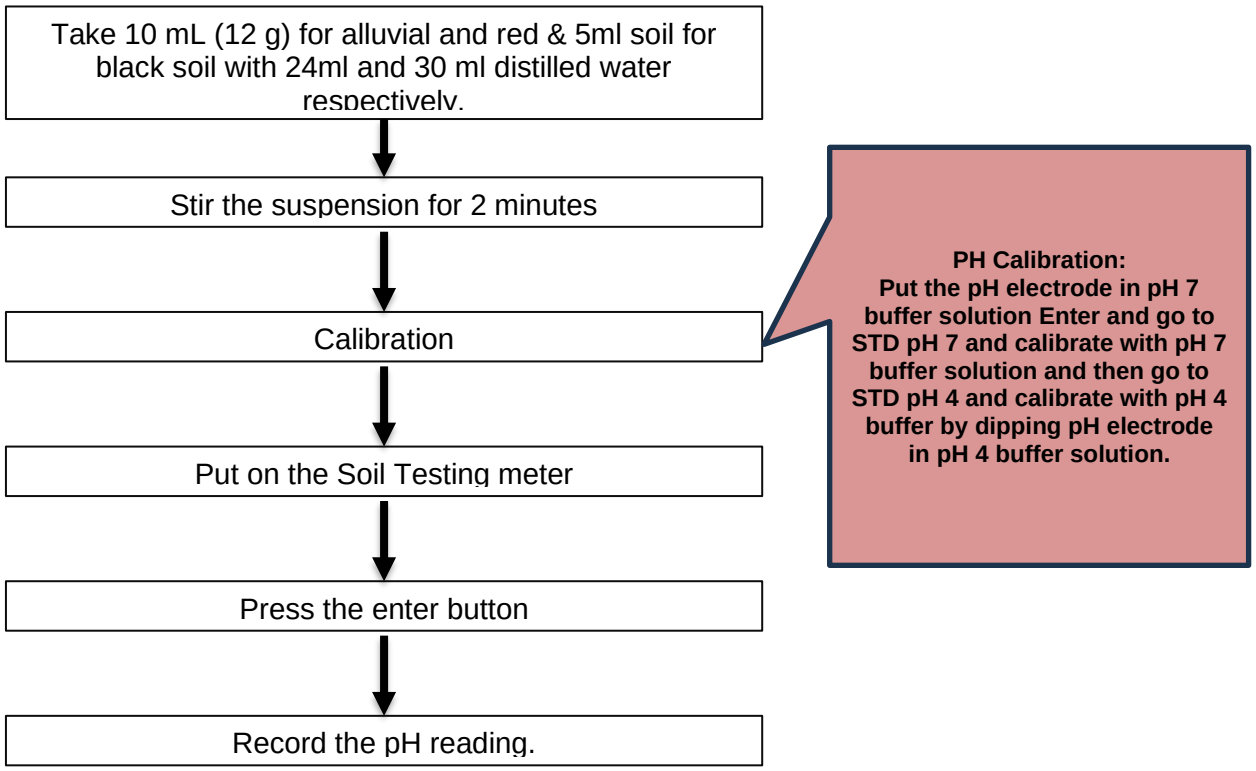
Objective: To study the pH of soil sample

Instrument required PUSA STFR meter

Reagents Required:

- Standard pH 7.0: One 100 ml solution
- Standard pH 4.0 (In case of neutral to acid soil area) One 100 ml bottle.
- Standard pH 9.2 (In case of alkali soil area) One 100 ml bottle
- LR solution (In case of acid soil area) Two 100 ml bottle

Procedure:



Result: Record the result

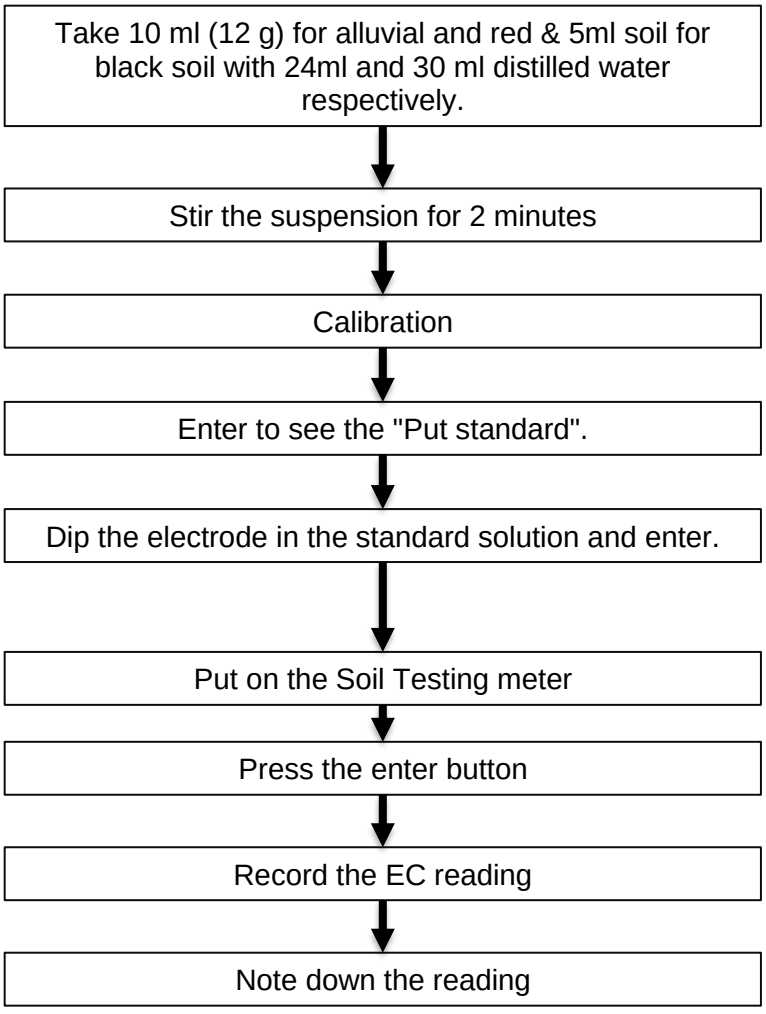
Experiment II - Estimation of Electrical Conductivity of soil

Objective: To study the EC of the given soil sample.

Instrument required PUSA STFR meter

Reagents Required EC standard solution: One 100 ml bottle

Procedure:



Result: Record the result

Experiment III- Estimation of Soil Organic Carbon

Objective: To study the organic carbon of the given soil sample.

Instrument required PUSA STFR meter

Reagents Required:

- OC1: one 60 ml dropping bottle. (1ml for one test)
- OC2: one pack of 60 small vials (2 ml for one test)

Procedure:

Take six glass beakers and mark them as B(for blank) and 1,2,3,4,5 for samples

↓

Take 11 drops of distilled water in blank beaker marked as DW and 0.4 ml soil in beakers

↓

OC1 reagent crystallizes in cold. Before using it should be warmed and shake to dissolve the crystals

Add 1ml. OC1 in all the beakers and then add one vial OC2 in all the beakers

↓

Keep undisturbed for 30 minutes

↓

Then add 47 ml distilled water with the help of 50 ml measuring cylinder to all the beakers and mix them with a glass rod

↓

Take another set of five glass beaker and mark them as 1,2,3,4 and 5

↓

Filter the sample solutions.

↓

Take readings of the blank solution first and then one by one the sample solutions.

Caution
OC2 is very corrosive and should not come in contact with skin

Result: Record the result (Annexure-II).

Experiment IV- Estimation of Soil Available Nitrogen

Objective: To study the available nitrogen content of given soil sample.

Instrument required PUSA STFR meter

Reagents Required:

Procedure:

Calculated from organic carbon content of soil

Result: Record the result

Experiment V- Estimation of Soil Phosphorus

Objective: To study the phosphorus content of given soil sample.

Instrument required: PUSA STFR meter

Reagents Required:

- PHX: 10 vials, of 5 ml capacity, the content of each of which has to be dissolved in 100 ml distilled water in a 100 ml bottle for 5 tests.
- PH1: One 100 ml bottle
- PH2: Two 100 ml bottles
- PH3: 10 vials of 5 ml capacity, the content of each has to be dissolved in 50 ml distilled water in a 100 ml dropping bottle for 5 tests.
- P free charcoal: one 100 ml container having 100 ml P free charcoal

Procedure: See next page

Sample:

0.5 ml (0.6 g) soil + 12 ml of PHX+ 0.3 (0.6 ml in case of red and black soil) ml of charcoal

↓

Shake for half an hour and filter.

Blank

12 ml of PHX+0.3 (0.6 ml in case of red and black soil) charcoals.

↓

Shake for half an hour and filter.

Reagent Preparation
PHX: Dissolve the content of 5 ml vial PHX In 100 ml DW in dropping bottle PHS: Dissolve the content of 2 ml vial PH3 in 50 ml DW dropping bottle

Colour Development Sample

2 ml sample extract +5 drops PH1 + 2ml PH2 + 1 ml PH3

↓

Dilute to 10 ml

↓

Keep for 15 min.

Colour Development Blank

2 ml blank extract +5 drops PH1 + 2ml PH2 + 1 ml PH3

↓

Dilute to 10 ml

↓

Keep for 15 min.

Result: Record the result

Experiment VI- Estimation of Soil Potassium

Objective: To study the potassium content of given soil sample.

Instrument required: PUSA STFR meter

Reagents Required:

- PSX: 10 vials of PSX1 and 10 vials of PSX2. The contents of one vial of each of PSX1 and PSX2 have to be dissolved in 125 ml of distilled water in 125 ml dropping bottles to get PSX.
- PT1: One 100 ml bottle
- PT2: One 100 ml bottle
- PS2: One 100 ml bottle
- PT3: 10 vials, the content of each is to be dissolved in 10 ml in dropping bottle for 5 tests

Procedure:

Sample:

2.5 ml (3 g) soil + 15 ml PS X.

↓

Pinch of charcoal (0.3 ml)

↓

Shake for half an hour and filter

Reagent Preparation
PSX: Dissolve the content of PSX1 and PSX2 In 125 ml distilled water in dropping bottle.
PT3: Dissolve the content of 2 ml vial PT3 in 10 ml DW in dropping bottle& Finer.

Blank:

20 ml PS X. + pinch of charcoal (0.3 ml)

↓

Shake for half an hour and filter.

Colour Development Sample

1 ml sample extract + 1ml blank extract + 1 ml PT1+ 11 drops PT2

↓

Shake up and down three times with cap closed.

↓

Wait for three minutes.

↓

Add 5 drops of PT3 quickly and wait for 1 minute.

↓

Shake up and down three times with cap closed.

↓

Add 1 ml PS2 and dilute to 10 ml with water and shake up and down three times with cap closed.

↓

Keep for 5 min.

Colour Development Blank

2 ml blank extract + 1 ml PT1 + 11 drops PT2.

↓

Shake up and down three times with cap closed.

↓

Wait for three minutes.

↓

Add 5 drops of PT3 quickly and wait for 1 minute.
Shake up and down three times with cap closed.

↓

Add 1 ml PS2 and dilute to 10 ml with water and shake up and down three times with cap closed.

↓

Keep for 5 min. Calibration with Potassium Standard: 1 ml standard solution + 1ml blank extract + 1 ml PT1+ 11 drops PT2.

↓

Shake up and down three times 17 with cap closed

↓

Wait for three minutes.

↓

Add 5 drops of PT3 quickly and wait for 1 minute.

↓

Shake up and down three times with cap closed

↓

Add 1 ml PS2 and dilute to 10 ml with water and shake up and down three times with cap closed.

↓

Keep for 5 min

↓

Enter reading in the STANDARD option of the meter.

Result: Record the result

Experiment VII- Estimation of Sulphur content in soil

Objective: To study the sulphur content of given soil sample.

Instrument required PUSA STFR meter

Reagents Required:

- SW: One 100 ml bottle of solution
- S1 : One 100 ml bottle of solution
- S2: One 100 ml container containing solid powder material
- S3: One empty 100 ml dropping bottle (solution to be prepared during testing)
- S4: One 100 ml dropping bottle of standard solution (All reagents except PS2 have lifetime of six months; the life of PS2 is three months. Solid reagents supplied, once dissolved in water can be used for one day only.)

Procedure:

Extraction: Same as potassium

See next page

Colour Development Sample

5 ml sample extract +4 drops S3+0.3 ml solid S2.

↓

Shake up and down 50 times till solid dissolves and keep it for 5 minutes.

↓

Then add 1 ml S1

↓

Shake up and down 10 times and keep it for 25 minutes and take reading

Colour Development Blank

5 ml black extract + 4 drops S3+ 0.3 ml solid S2+ Shake up and down 50 times till solid dissolves and keep it for 5 minutes.

↓

Add 1 ml S1. Shake up and down 10 times and keep it for 25 minutes and take reading

↓

Calibration with Sulphur standard: 5 ml standard solution +4 drops S3+ 0.3 ml solid S2.

↓

Shake up and down 50 times till solid dissolves and keep it for 5 minutes.

↓

Then add 1 ml S1. Shake up and down 10 times and keep it for 25 minutes and take reading.

Result: Record the result (Annexure-II).

Experiment VIII- Estimation of Zinc content in soil

Reagent
ZNX: Dissolve the content of ZNX in 100 ml distilled water.
ZN3: Dissolve the contents of vial in 50 ml DW
ZN4: Take the content of 2ml dark vial ZN41 in 50 ml dropping bottle and add 25 ml ZN42 solution shake well to dissolve it

Objective: To study the zinc content of given soil sample.

Instrument required: PUSA STFR meter

Reagents Required:

- ZNX: 10 vials, of 5 ml capacity, the content of each of which has to be dissolved in 100 ml distilled water in a 100 ml bottle for 5 samples and one blank.
- ZN1: (ZN1A for alluvial and red soil, ZN1B for high clay or black soil) Two 100 ml bottle (200 ml solution)
- ZN2: Two 100 ml bottle (150 ml solution)
- ZN3: 10 vials (1ml capacity), the content of each is to be dissolved in 100 ml solution in dropping bottle for 5 tests
- ZN41: 10 vials (dark colour 1 ml capacity) the content of each is to be dissolved in 25 ml ZN42 solution and filtered in dropping bottle for 5 tests

Procedure:

Sample Extraction:

2.5 ml (3 g) soil + 15 ml ZNX.

↓

Shake for half an hour and filter

Colour Development Sample

2 ml sample extract+3ml ZN1(A for alluvial and B for black soil) + 2 ml ZN2+ 1ml ZN3+ 2ml ZN4.

↓

Keep for 15 min

Colour Development Blank

2 ml blank (ZNX)+, 3ml ZN1(A for alluvial and B for black soil) + 2 ml ZN2+ 1ml ZN3+ 2ml ZN4.

↓

Keep for 15 min.

Result: Record the result

Experiment IX- Estimation of Iron content in soil

Objective: To study the iron content of given soil sample.

Instrument required PUSA STFR meter

Reagents Required:

- ZNX as in case of zinc
- FE1: One 100/125 bottle containing 100 ml solution
- FE2: One 100/125 bottle containing 100 ml solution

Procedure:

Extraction: Same as Zinc

Colour Development Sample

2 ml sample extract+ 1ml ZNX+1 ml FE1+ 1ml FE2.

↓

Keep for 15 min

Colour Development Blank

2 ml blank (ZNX) + 1ml ZNX+1 ml FE1+ 1ml FE2.

↓

Keep for 15 min

Result: Record the result

Experiment X- Estimation of Copper content in soil

Objective: To study the copper content of given soil sample.

Instrument required PUSA STFR meter

Reagents Required:

- ZNX as in case of zinc
- CU1: One 100/125 bottle containing 100 ml solution
- CU2: CU1: One 100/125 bottle containing 100 ml solution
- CU3: 10 vials(1ml capacity), the content of each is to be dissolved in 50 ml
- DW in dropping bottle for 5 tests

Reagent Preparation

ZNX: Same as above
CU3: Dissolve the 2ml vial CU3 contents in 50 ml DW

Procedure:

Extraction: Same as Zinc

Colour Development Sample

4 ml Sample extract+ 2ml CU1+1 ml CU2 Filter + 1ml CU2+ 1ml CU3.

↓

Keep for 15 min

Colour Development Blank

4 ml blank (ZNX) + 2ml CU1+1 ml CU2 Filter + 1ml CU2+ 1ml CU3.

↓

Keep for 15 min.

Result: Record the result

Experiment XI- Estimation of Manganese content in soil

Objective: To study the manganese content of given soil sample.

Instrument required PUSA STFR meter

Reagents Required:

Reagent

MNX: Dissolve the content of MNX in 100 ml

- MNX: 10 vials, of 5 ml capacity, the content of each of which has to be dissolved in 100 ml distilled water in a 100/125 ml bottle for 5 samples and one blank.
- MN1: One 100/125 bottle containing 100 ml solution
- MN2: One 100 ml container containing 20 g of solid powder

Procedure:

Sample Extraction:

Sample: 2.5 ml (3 g) soil + 15 ml MNX.

↓

Shake for half an hour and filter

Colour Development Sample

5 ml sample extract+0.5 ml MN1+0.2 g MN2.

↓

Shake and keep in boiling water for 5 minutes and take reading after 15 min

Colour Development Blank

5 ml blank (MNX) +0.5 ml MN1+0.2 g MN2.

↓

Shake and Keep in boiling water for 5 minutes and take reading after 15 min

Result: Record the result

Experiment XII- Estimation of Boron content in soil

Objective: To study the boron content of given soil sample.

Instrument required: PUSA STFR meter

Reagents Required:

Reagent

- **BX: Dissolve both the contents of one BXA and one BXB in 250 ml distilled water in the bottle marked as BX**
- **B2: Dissolve the contents of each vial in 10 ml distilled water for one day use**

- BX: 10 vials of BXA and 10 vials of BXB. To make BX the contents of one BXA and one BXB vial have to be dissolved in 250 ml distilled water. First dissolve BXA in BXB + some water and then make volume up to 250 ml
- B1: One 100 ml dropping bottle
- B2: 10 vials, the contents of which have to be dissolved in 10 ml of distilled water in a 50 ml dropping bottle.

Procedure:

Extraction:

10 ml soil (12.0g) +24 ml of BX.

↓

Shake for half an hour and filter with double filter paper.

Colour Development Sample

3ml sample extract+1ml B1+1ml B2

↓

Keep it for half an hour and take reading.

Colour Development Blank

3 ml blank (BX) + 1 ml B1+1 ml B2.

↓

Keep it for half an hour and take reading.

Result: Record the result.

Chapter 5: Assessment and Evaluation

Interpretation of Results

Interpretation refers to the task of drawing inferences based on the results of soil samples analysis. The interpretation of soil test results will typically indicate whether a nutrient level is –

Low or (in case of macro-nutrients)		Deficient or (In case of micro-nutrients)	
Medium (moderate) or (in case of macro-nutrients)		Sufficient (In case of micro-nutrients)	
High (adequate)/ Very high (in case of macro-nutrients)		High Acidity/ Alkalinity (In case of soil pH)	

These levels are known as “nutrient classes” or categories.

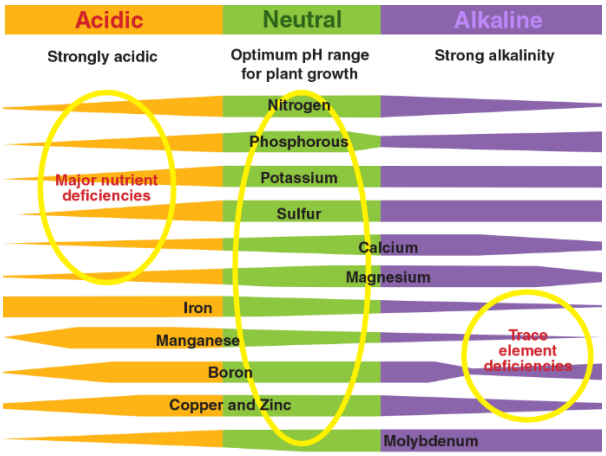
The nutrient classes or categories used in Digital Soil Testing Mini Lab for 12 soil health parameters are as given below-

Soil pH

pH range	Classes
<4	Extremely acid
4-5	Strongly acid
5-6	Moderately acid
6-7	Slightly acid
7	Neutral
7-8	Moderately alkaline
>8.5	Strongly alkaline

Soils are not happy in High Acidity/ Alkalinity conditions.

Because it indicates the major nutrient deficiencies in soils (in high acidic soils) and trace element deficiencies along affecting other soil properties in soils (in high alkaline soils).



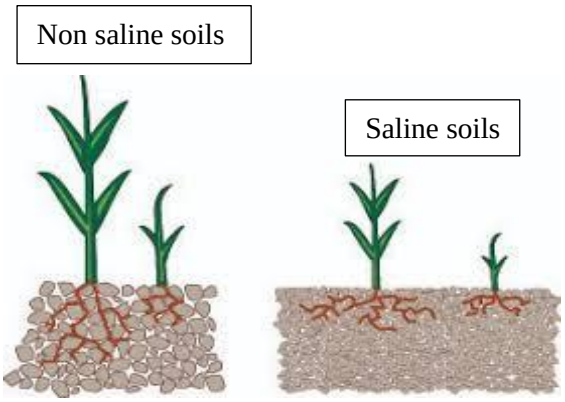
Soil EC

EC range of extract (dS/m)	Salt (%) range in soil	Classes
0-0.4	0-0.05	Non saline (Salinity effect mostly negligible)
0.4-0.8	0.05-0.1	Very slightly saline (Yield of very sensitive crops may be restricted)
0.8-1.6	0.1-0.2	Moderately saline (Yield of many crops restricted)
>1.6	>0.2	Strongly saline (Only tolerant crops yield satisfactorily)

NOTE- Alluvial soil (silt loam) = soil: water is 1:2; Black soil (clay loam)= soil: water is 1:5

Soils are not happy in Salinity conditions.

Because it affects the growth of plants.

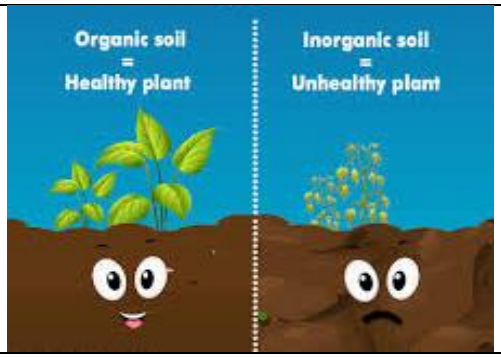


Soil Organic Carbon (OC)

OC range (%)	Classes
<0.5	Low
0.5 – 0.75	Medium
>0.75	High

Soils are happy in when soil organic carbon is high.

Because then soils are healthy.



Nitrogen

Nitrogen (kg/ ha)	Classes
<280	Low
280 - 560	Medium
> 560	High

Phosphorus

Phosphorus (kg/ ha)	Classes
<10	Low
10 – 25	Medium
> 25 – 50	High
> 50	Very High

Potassium

Potassium (kg/ ha)	Classes
<120	Low
120 – 280	Medium
> 280 – 600	High
> 600	Very High

Soils are happy when Nitrogen, Phosphorus and Potassium (Macro-nutrients) are high in soils.

Because these are essential nutrients for plant growth.

Sulphur

Sulphur (ppm)	Classes
<10	Deficient
>10	Sufficient

Micro-nutrients, i.e., Zinc, Iron, Copper, Manganese, Boron

Zinc (ppm)	Iron (ppm)	Copper (ppm)	Manganese (ppm)	Boron (ppm)	Classes
<0.6	<4.5	<0.2	<2.0	<0.5	Deficient
>0.6	>4.5	>0.2	>2.0	>0.5	Sufficient

Soils are very happy when Macro as well as Micro nutrients are high/ sufficient in soils.

Because plants needs these are essential nutrients from soils for its growth.

Conversion Factor to Multiply Soil Testing Value to Get STL Value

Nutrient	Extractant	Critical limit for STL (mg/kg)	Critical limit for Soil Testing Meter (mg/kg)	Factor to multiply Soil Testing Meter to get STL
S	0.15% $CaCl_2$	10	10	1
Zn	0.005M DTPA+0.01M $CaCl_2$+0.1M TEA	0.6	1.3	0.461
Fe	-do-	4.5	14.0	0.321
Cu	-do-	0.2	0.72	0.277
Mn	-do-	2.5	2.5	1
B	Hot water	0.5	0.5	1

Recommended Dose of Fertilizers (RDF)

Soil Test Value		RDF
If Soil Test Value of any of the nutrient lies in the LOW category		Apply 25 % more than RDF
If Soil Test Value of any of the nutrient lies in the MEDIUM		Apply RDF
If Soil Test Value of any of the nutrient lies in the HIGH category		Apply 25 % less than RDF
If Soil Test Value of any of the nutrient lies in the VERY HIGH category		Do not apply any fertilizer of that nutrient.

Chapter 6: Standard Operating Procedure for School Soil Health Card

Introduction

School Soil Health Card (SSHC) is an ambitious project from the Ministry of Agriculture and Farmers Welfare, Department of Agriculture and Farmers Welfare, Government of India. The project aims at creating awareness among the students and farmers about the importance of soil nutrition management using soil testing.

Soil Health Card Scheme is a scheme launched by the Government of India on 19 February 2015. Under the scheme, the government plans to issue soil cards to farmers which will carry crop-wise recommendations of nutrients and fertilisers required for the individual farms to help farmers to improve productivity through judicious use of inputs. All soil samples are to be tested in various soil testing labs across the country. Thereafter the experts will analyse the strength and weaknesses (micro-nutrients deficiency) of the soil and suggest measures to deal with it. The result and suggestion will be displayed in the cards.

Block Diagram

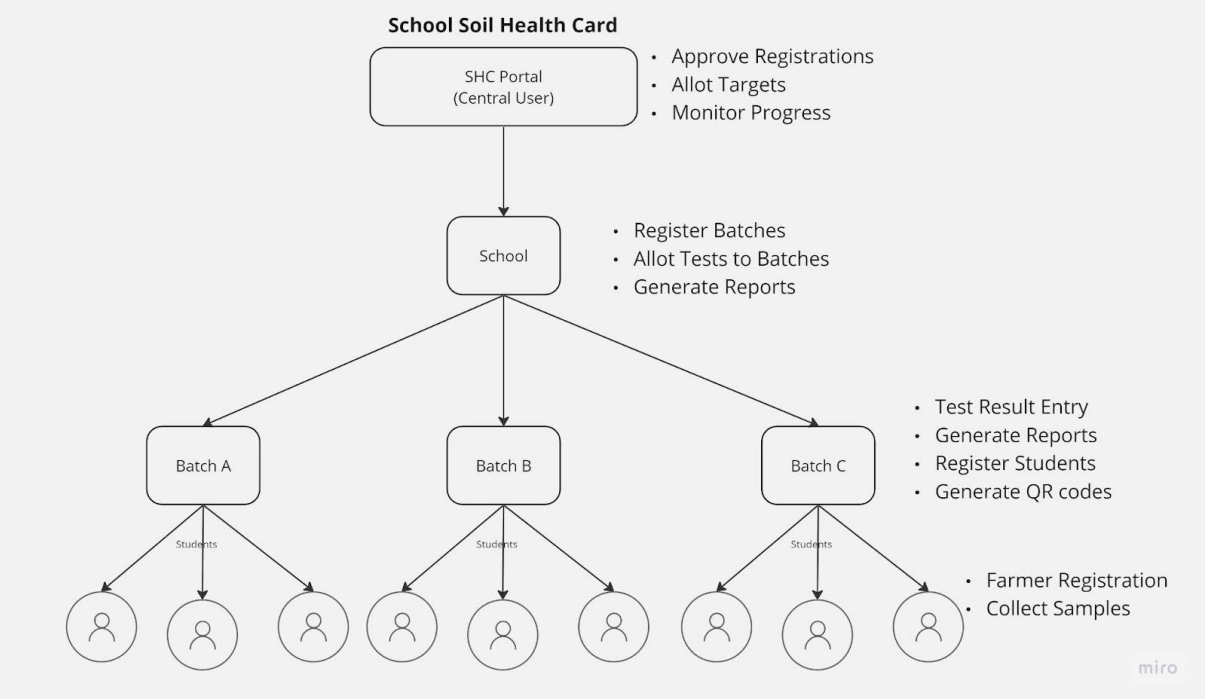


Fig 1. Block diagram of School Soil Health Card scheme

The project has 4 major components:

- SHC Portal managed by Government of India (GoI)
- Schools registered under SHC Portal
- Batches/Classrooms of the School monitored by class teacher/ proctor
- Students of the class

The functions and responsibilities of these components are given below:

- **SHC Portal managed by GoI:** The Soil Health Card is developed by the Department of Agriculture and Farmers Welfare, Government of India. The portal gives the statistics of the soil tests conducted and soil health parameters. The portal is also used to monitor the progress of the scheme at various administration levels. 'Central user' is the main super-admin for the portal. The registrations of the schools on the portal is approved by the central user and the central user will allot targets for the schools.

- **Schools registered under SHC Portal**: Schools need to register themselves on the SHC portal by filling the online registration form. Once the registration is approved by the Central user, the admin of the school can login to the portal. The admin of the school needs to register the Batches or Classrooms of the school by assigning a classroom teacher or proctor to manage the batches. The school admin needs to allot targets for the batches for the soil testing.

- **Batches/Classrooms of the School monitored by class teacher/ proctor:** Once the batches are registered by the school admin, the students of the class must be registered by filling the student details. After the registration of the students, the class teacher must share the login details with the students to use the **SSHC Mobile App**. Class teacher needs to generate QR codes for the sample collection and distribute the QR codes to the students. After the samples are collected and analysed in the school, the class teacher needs to enter the test analysis results in the SHC portal. The soil health cards can be generated after this step and can be distributed to the farmers in soft/hard copy.

- **Students of the class**: Students of the app need to use the SSHC mobile app to register farmers and collect soil samples. Students must visit farmer's land and collect farmer details to complete the farmer registration. After farmer registration, the students must collect soil samples from the farmers' land and then register the samples in the SSHC Mobile App using the QR code. The QR code must be attached to the soil sample collection bag and secured by pasting a transparent adhesive tape on the QR code. An image of the land must be captured in the app. If the internet connectivity is not available in the farmer's place, the mobile app will work in offline mode. In offline mode, QR code

is not used. A unique Sample ID is generated on the mobile app after submitting the sample, which needs to be mentioned on the soil sample bag.

The Mobile app is used by School Admin/Class Admin & Students. The features of mobile app are:

- Farmer Registration using Farmer Mobile number
- Sample collection using QR code
- Plot image and GPS location capture
- Track Sample to check the status of soil sample
- Run Test to enter soil test results
- View and download soil health cards if test completed
- App works in Offline mode for farmer registration and sample collection
- User manual of the app is available

SSHC Mobile App User Guide

Introduction

- Soil Health Card mobile App is used for registration of soil samples collected at farm fields and entry of test results. This information is then sent to the national Soil Health Card Portal (http://soilhealth.dac.gov.in).

- Sample Registration requires entry of details about Farmer, his Land holdings, crops for which recommendations are sought and fertilizers available to improve the health of the soil.

- Mobile application captures the longitude and latitude of the place automatically where samples are collected thus ensuring authenticity of the sample collection and correctness of the information.

App Download

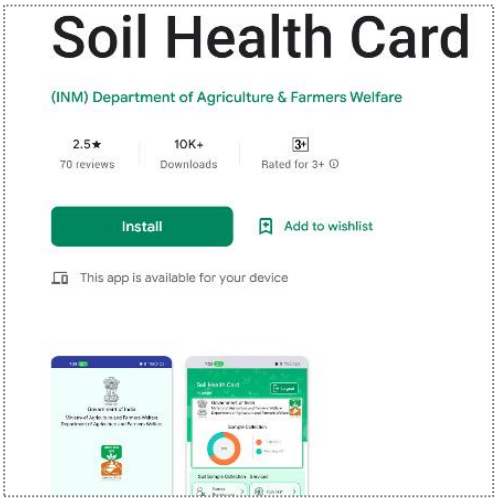
SHC Sample Collection App is available on Android Play store for download:

Link: https://play.google.com/store/apps/details?id=com.kt_goi_shc

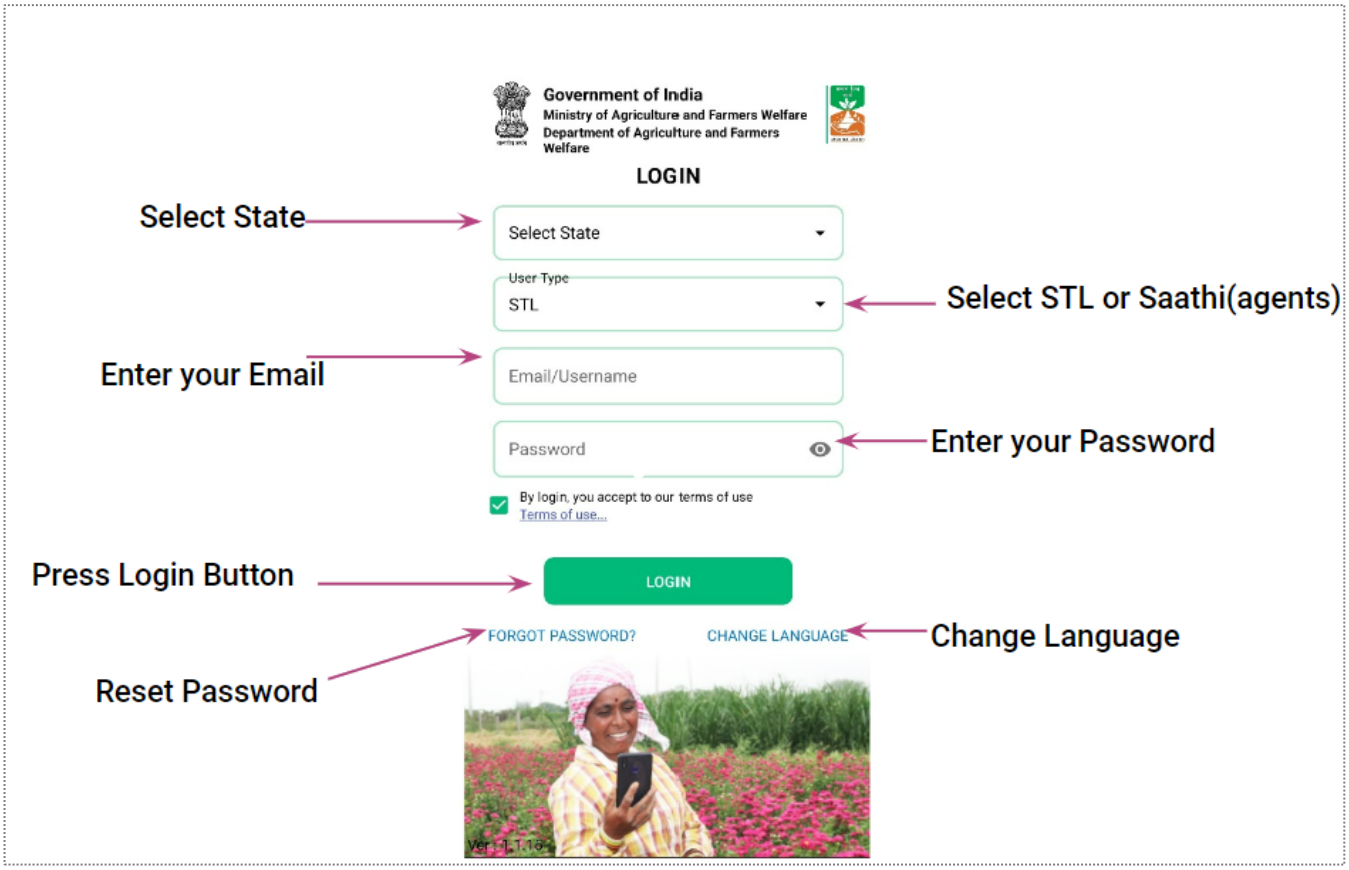
Visit Android Play Store

Search SHC Sample Collection App

Download & Install the app



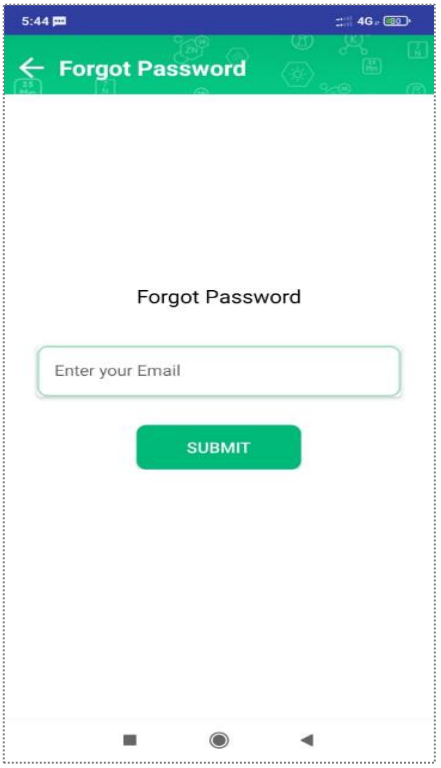
Login Page



Forgot password

If you wish to change your password, click on the “FORGOT PASSWORD?”

- After this, you will be navigated to forgot password page
- Need to enter the email Id to which the reset password will be sent
- Click on the “SUBMIT” button



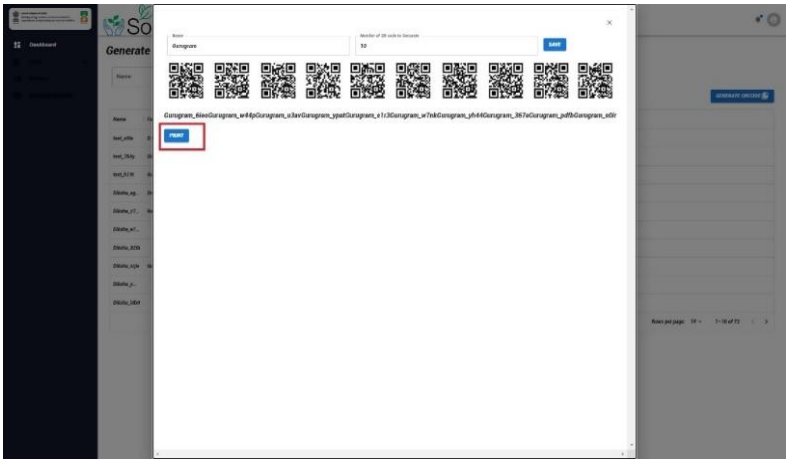
Change language

If you want to change the language which you want to prefer, click on “CHANGE LANGUAGE” button.

- You will be navigated to change language page
- Here you need to choose one language whichever you want. Click on “OK” button

Generate QR Code

Login to SHC Admin panel as VLE



- Go to Generate QR
- Enter a name for your reference and number of QR codes.
- Press Save
- Press Print

Soil Sample Collection

Divide the field into different units and Select soil sampling spots in a zig-zag manner in the field.

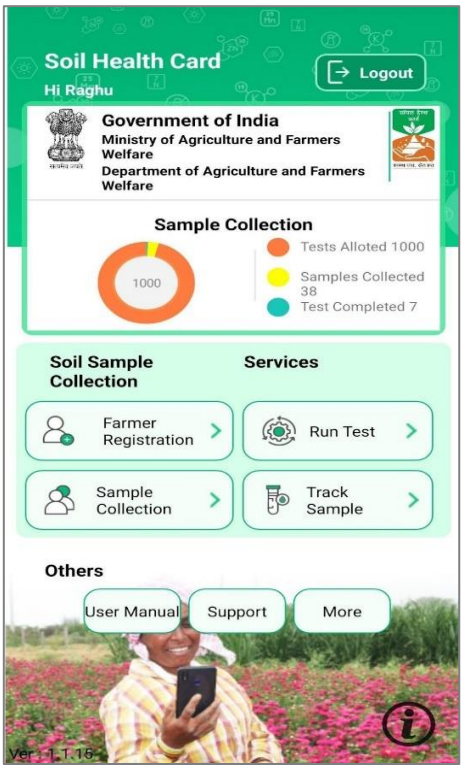
- Remove the surface leaves, sticks, grass, glass, metals, stones etc. at the sampling spot.
- Collect the soil sample from a depth of 15 cm or 6 inches with the help of a spade
- Mix all the soil samples collected from different spots and reduce the total quantity by following the quartering technique

- After drying, pass the soil sample through sieve to remove the unwanted materials.
- Pack the sample in a polythene bag and attach the QR sticker.

Registration of farmers

Click New Farmer in the dashboard.

APP Dashboard

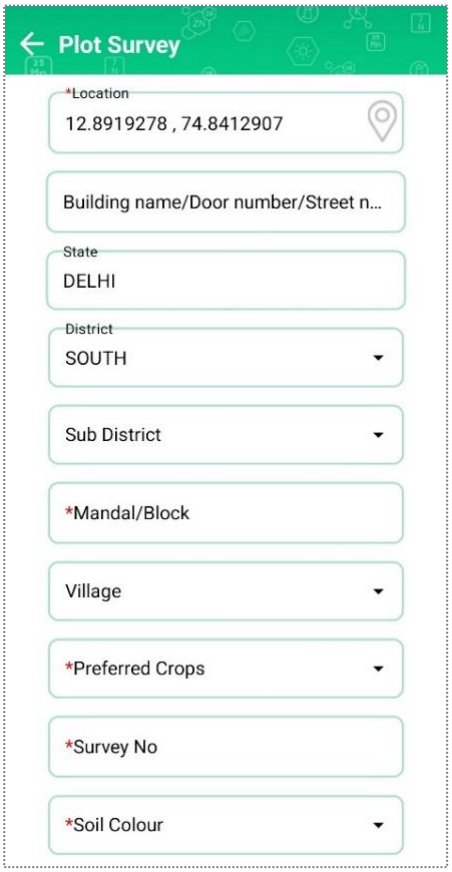


- Enter farmer name, phone number, Aadhar number.
- Select the preferred language for soil health card
- Select the farmer location in the map
- Enter the farmer address
- Click **Add New Farmer** button.

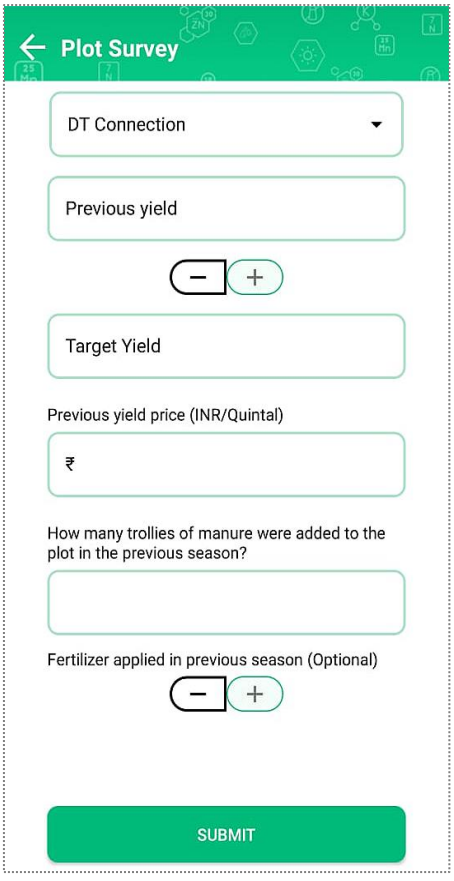
Plot Survey

After registering the farmer, plot survey form will appear.

- Select farmer location and enter details like survey number, soil colour, soil type, area size and current crop
- **Scan the QR code** from the soil sample bag.
- Take a picture of the plot and follow the given steps:



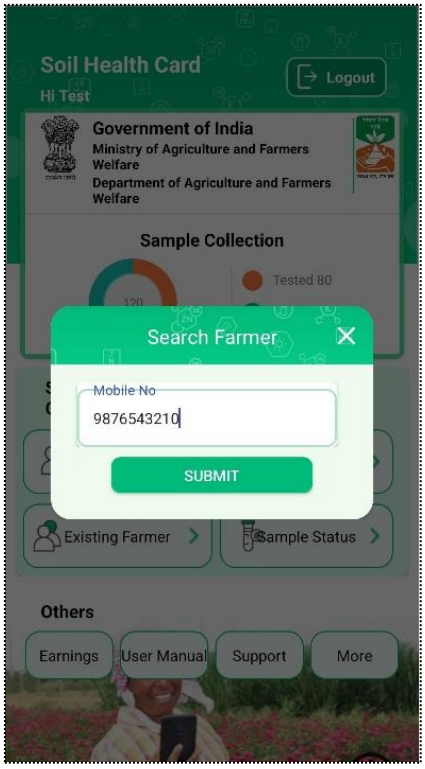
1. Complete the **additional plot survey**



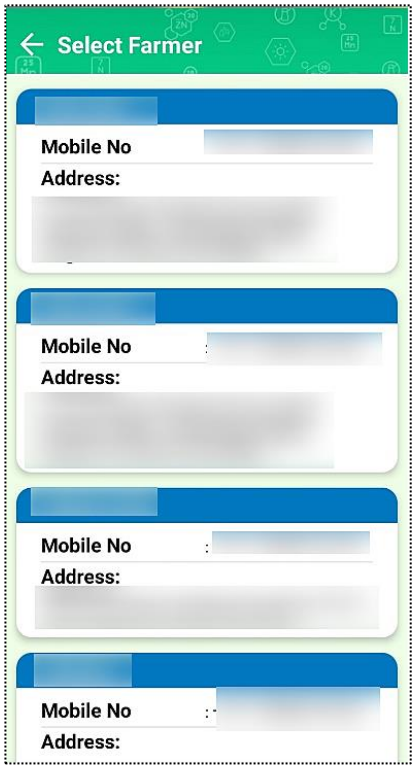
2.Click **Submit** button

Existing Farmer

For the farmer who has done soil test previously, use Existing Farmer button to collect new soil samples.



- Enter farmer's phone number and press **Submit**

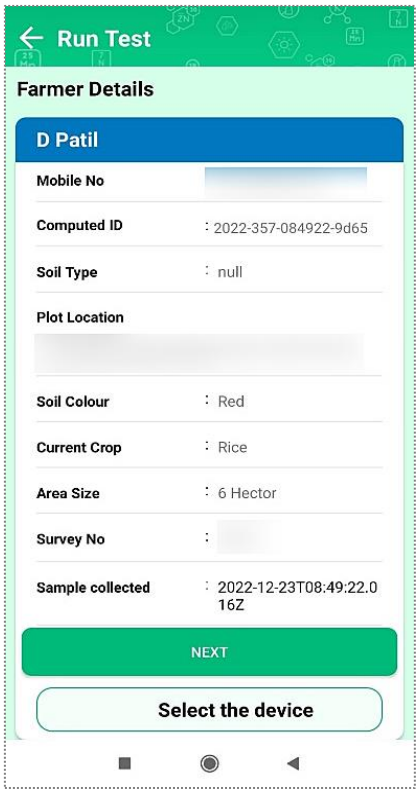


- Select the farmer from the search results.
- Complete the plot survey.
- Scan the QR code and take a plot survey.
- Click **Submit** button.

Run Test

Click Run Test in the dashboard

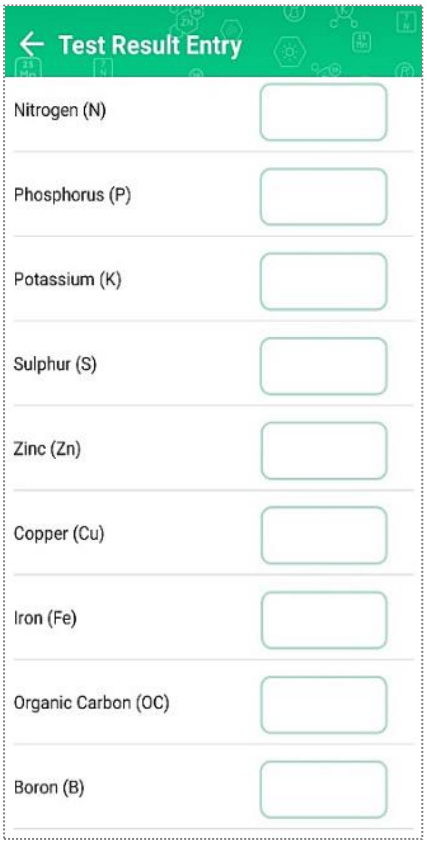
- Scan QR code on the soil sample bag

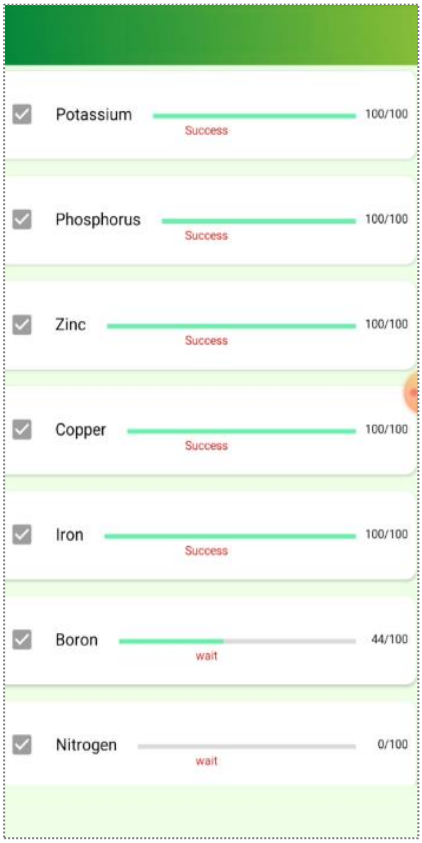


- Sample Details are shown
- Click **Next**

Static Labs

- Screen for Entering Test result is shown
- Enter the data and click Submit.



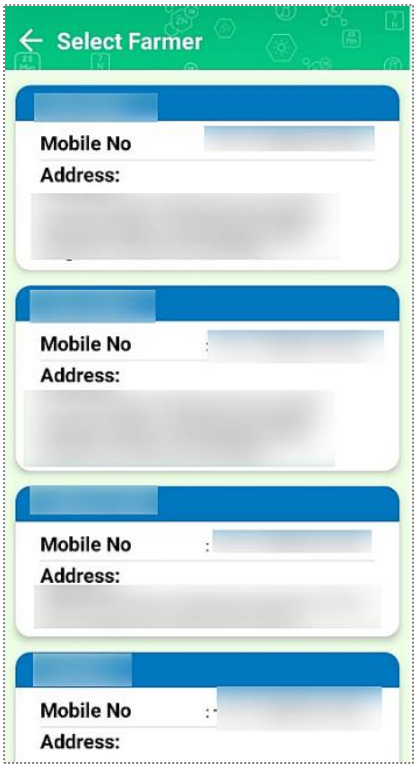


Third-Party App-based Labs

- Third-party app is triggered
- Complete the test
- Result is fetched by SHC App after completion

Sample Status

To check the status of the soil sample, click Sample Status button in the dashboard.

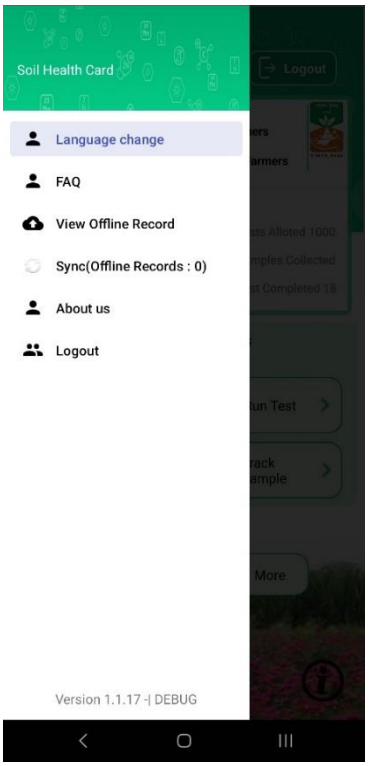


- Enter farmer's phone number and press **Submit**
- Select the farmer from the search results.

The details of the sample with status is displayed.

Offline Mode

In offline mode, users can do farmer registration and collect samples for offline registered Samples.



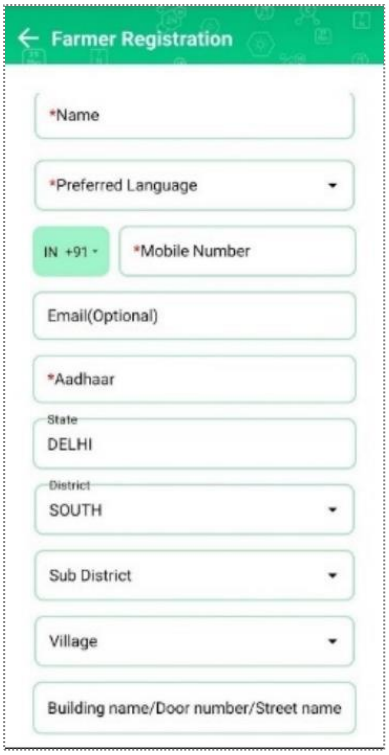
- SHC App will work in offline mode if the internet or network is not available.
- Users can use offline mode manually by turning off the Mobile Data or by disconnecting from the Wi-Fi network.

Farmer Registration in Offline Mode

Click on Farmer Registration →

Press Submit Button

Enter Farmer Detail

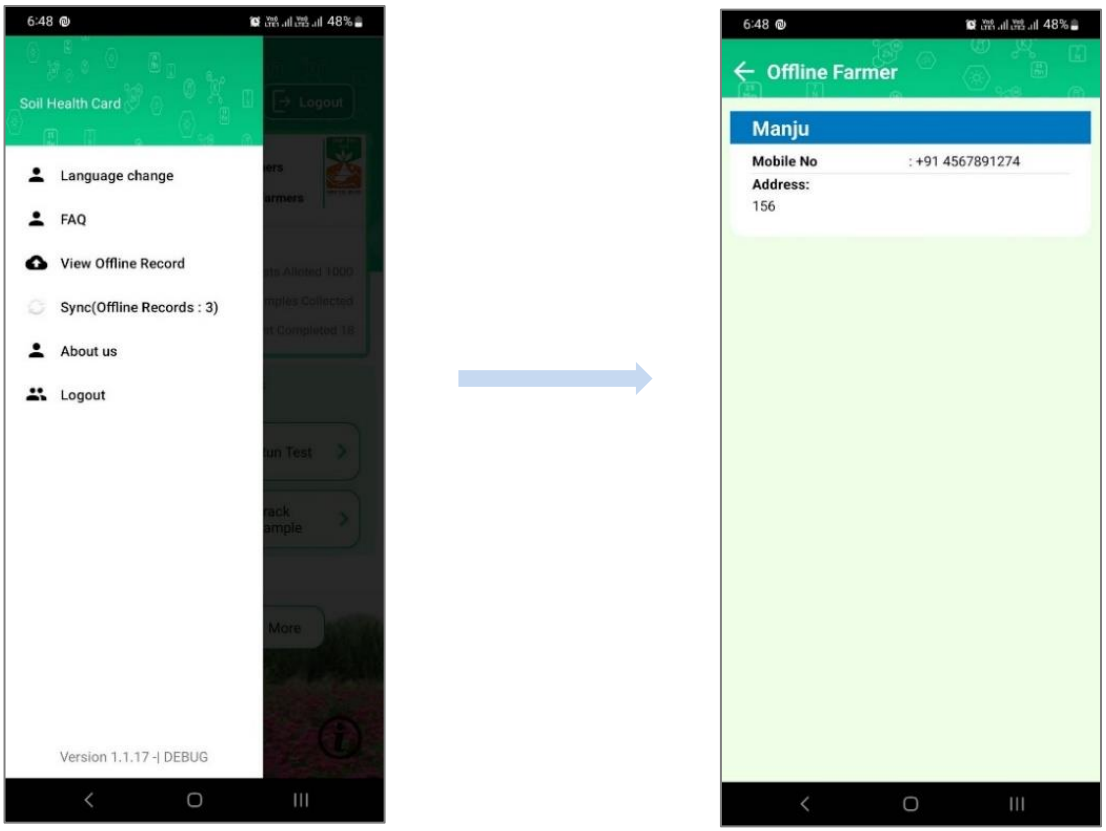


“Successfully Created Farmer” is displayed.

View Data collected in Offline Mode

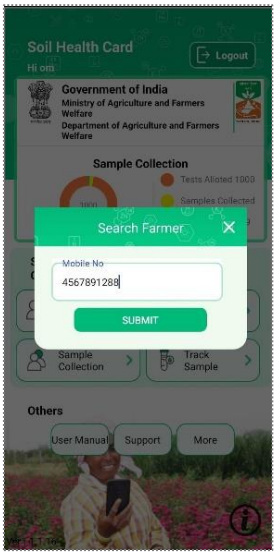
- Click ‘More’ button in App dashboard and click ‘View Offline Records’

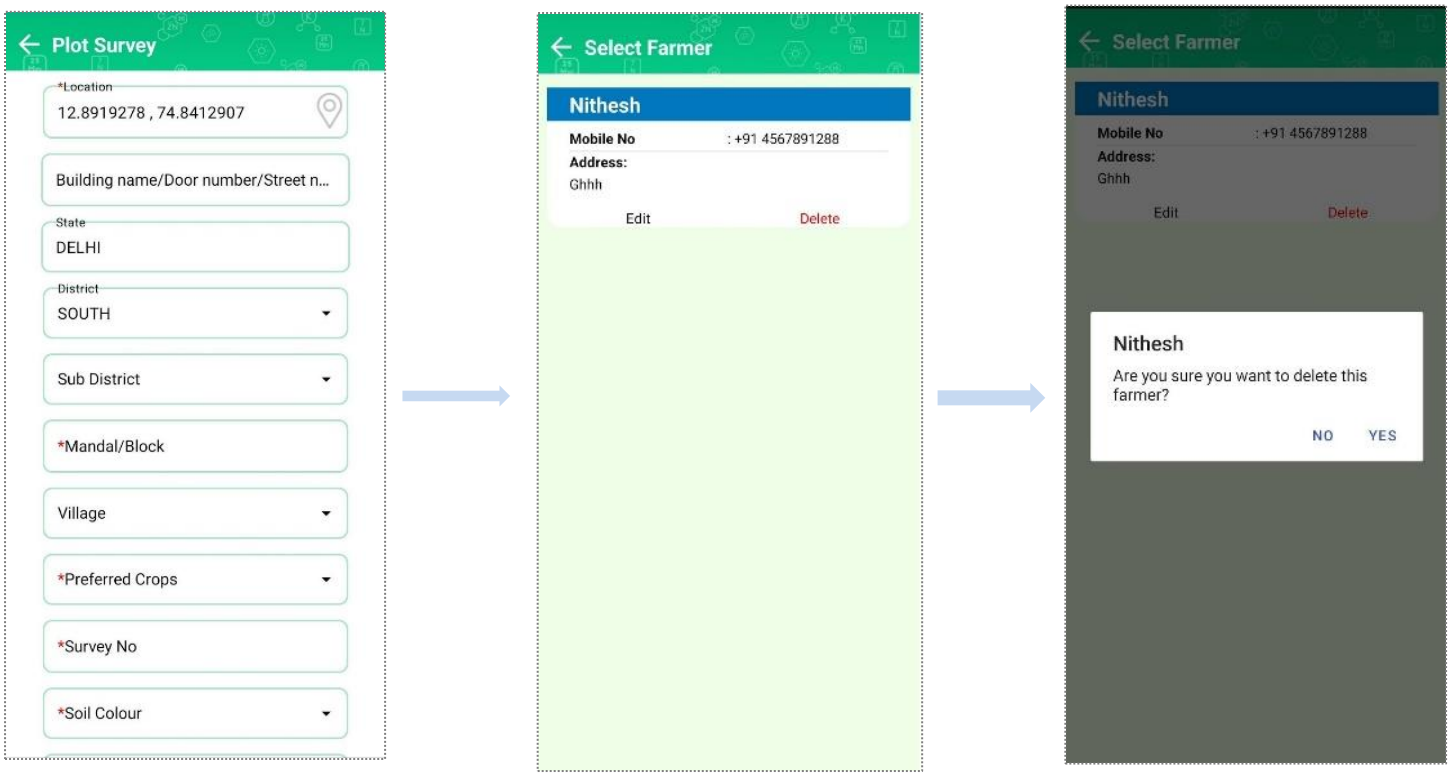
- The list of offline registered farmers details is shown on the screen.



Edit/Delete Details of Farmers Registered in Offline Mode

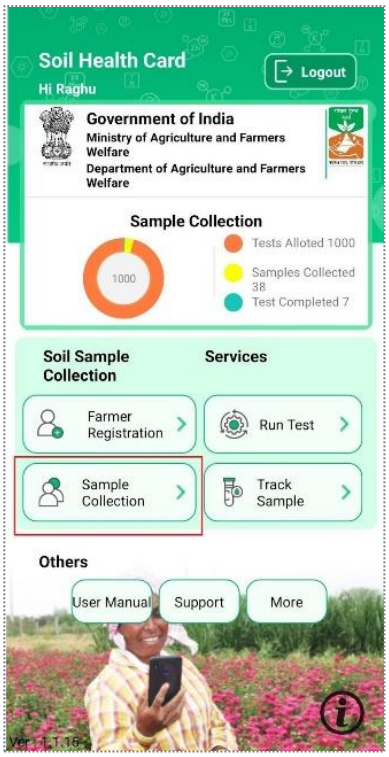
- Click on Sample Collection Button
- Enter Mobile number of Farmer registered in the offline mode
- Click on the Edit button below the Farmers details
- Edit the Farmer details and click Submit button
- Click the Delete button to delete the offline registered farmer details.

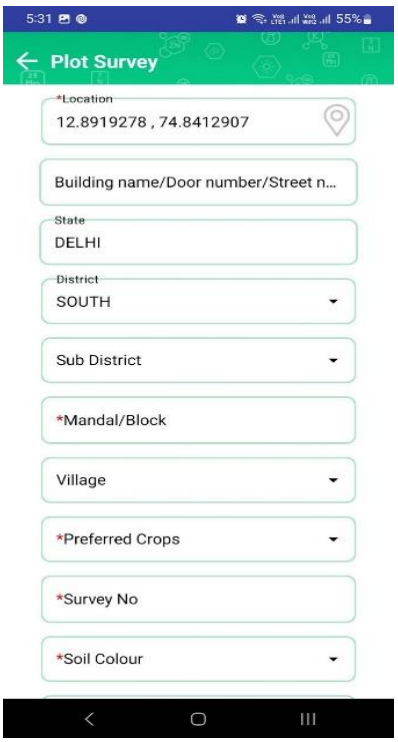


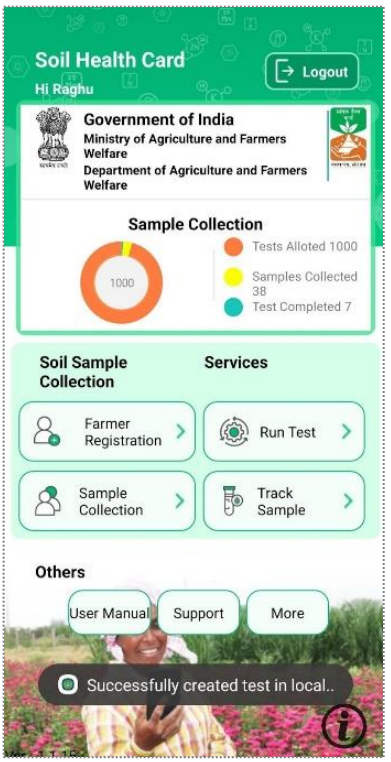


Sample Collection in Offline Mode

- Click on Collect Sample
- Enter Farmer Mobile number. Farmer Details are shown. Click on Farmer Name.
- Plot Survey will appear on the screen. Fill the Plot Survey
- QR Scan is not possible in offline mode. No need to scan QR code.
- Click Plot image
- Press Submit Button
- “Successfully Created Test in local” is displayed.

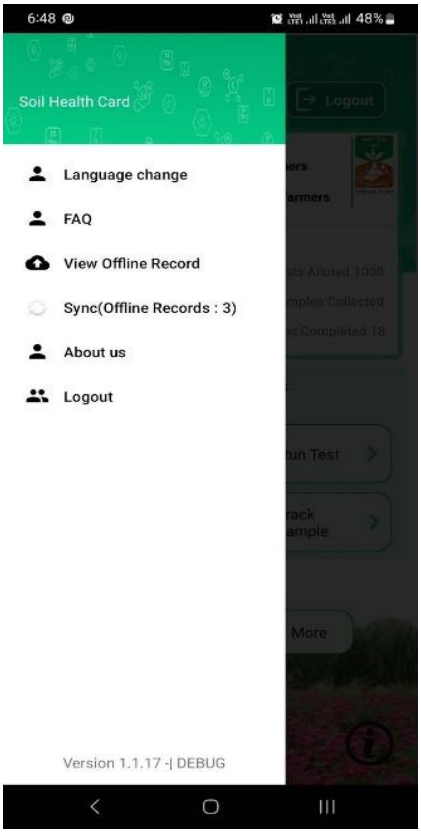




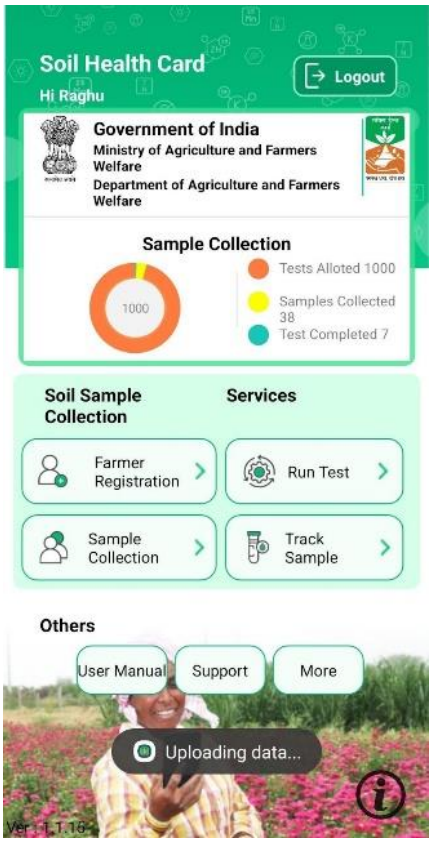


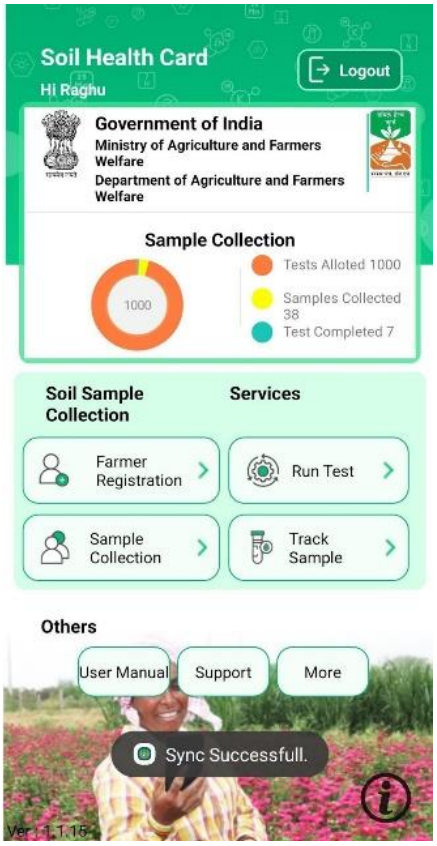
Sync Data collected in Offline Mode

- To Sync the data collected in offline mode to the SHC server, you need a stable internet connection.
- Click on More button
- The number of records collected in offline mode is displayed in front of the Sync button. Press the Sync



- “Uploading Data” will be displayed.
- After a few seconds (depending on the number of farmers registered & samples collected in offline mode), “Sync successful” message is displayed.





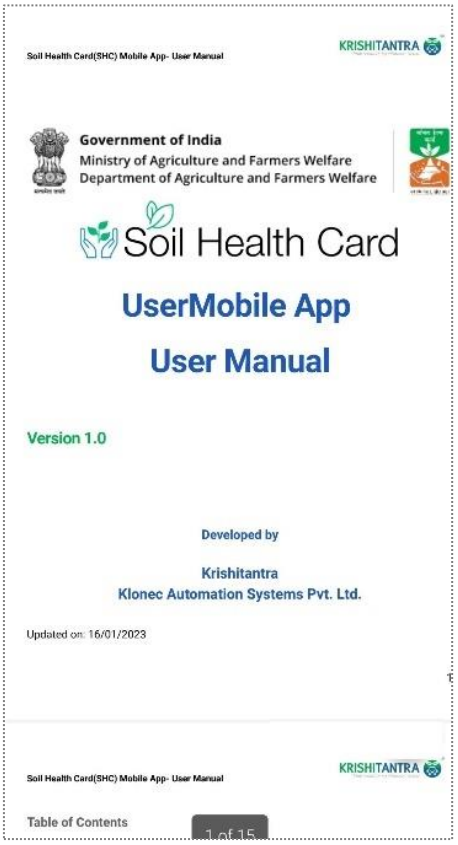
If “Error connecting server, please try again” is displayed on the screen. Click the Sync button again.

User Manual

To view the App use manual,

click **Manual** button in the

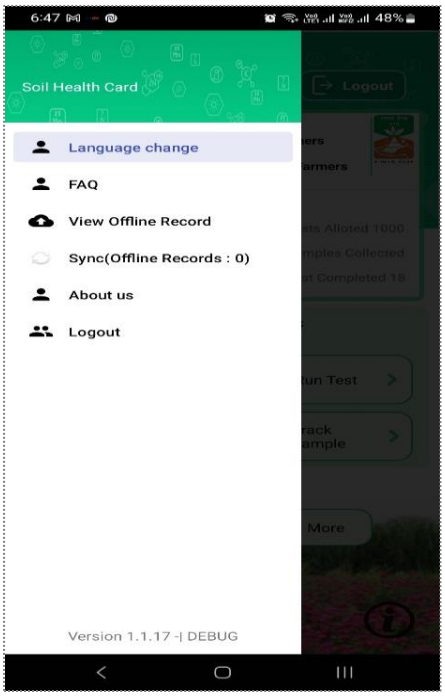
dashboard.

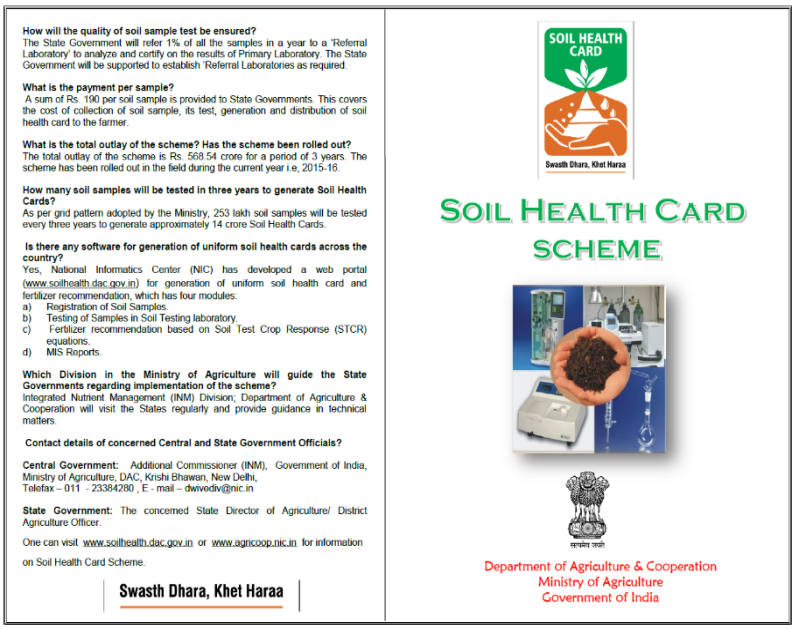


FAQs

Click **More** in the dashboard and select **FAQs** button to view the frequently asked questions with answers.

See next page





How will the quality of soil sample test be ensured?
The State Government will refer 1% of all the samples in a year to a 'Referral Laboratory' to analyze and certify on the results of Primary Laboratory. The State Government will be supported to establish 'Referral Laboratories as required.

What is the payment per sample?
A sum of Rs. 190 per soil sample is provided to State Governments. This covers the cost of collection of soil sample, its test, generation and distribution of soil health card to the farmer.

What is the total outlay of the scheme? Has the scheme been rolled out?
The total outlay of the scheme is Rs. 568.54 crore for a period of 3 years. The scheme has been rolled out in the field during the current year i.e, 2015-16.

How many soil samples will be tested in three years to generate Soil Health Cards?
As per grid pattern adopted by the Ministry, 253 lakh soil samples will be tested every three years to generate approximately 14 crore Soil Health Cards.

Is there any software for generation of uniform soil health cards across the country?
Yes, National Informatics Center (NIC) has developed a web portal (www.soilhealth.dac.gov.in) for generation of uniform soil health card and fertilizer recommendation, which has four modules:
a) Registration of Soil Samples.
b) Testing of Samples in Soil Testing laboratory.
c) Fertilizer recommendation based on Soil Test Crop Response (STCR) equations.
d) MIS Reports.

Which Division in the Ministry of Agriculture will guide the State Governments regarding implementation of the scheme?
Integrated Nutrient Management (INM) Division, Department of Agriculture & Cooperation will visit the States regularly and provide guidance in technical matters.

Contact details of concerned Central and State Government Officials?

Central Government: Additional Commissioner (INM), Government of India, Ministry of Agriculture, DAC, Krishi Bhawan, New Delhi, Telefax – 011 - 23384280 , E - mail – dwivodiv@nic.in

State Government: The concerned State Director of Agriculture/ District Agriculture Officer.

One can visit www.soilhealth.dac.gov.in or www.agricoop.nic.in for information on Soil Health Card Scheme.

Swasth Dhara, Khet Haraa

SOIL HEALTH CARD
Swasth Dhara, Khet Haraa

SOIL HEALTH CARD SCHEME

Department of Agriculture & Cooperation
Ministry of Agriculture
Government of India

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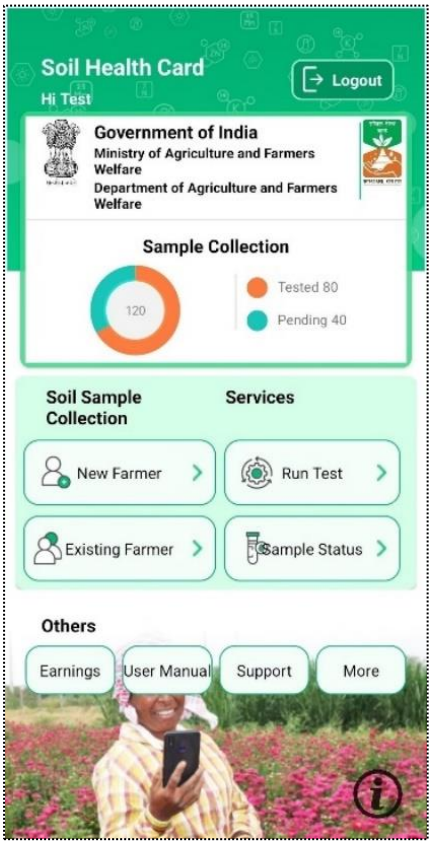

Chapter 7: Making aware the farmers as per advisories generated under Soil Health Card

To create awareness among cultivator farmers about the advisories made on the Soil Health Card program and encourage them to follow the recommendations, students, with support from their teachers and school, may use the following approaches:

1. **Community Meetings:** Students, with support from their teachers and their school, may organize community meetings in agricultural areas where cultivator farmers gather. Using this platform, they can explain the purpose and benefits of the Soil Health Card (SHC) program and the farm advisories provided through it. They may encourage farmers to actively participate, ask questions, and share their experiences. The following information may be shared with farmers from their SHCs.
    a. Insufficiency of Nutrients: The government launched the SHC scheme as an initiative to cure the overuse of urea or nitrogenous fertilisers causing a deficiency of nutrients in soil like potassium, nitrogen, Sulphur, zinc, boron, copper and phosphorus.
    b. Soil Productivity: Farmers can assess and raise the soil and crop productivity using key inputs from the card that carries crop-wise recommendations and other physical parameter of fertilizers and nutrients required for farm land
    c. Increase in Soil Fertility: With the help of the SH farmers can improve integrated nutrient management by judiciously using the soil nutrients.
        i. After getting SHC farmers have reduced N, and K use, especially nitrogen use and increased the use of micronutrients which helped them to increase fertility.
    d. Crop-wise Guidance: It is a field-specific report that helps the farmers to receive crop-wise recommendations of required fertilizers and nutrients in each type of soil
    e. Fertiliser Based Recommendations: SHC offer two sets of fertiliser recommendations for six crops

2. **Farmer Field Days:** Students, with support from their teachers and their school, may conduct farmer field days or on-site demonstrations to showcase the positive outcomes of implementing the soil health advisories. They can invite cultivator farmers to witness firsthand the results achieved by following the recommendations from the Soil Health Card program. This can help build trust and confidence among farmers.

3. **Local Language Communication:** Students, with support from their teachers and their school, may communicate the advisories and related information in the local language or dialect to ensure better understanding and engagement. They can prepare informational materials, pamphlets, and brochures that provide simplified explanations of the advisories. They can distribute these materials among farmers during community events, local markets, or through agricultural extension offices.

4. **Mobile Apps and SMS Services**: Students, with support from their teachers and their school, may develop mobile applications or SMS services, if possible, that can deliver personalized farm advisories directly to the cultivator farmers' smartphones. These apps can provide real-time information, reminders for key activities, and expert guidance tailored to specific crops and soil conditions. They can promote these developed or existing digital tools and their benefits through local radio stations, community gatherings, and social media platforms.

5. **Farmer-to-Farmer Approach**: Students, with support from their teachers and their school, may encourage successful cultivator farmers who have witnessed positive results by following the advisories to share their experiences with their peers. This can be done through field visits, interactive sessions, or even creating a network of experienced farmers who can mentor and guide others in implementing the farm advisories effectively.

6. **Training and Capacity Building**: Students, with support from their teachers and their school, may organize training programs and workshops focused on soil health management, nutrient management, organic farming techniques, and sustainable agricultural practices. They may collaborate with agricultural experts, local universities, and research institutes to provide

practical training to cultivator farmers. These programs can help them understand the significance of the advisories and develop the necessary skills to implement them.

7. **Demonstration Plots:** Students, with support from their teachers and their school, may set up demonstration plots in collaboration with local agricultural institutions or research centers. These plots can showcase the impact of following the soil health advisories on crop yield, quality, and overall soil health. They may conduct regular field visits and invite cultivator farmers to observe the results and learn from the best practices implemented in these plots.

8. **Government and NGO Collaboration**: Students, with support from their teachers and their school, may collaborate with government agricultural departments, NGOs, and farmer cooperatives to jointly organize awareness campaigns, training sessions, and field demonstrations. They may leverage their networks and resources to reach a larger number of cultivator farmers and ensure sustained engagement.

9. **Incentives and Recognition:** Students, with support from their teachers and their school, may recognize and appreciate cultivator farmers who actively implement the soil health advisories and achieve notable improvements in their agricultural practices. They may publicly acknowledge their achievements through local media channels, community events, and award ceremonies.

10. **Follow-up and Monitoring:** Students, with support from their teachers and their school, may establish a system for regular follow-up and monitoring to assess the progress and challenges faced by local cultivator farmers in implementing the farm advisories. They may conduct periodic visits, collect feedback, and provide additional support or clarification as required. This ongoing engagement will reinforce the importance of following the advisories and build a sense of accountability among farmers.

By adopting these strategies, Students, with support from their teachers and their school, can effectively raise awareness among cultivator farmers about the advisories made on the Soil Health Card program and motivate them to follow the recommendations. This will contribute to sustainable agriculture, improved soil health, and enhanced productivity in farming communities.