FORM

FORM - DEVIATION REQUEST SUBMISSION

PUBLICATION DATE: **12/11/2024**
VERSION: **6.0**
NEXT PLANNED UPDATE: **12/11/2026**

RELATED DOCUMENTS
– Deviations Approval Requirements and Procedures

CONTACT DETAILS
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1| General Guidelines

1.1 | Applicability

1.1.0 | This form is to be completed for projects (project activities/PoAs/VPAs) seeking deviation or is/are at a risk of deviating from any applicable requirements, GS4GG-specific requirements listed in the applicable Methodologies or any other deviations occurring in any of the various aspects of the project.

1.1.1 | Refer to the latest version of Deviation Request Requirements and Procedures for detailed information on the procedures and requirements.

1.1.2 | This form can be used in the following instances i.e.,

a. Deviation from GS4GG requirements and/or applicable methodologies prior to submission for certification with GS4GG.

b. Temporary changes to a certified project - which include changes from the registered monitoring plan, the applied methodologies or other standard documents - that are expected **not** to occur beyond a given monitoring period.

1.1.3 | For any permanent changes to a design certified project, the requirements set in Design Change Approval Requirements and Procedures shall be followed.

2| Submission of deviation form

2.1.0 | This form shall be submitted in Microsoft Word (.doc) format to Gold Standard at deviations@goldstandard.org

2.1.1 | Forms with incomplete/inaccurate information shall not be considered for review and shall be returned to the applicant.

3| Implementation of deviation decision

3.1.0 | The decision prescribed in this form shall be considered by the entity applying for deviation for further course of action.

Table of Content

4| Decision summary

To be completed by Gold Standard

4.1 | General information

DEVIATION REFERENCE NUMBER	DEVRQ-186
Date of decision	03/02/2026
Decision	☐ **Approved** [No precondition to apply the deviation decision] ☒ **Conditionally approved** [Decision is subject to compliance with the precondition defined below] ☐ **Not approved** [reason for rejection is provided in decision summary]

4.2 | Decision

4.2.0 | Decision Summary

Thank you for submitting the deviation request.

The deviation is conditionally approved. The UPASI soil sampling protocol may be used, provided that the identified gaps are adequately addressed through the adjustments outlined below:

1. Ensure Walkley–Black results are cross-validated with one more method such as dry combustion or NIR/MIR spectroscopy for a subset of samples.
2. Develop and apply a site-specific correction factor used in the Walkley–Black method, rather than using a generic f = 1.3, based on calibration against reference methods.
3. Validate tapped bulk density measurements with in-situ core samples and apply appropriate correction factors to account for variability.
4. Conduct a coarse fragment analysis to confirm that simple sieving is sufficient; if coarse content is significant, consider layered volume accounting.

Project Developer shall adhere to all QA/QC provisions in the UPASI protocol and ensure that the identified requirements are met to assure that data collection and processing are aligned with the protocol and GS requirements (QA/QC of ICRAF protocol), including on all the points raised above.

4.2.1 | Directions for the project developer/CME, if applicable

Project developer/CME shall report the deviation in PDD along with the details of compliance with the conditions and decision.

4.2.2 | Directions for the Validation and Verification Body (VVB), if applicable

VVB shall assess adherence to the deviation decision.

4.2.3 | Directions for the Gold Standard, if applicable

The assurance review team must review PD's and VVB's reporting and establish compliance with the decision.

4.3 | Applicability to other activities

Is this decision applicable to other projects under similar circumstances?[1]	☐ Yes ☒ No
Does this decision set a precedent for future projects with similar circumstances?[2]	☐ Yes ☒ No
Precedent details (if applicable to other activities)	

[1] If this is marked yes, this means that any other project (PoA/VPA/PA) in similar situation may apply the decision of this deviation to their project as well. The project developer/VVB may quote this deviation decision in the relevant certification documents. This is relevant to only the projects which have already entered the certification cycle with GS4GG.

[2] If this is marked yes, it means the decision is valid to all the future projects which will enter the certification cycle with the similar situation. This is relevant to all the projects which are not yet design certified with GS4GG or have not submitted their documents for preliminary review yet.

5| Deviation Request Details

To be completed by the entity requesting deviation - (Project Developer/Coordinating and Managing Entity and/or VVB)

5.1 | Submitted by

☒ Project developer
☐ CME
☐ VVB
☐ Other (specify…)

5.2 | Details of the entity and its representative submitting the form

Item	Information
Name[3] :	: K Mathew Abraham, Managing Director, Kanan Devan Hills Plantations Company Private Limited
Email ID[4] :	kmathew.abraham@kdhptea.co.in
Organization:[5]:	Kanan Devan Hills Plantations Company Private Limited (KDHP)
Are you an authorized project participant as per the cover letter submitted for this activity?	☒ Yes ☐ No

5.3 | Background information

Type	☐ Project activity	☐ PoA GSXXXX	☐ VPA
GS ID	GS12321	*GS XXXX* *GS XXXX*	*GS XXXX* *GS XXXX*
Host country(ies)	INDIA		
Project Title	Sustainable agricultural practices in tea plantations		
Registry link			
Scale	☐ Microscale (GS) ☐ Small scale ☒ Large scale ☐ Other, if applicable please specify below *Insert text here*		

[3] Name of the individual representing the entity requesting the deviation
[4] Email ID for further correspondence related to the deviation request
[5] The name of the entity requesting the deviation

Certification Status and corresponding date of latest status	☒ Listed	☐ Certified design	☐ Certified project	☐ Other *If other, specify here*
	dd/mm/yyyy	*dd/mm/yyyy*	*dd/mm/yyyy*	*dd/mm/yyyy*

Applied version of Standard	☒ GS4GG			
	☐ Previous version of Gold Standard	Version no.		
		☐ 1.0	☐ 1.1	☐ 1.2	☐ 2.2

Transition date, if applicable	From previous GS version to GS4GG	*dd/mm/yyyy*
	From another standard to GS4GG	*dd/mm/yyyy*
	Name of another standard	☐ CDM
		☐ Other Name of the Standard – Insert text here

Applicable activity requirement	☐ Renewable Energy Activity Requirements ☐ Community Services Activity Requirements ☒ Land-use and Forests Activity Requirements ☐ Other *Insert name here*

5.4 | Project deviation history

Is there any deviation request(s) for the same project activity/PoA/VPA(s) that was submitted to GS previously? If yes, below information.			☒ Yes ☐ No
Reference number	DEV_649		
Status of the deviation	☐ Approved	☒ Rejected	☐ Under review
Were there any findings (CL, CAR, FAR) raised during any certification step (preliminary review, design and/or performance review etc.) that are relevant to this deviation request?	☐ Yes ☒ No		

6| Deviation detail

To be completed by the entity requesting deviation (Project Developer/Coordinating and Managing Entity and/or VVB)

6.1 | Standard document reference

Standard document reference	Title	The deviation is from the Soil Organic Carbon Framework Methodology (Version 1.0), specifically in sections 6.1,7.1 baseline and project calculation Approach 1, which mandates using approved protocols listed in Annex 6 Eligible Soil Sampling Protocols Table 6 (e.g., ICRAF protocol, VCS SOC Module).

	Version	1.0
	Paragraph	Paragraph 5.2.2

6.2 | Description of the deviation

Title	*Request to Follow Soil Sampling as per Guidelines on Tea Culture in South India Published by the United Planters Association of Southern India (UPASI) for SOC Monitoring in Tea Plantations.*	
Confirm the nature of changes related to deviation	☐ Temporary (e.g. not expected to occur beyond one monitoring period)	☒ Permanent (e.g. deviation from requirements prior to submission for certification)
	This deviation is requested prior to the project's first submission for certification. The Soil sampling as per UPASI guidelines will be used consistently throughout the project for all future monitoring events.	
Relevant monitoring period, if applicable	Start date	Dd/mm/yyyy
	End date	Dd/mm/yyyy
Summarise the changes	The project seeks to deviate from the requirement to use one of the approved soil sampling protocols listed in Table 6 under Annex 1: Eligible Soil Sampling Protocols of the Soil Organic Carbon Framework Methodology (Version 1.0), specifically in sections 6.1,7.1 baseline and project calculation Approach 1. Instead, the project proposes to use the Standard Operating Procedure (SOP) for soil sampling developed as per recommendations of UPASI (United Planters Association of South India) Tea Research Foundation (refer appendix 1- 4), the apex Tea Research body in South India recognized by the Tea Board of India.	
Reason for deviation	The SOP developed by KDHP follows UPASI recommended approach which also aligns with the general principles of SOC sampling as outlined in the Gold Standard methodology, including: • Spatial Representativeness: The project area is stratified into 7 main strata based on landscape and agronomic variability (e.g., crop growth, slope, soil colour, texture, and drainage), with each stratum subdivided into 2-hectare sub-strata (totalling 4,356 sampling plots). At least 5 core samples are collected and composited per plot in a zigzag pattern, ensuring comprehensive coverage. • Depth Stratification: Sampling is conducted at depths of 0–22.5 cm (0–9 inches) and 22.5–45 cm (9–18 inches), using a 2-inch screw auger or crowbar. • Timing: Sampling is performed 90 days post-fertilizer application and following 15 cm cumulative rainfall, standardizing soil conditions. • Quality Control: Procedures include avoiding non-representative zones (e.g., road margins, compost pits), cleaning sample surfaces to prevent contamination, proper sample handling, air-drying, and sieving to ≤2 mm before analysis. Bulk density is calculated by dividing the dry weight by the sample volume, and	

	coarse fraction is determined by dividing the weight of the sample passing through the sieve by the weight retained. • Laboratory Analysis: The Walkley & Black chromic acid wet oxidation method is used, with a recovery efficiency of ~77%, corrected by a 1.3 factor to estimate total SOC, ensuring comparability with more precise methods. Further, the proposed deviation has following main characteristics: - As opposed to in the approved methodology where the sampling plots are predetermined, in the deviated methodology, the sampling spots are not predetermined as the samples are derived from 5 or more random points in sub-plots of every 2 ha in the strata. This results in an exhaustive and a more randomised sampling approach eliminating chances of bias. The compositing approach sought for in the deviation uses the blending and quartering method which offers better homogenisation ensuring better sample consistency.
Proposed resolution	The project will implement the UPASI Recommended soil sampling approach as follows: • Sampling Design and Stratification: o Divide the project area into 7 main strata based on landscape and agronomic variability (e.g., crop growth, slope, soil colour, texture, and drainage). o Subdivide each stratum into 2-hectare sub-strata, totalling 4,356 sampling plots. o Collect at least 5 samples per 2-hectare plot in a zigzag pattern, considering variability in slope, soil texture, drainage, and crop growth, and composite them for analysis. • Sampling Protocol: o Conduct sampling 90 days after fertilizer application and following 15 cm cumulative rainfall. o Exclude non-representative zones such as road margins and compost pits. o Use a 2-inch screw auger or crowbar to collect samples at depths of 0–22.5 cm and 22.5–45 cm. o Collect at least 5 composite cores per 2-hectare block in a zigzag pattern. o Reduce composite samples to a 500 g lab sample using the equal quartering method. • Quality Assurance and Sample Integrity: o Ensure representativeness through spatial stratification and seasonal standardization. o Prevent contamination by cleaning sample surfaces and using proper tools. o Air-dry and sieve all samples to ≤2 mm before laboratory analysis. • Laboratory Analysis – SOC Determination:

<table>
<tr><td></td><td>

Use the Walkley & Black method: Oxidize soil organic carbon with 0.167 M potassium dichromate in concentrated sulfuric acid, followed by back-titration with ferrous sulphate or ammonium ferrous sulphate.
Express SOC as a percentage on an oven-dry weight basis, with analytical replicates for accuracy. This approach ensures that SOC monitoring is conducted with the highest standards of scientific rigor and accuracy, fully complying with the objectives of the Gold Standard.

Additional Measurements:

Calculate bulk density by dividing the dry weight of the sample by its volume.
Calculate coarse fraction by dividing the weight of the sample passing through a ≤2 mm sieve by the weight retained.

Illustrative calculations are attached as Appendix 5 & 6. Also enclosing a technical literature on SOC levels for guidance as Appendix 7.
</td></tr>
<tr><td>Is there any potential temporary or permanent impact of deviation on other aspects of the project?</td><td>
Select the relevant area:
☐ Project design
☐ Local stakeholder consultation
☐ Safeguarding principles
☐ SDG assessment
☐ Regulatory compliance
☐ Additionality
☒ Applicability of methodology
☐ Annual emission reduction volume (if yes, fill the table below)

<table>
<tr><th>Annual emission reduction/removal before applying deviation</th><th>Annual emission reduction/ removal after applying deviation</th></tr>
<tr><td>No impact (the deviation does not affect annual emission reduction volume, as the alternative method ensures equivalent accuracy in SOC quantification).</td><td></td></tr>
</table>

☐ any other matrix, please specify…
</td></tr>
<tr><td>Summary of the impact</td><td>The deviation does not impact the project's design, local stakeholder consultation, safeguarding principles, SDG assessment, regulatory compliance, or additionality. The applicability of the methodology remains valid, as the deviation is permitted under the methodology's provisions for alternative protocols (Annex 1: Eligible Soil Sampling Protocols). The use of the UPASI recommended approach is providing a more accurate and reliable SOC data, while ensuring the integrity of the project's monitoring and reporting. The adopted approach, including bulk density and coarse fraction calculations, ensures accurate and</td></tr>
</table>

	reliable SOC data, enhancing the project's monitoring capabilities without compromising accuracy or reliability.

Insert text here

6.3 | VVB information

Is a VVB opinion on the deviation request required?	Yes ☒ No ☐

6.4 | VVB's assessment

The below information is to be completed by VVB, if applicable.

VVB's assessment of deviation request	VVB confirms that this is a methodological deviation from the Soil Organic Carbon Framework Methodology (Version 1.0), specifically Section 6.1 and 7.1 (Approach 1), which mandates use of soil sampling protocols listed in Annex 6 – Table 6 (e.g., ICRAF, VCS SOC Module, etc.). The deviation proposed by the PD to use the UPASI (United Planters Association of South India) Tea Research Foundation's soil sampling protocol in place of one of the approved protocols listed in Table 6 of Annex 1 of the Soil Organic Carbon Framework Methodology (Version 1.0) has been reviewed by the VVB. Sampling is conducted at depths of 0–22.5 cm and 22.5–45 cm, which is in line with standard SOC monitoring practices. The use of appropriate tools (screw auger or crowbar), standardized timing (90 days post-fertilizer and after 15 cm rainfall), and exclusion of non-representative areas ensure scientific robustness. The compositing approach using blending and quartering ensures sample homogenization and consistency. The following documents were reviewed by the VVB to substantiate the deviation request:

	1. **Document 1: SOP SOIL MAP-2023-24** PD has provided soil maps to confirm spatial stratification of the entire project area into 7 main strata based on landscape and agronomic variability, further subdivided into 2-hectare sub-strata totaling 4,356 sampling plots. VVB confirms that the stratification is in compliance with spatial representativeness as required by the methodology. 2. **Document 2: SOIL SOP – SOC** VVB has reviewed the Soil SOP which includes the detailed field sampling protocol adopted by the PD, including random zigzag sampling of ≥5 cores per 2-hectare plot, depth intervals (0–22.5 cm and 22.5–45 cm), tools used (screw auger/crowbar), sampling time post-fertilizer and rainfall, and the exclusion of non-representative areas. 3. **Document 3: SOIL SOP - Bulk Density & Coarse Fraction** The document "Appendix 3- SOIL SOP - Bulk Density & Coarse Fraction" includes procedures for calculating bulk density and coarse fraction. VVB confirms that the SOP ensures that values are derived through standard and verifiable methods, aligning with SOC quantification requirements under the methodology. 4. **Document 4: Extract of UPASI Guideline** PD has submitted an extract from UPASI's "Guideline on Tea Culture in South India" by J. Durairaj at el." which confirms that the protocol is recognized and scientifically endorsed by the UPASI Tea Research Foundation, a credible institution backed by the Tea Board of India. 5. **Document 5: Illustration of Soil Analysis** VVB has further verified the analytical process

	using the Walkley & Black method, with correction factor (1.3) applied to account for incomplete recovery. The document includes visual and procedural clarity on how lab analysis is conducted, ensuring transparency and methodological conformity. 6. **Document 6: Illustration of Calculations** VVB has verified worked-out examples of SOC stock calculations based on sampling and analysis results. This confirms that the methodology for converting lab values into SOC stocks is consistent with accepted standards. Hence, VVB, based on above assessment and based on a well-substantiated scientific rationale, confirms that the deviation is acceptable.
VVB's assessment of impact of deviation request	VVB confirms that the proposed deviation has **no negative impact** on the project's scientific integrity or the methodological applicability. Furthermore, VVB confirms that the deviation does not affect the annual emission reduction volume and remains within the flexibility allowed under Annex 1 of the SOC methodology.
VVB recommendation	The VVB recommends approval of this deviation request. The UPASI protocol aligns with the intent and technical standards of the Gold Standard methodology and enhances contextual applicability for tea plantations in hilly regions of South India. This deviation ensures reliable SOC stock estimation without compromising accuracy, transparency, or environmental integrity.

VVB details	VVB name:	Carbon Check (India) Private Limited
	Auditor name(s):	**Isha Kapoor -** Team Leader/ Technical Expert

		Vikash Kumar Singh – Team Member/ Technical Expert **Vijay Mathew**- Team Member/ Local Expert **Ramesh Penaganti** - Trainee Assessor
	Email (s):	isha@carboncheck.co.in vikash@carboncheck.co.in vijay@carboncheck.co.in ramesh@carboncheck.co.in

6.5 | Documents:

6.5.0 | List of documents provided (*note that once a decision has been made by Gold Standard, this deviation form will be made public on the Gold Standard website. Kindly refrain from including any confidential information in the form.*)

Document 1. SOP SOIL MAP-2023-24

Document 2. SOIL SOP – SOC

Document 3. SOIL SOP - Bulk Density & Coarse Fraction

Document 4. Extract of UPASI recommendation

Document 5. Illustration of soil analysis

Document 6. Illustration of calculations

DOCUMENT HISTORY

VERSION NUMBER	RELEASE DATE	DESCRIPTION
6.0	12.11.2024	Editorial and structural changes to the template
5.0	11.04.2022	Additional information added: - date of listing, design certification, transition - standard version - specific reference to a requirement deviated from - any previous deviations/design changes approved - Guidance on VVB opinion
4.0	14.01.2021	Editorial changes
3.0	16.07.2020	Editorial changes
2.0	03.05.2018	Editorial changes
1.0	01.07.2017	Initial adoption

Appendix 1- SOP SOIL MAP-2023-24

'Soil Map Project'- Collection of soil sampling from fields programmed for pruning (2023-24 onwards).

Soil sampling and analysis from fields programmed for pruning is a regular practice in our estates. Generally, soil samples are collected during January/ February and samples are being send to R&D department for complete soil analysis. However, we have noticed variations in organic matter content and other soil nutrient values when compared to the analysis done during the previous pruning cycles. Therefore, it has been decided to introduce geo-tagging system for all the locations where soil samples are collected for further random verifications by the R&D department. Longitude and latitude of all the sampling points should be recorded with the help of Tab/ smart phone. You may refer the point number 15, given below for further details on geo-tagging of sampling locations.

The modified soil collection procedure for soil map project is given below.

PROCEDURE FOR COLLECTING SOIL SAMPLES FROM PROPOSED PRUNING FIELDS

1. Soil collection should be done under the supervision of the management staff/ field staff.
2. Two composite sample of 0-9" and 9-18" from every 2 Hectare block of tea fields should be collected and send for analysis to the laboratory. Sectors of the fields should be considered for identification of blocks.
3. Soil samples should not be collected from roadsides, areas adjacent to labour lines, cattle sheds, below shade trees, compost pits, vacant patches, swamps and other nonrepresentative locations.
4. At the time of sampling, variation in slope, soil colour and texture should be considered, and separate samples should be collected from each area, if necessary.
5. The field should be divided into different block/sectors across the slope and never along the slope. If the field is too steep, samples should be drawn from top, middle and bottom portions separately.
6. Before collecting the samples, clean the surface (dried leaves, weeds and other decomposed material lying on the surface); but never remove surface soil.
7. From a location, representative samples from two depths (0-9" & 9-18") should be collected and kept separately.
8. The ideal tool for sampling in field is Crowbar ("ALAVANGOO").
9. Dig a pit of 8-10" diameter and 9" depth. The soil from 0-9" along the periphery of the pit should be scrapped and collected in a container. Samples of the bottom soil (9-18" depth) is collected similarly from the same pit and kept in another container separately.
10. Repeat the above process and collect samples from minimum 5 locations at random in zig-zag manner in every 2 Ha block. The location of soil collection should be geo tagged and recorded immediately for future verification.

11. Adopt repeated equal quartering method and draw 500 g representative sample the block.
12. R&D is analyzing physical analysis of soil; hence, sample collected from the fields should not be sieved at the division level.
13. Pack the sample in a clean polythene bag and send for analysis with proper labels as indicated below Soil Sample Chit (SSC).

SOIL SAMPLE CHIT

Name of the Estate	
Section	
Division	
Field Number	
Block Number	
Area (Ha)	
Depth of sampling	(Example: 0-9"/9-18")
Date of collection	
Nature of Analysis (complete/ specific parameters)	**SOIL MAP PRPJECT**

14. Labels should be affixed on the soil packets. Use only ball point pen for writing the labels.
15. Maintain proper record on the exact location from where the soil samples are drawn by GPS tagging of the location using COMPASS Apps available in the Mobile phones/ Tabs. Sample Location recording format is provided below.
16. R&D team will impart training on soil sampling and geo tagging during next week and you may contact Dr. Jagadish for any assistance in this regard.

GPS coordinates (Latitude and Longitude) (DMS (degrees, minutes, seconds format)	Sampling location No. 1	(Example: 10°09'02.0"N 77°13'17.0"E)
	Sampling location No. 2	(Example: 10°09'02.0"N 77°13'17.0"E)
	Sampling location No. 3	(Example: 10°09'02.0"N 77°13'17.0"E)
	Sampling location No. 4	(Example: 10°09'02.0"N 77°13'17.0"E)

Geo-coordinates of sampling points should be compiled in 'Excel file' and send the same to R&D by email along with the samples.

17. Soil samples should reach R&D before 31st of March

R&D Department
March 2023

Appendix 2- SOIL SOP – SOC

	R&D Department Kanan Devan Hills Plantations Co (P) Ltd.	Standard Operating Procedure
Document No:R&D/KDHP-03	Issue No :01	Issue Date: 04.01.2023
Amendment No:00	Amendment Date: -	Status : Controlled

Soil Organic Carbon	WALKLEY-BLACK METHOD	No. of Page(s) : 4

1.0 Principle:

The determination of soil organic carbon is based on the Walkley & Black chromic acid wet oxidation method. Oxidizable organic carbon in the soil is oxidized by 0.167 M potassium dichromate ($K_2Cr_2O_7$) solution in concentrated sulfuric acid. The heat of reaction raises the temperature which is sufficient to induce substantial oxidation.

2.0 **Reference:** Global Soil Laboratory Network, 2019 *(FAO, SOP for Soil Organic Carbon,Walkley Black Method, Titration and Colorimetric Method, GLOSOLAN SOP – 02, Ver. No. 1, Page No. 1-25)*

3.0 Chemical reaction is as follows:

The $Cr_2O_7^{2-}$ reduced during the reaction with soil is proportional to the oxidizable organic Carbon present in the sample. The organic carbon can then be estimated by measuring the remaining unreduced dichromate by back-titrating with ferrous sulphate or ammonium ferrous sulphate using diphenylamine or o-phenanthroline-ferrous complex as an indicator.

3.1 Points to be noted:

- Recoveries of the total Soil Organic Carbon by this method can typically be between 75 – 90 % in surface soils and will vary with soil type and depth. Walkley & Black found that on the average about 77% of the organic C was recovered by the heat of dilution procedure, and they proposed that a correction factor of 1.3 be used to account for unrecovered organic Carbon.
- For soils that are very high in organic carbon content, the Walkley & Black method may result in low test results, due to the incomplete oxidation of the organic carbon in the sample. Smaller sample weights should be used for samples with very high carbon content.
- This method is for the determination of organic carbon in soils. It is not applicable to soils containing significant amounts of carbonized materials.

3.2 Apparatus

Analytical balance, with an appreciation of 0.0001 g for the preparation of reagents; Precision balance, with an appreciation dependent on the weight of the sample (Table 1); Burette 50 mL, with an appreciation of ± 0.02 mL for the titrant solution; Volumetric burette/ dispenser of 10.00 mL ± 0.01 mL, of known uncertainty, to be used with the potassium dichromate solution; Volumetric dispenser, adjusted to 20.0 mL, to be used with concentrated sulfuric acid; Erlenmeyer flasks, 500 mL; Oven able to reach a temperature of

Prepared by

Technical Manager Chemical

Approved by

Head - Laboratory

105° C; Volumetric flasks; 1000 mL; Glass rod; Beaker; 100 mL, 250 mL; Fume hood – extraction/ventilation; Burette and stand.

3.3 Materials

Deionized water/distilled water, it should have an EC < 1.5 X 10^{-3} dS m^{-1}

Potassium Dichromate Standard, 0.167 M (1.0 N) Dissolve 49.04 g of traceable or equivalent analytical grade $K_2Cr_2O_7$ (previously dried at 105° C for 2 hours and cooled in a desiccator to room temperature) in deionized/distilled water and dilute the solution to a volume of 1000 mL.

Sulfuric Acid concentrated (not less than 96%).

Phosphoric Acid, 85% (If Diphenylamine indicator is used) The phosphoric acid is added to form a complex with the interfering iron (III), providing a sharper color change of the indicator.

Indicator:

"Ferroin" Indicator -o-Phenanthroline & Ferrous Complex, 0.025 M Dissolve 1.485 g of o-phenanthroline monohydrate (analytical grade) and 0.695 g of ferrous sulfate heptahydrate ($FeSO_4 \cdot 7H_2O$) (analytical grade) in deionized/distilled water. Dilute the solution to a volume of 100 mL. / Barium diphenylamine sulfonate Indicator, 0.16% aqueous solution.

Titrant:

Ferrous Sulphate ($FeSO_4$) solution, 0.5 M Dissolve 140 g of analytical grade $FeSO_4 \cdot 7H_2O$ in deionized/distilled water, add 15 mL of concentrated sulfuric acid, cool the solution, and dilute it to a volume of 1000 mL with deionized/distilled water. Standardize this reagent daily by titrating it against 10 mL of 0.167 M (1 N) potassium dichromate. / Ferrous Ammonium Sulphate, 0.5 M Dissolve 196 g of analytical grade $(NH_4)_2\ Fe(SO_4)_2.6H_2O$ in 700 mL of distilled water, add 20 mL of concentrated sulfuric acid, cool the solution, and dilute it to a volume of 1000 mL with distilled water. Standardize this reagent daily by titrating it against 10 mL of 0.167 M potassium dichromate.

Note: The Fe^{2+} in both solutions oxidizes slowly on exposure to air so it must be standardized against the dichromate daily. Prepare a new solution every 30 days.

Prepared by

Technical Manager Chemical

Approved by

Head - Laboratory

3.4 Sample preparation

Air dry soil sample and sieve to ≤ 2.0 mm size.

3.5 Procedure

Weigh 0.1 g of air-dried soil (adjust, if necessary, see guideline recommended from Table 1) into a 1000 mL erlenmeyer flask.

Add 10 mL of 0.167 M $K_2Cr_2O_7$ and swirl the flask gently to disperse the soil in the solution. Then with care, rapidly add 20 mL concentrated H_2SO_4, directing the stream into the suspension. Immediately swirl the flask gently until soil and reagents are mixed, then more vigorously for a total of 1 min. To minimize heat loss, allow the flask to stand on an insulated sheet for 30 min in a fume hood. Add 200 mL of water to the flask. Add 10 mL of 85% H_3PO_4.(if barium diphenylamine sulfonate indicator is used). Add three to four drops of o-phenanthroline indicator or barium diphenylamine sulfonate indicator and titrate the solution with 0.5 M $FeSO_4$ solution or 0.5 M $(NH_4)_2$ $Fe(SO_4)_2.6H_2O$

3.6 As the end point is approached,

"Ferroin" Titration, when using the o-phenanthroline indicator, the solution takes on a greenish cast and then changes to a dark green. At this point, add the ferrous sulphate heptahydrate drop by drop until the colour changes sharply from blue to red (maroon colour in reflected light against a white background). / "Diphenylamine" Titration, when using the diphenylamine indicator, near the endpoint the colour changes to deep violet-blue; slow down the titration by adding the ammonium ferrous sulphate dropwise. At the endpoint the colour changes sharply to brilliant green. Determine a blank in the same manner, but without soil, to standardize the $K_2Cr_2O_7$.

Compute for the %OC with the computation given at section 3.7 and report as oven-dry basis with two (2) decimal places.

Table 1. Recommended weight of sample for analysis

Weight (g)	OC %	Colour
0.1	> 2	black, dark Gray, dark brown
0.25	≤ 2	brown - dark brown, Gray - dark Gray
0.5	< 0.6	Brown

Note: Above is just a guide for determining the appropriate weight to be used for each sample based on soil colour. % OC may vary per soil colour type. Generally, dark coloured soils which are described as dark brown to black show a higher content of carbon and nitrogen than soils that are lighter in colour.

Prepared by

Technical Manager Chemical

Approved by

Head - Laboratory

3.7 Calculation

1 mL of 1 N dichromate solution is equivalent to 3 mg of carbon.

After the reaction, the excess Cr_2O_7 is titrated with 0.5 M $FeSO_4$ or 0.5 M $(NH_4)_2$ $Fe(SO_4)_2.6H_2O$

$$Organic\ C, \% = (Vblank - Vsample) \times MFe^{2+} \times 0.003 \times 100 \times f/W$$

where:

$Vblank$ = volume of titrant in blank, mL

$Vsample$ = volume of titrant in sample, mL

$MFe2+$ = concentration of standardized $FeSO_4$ or $(NH_4)_2$ $Fe(SO_4)_2.6H_2O$ solution, molarity

0.003 = carbon oxidised (shown below)

$= (12\ g\ C/mole) \times (1\ mole\ K_2Cr_2O_7 / 6\ moles\ FeSO_4) \times (3\ moles\ C / 2\ moles\ K_2Cr_2O_7) \times (1\ L / 1000\ mL)$.

f = correction factor, 1.3

W = weight of soil, g

Note: An oxidation correction factor of 1.3 is required because, on average, only about 77% of organic carbon is recovered by this method.

Prepared by

Technical Manager Chemical

Approved by

Head - Laboratory

Appendix 3-. SOIL SOP - Bulk Density & Coarse Fraction

	R&D Department Kanan Devan Hills Plantations Co (P) Ltd.	Standard Operating Procedure
Document No:R&D/KDHP-03	Issue No :01	Issue Date: 04.01.2023
Amendment No:00	Amendment Date: -	Status : Controlled

Soil Bulk Density	Tapping Method	No. of Page : 1

1.0 Scope: Bulk density of soil is defined as the ratio of the mass of dried soil particles to the total volume of soil

2.0 Reference: Tapping method

3.0 Apparatus: Bulk Density meter, Weighing Balance & Measuring Cylinder

4.0 Procedure

Air dry soil sample and sieve to ≤ 2.0 mm size. Weigh 50 g (W) of soil and transfer the soil into a 100 ml measuring cylinder. Place the cylinder with soil on the bulk density meter (FLOW MATIC) and switch on the equipment for 80- 100 vibration. After the soil is firm, note the volume occupied by the soil from the graduations in the measuring cylinder (V)

5.0 Calculation

Dry weight of the soil sample (g) = W

Volume of soil sample (c.c.) = V

Bulk density of soil (g/c.c.) = W/V g/cm^3

Prepared by

Technical Manager
Chemical

Approved by

Head - Laboratory

	R&D Department Kanan Devan Hills Plantations Co (P) Ltd.	Standard Operating Procedure
Document No:R&D/KDHP-03	Issue No :01	Issue Date: 04.01.2023
Amendment No:00	Amendment Date: -	Status : Controlled

Coarse Fraction	Sieve method	Page : 1 of 1

1.0 Scope: Particle size of soil is defined as the Sieve method using 2 mm mesh

2.0 Reference: Sieve method (2 mm mesh)

3.0 Apparatus: Test sieves (Mesh No. 2 mm), Weighing Balance

4.0 Procedure:

5.1 Weigh 100 g (W) of air-dried soil in the beaker.
5.2 Sieve the weighed sample through 2 mm sieve
5.3 Weigh the sample retained over the sieve (W1) and record the mass

5.0. Calculation:

Coarse % = W_1*100/W

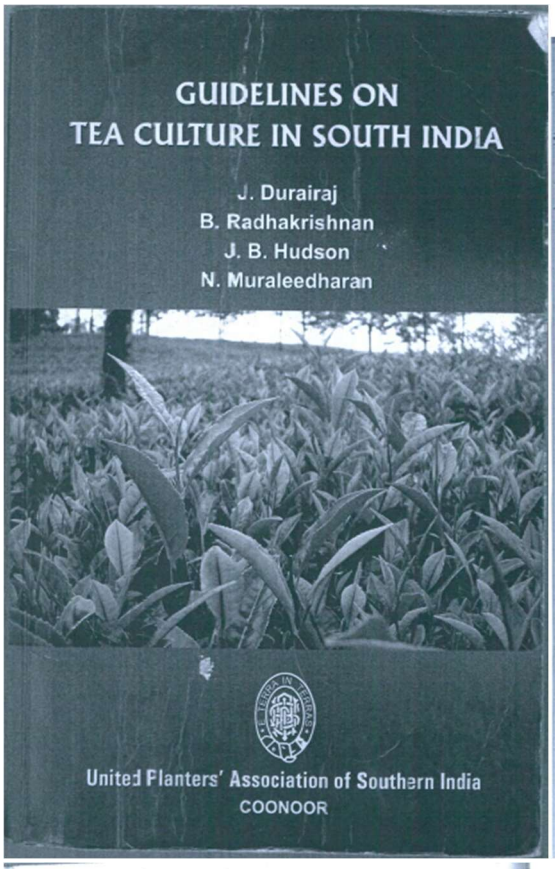
Prepared by

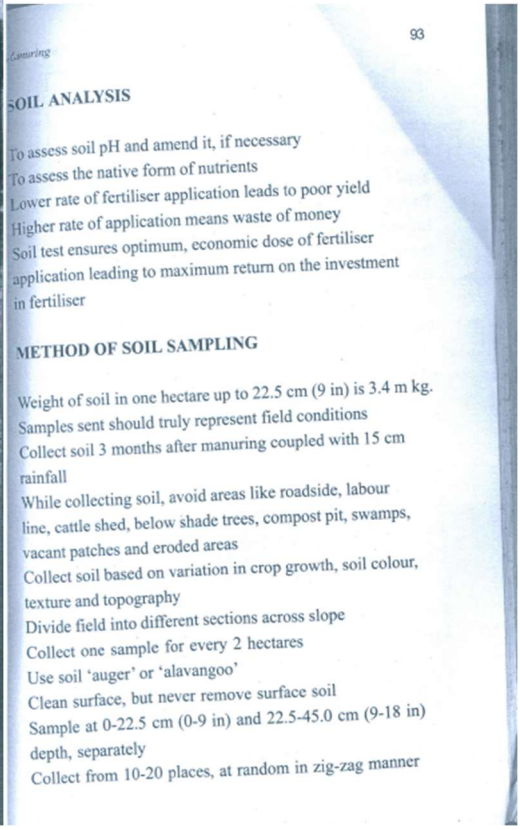
Technical Manager
Chemical

Approved by

Head - Laboratory

Appendix 4-. Extract of UPASI recommendation





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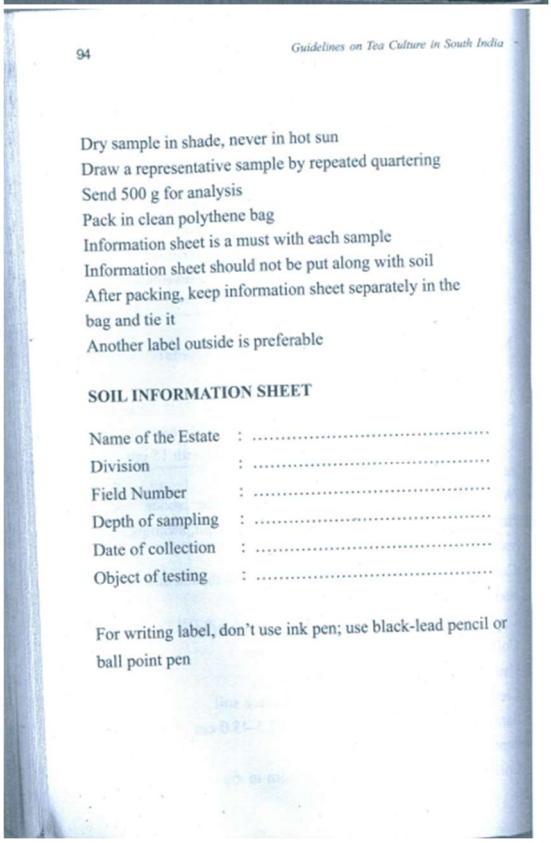
Manuring

SOIL ANALYSIS

To assess soil pH and amend it, if necessary
To assess the native form of nutrients
Lower rate of fertiliser application leads to poor yield
Higher rate of application means waste of money
Soil test ensures optimum, economic dose of fertiliser application leading to maximum return on the investment in fertiliser

METHOD OF SOIL SAMPLING

Weight of soil in one hectare up to 22.5 cm (9 in) is 3.4 m kg.
Samples sent should truly represent field conditions
Collect soil 3 months after manuring coupled with 15 cm rainfall
While collecting soil, avoid areas like roadside, labour line, cattle shed, below shade trees, compost pit, swamps, vacant patches and eroded areas
Collect soil based on variation in crop growth, soil colour, texture and topography
Divide field into different sections across slope
Collect one sample for every 2 hectares
Use soil 'auger' or 'alavangoo'
Clean surface, but never remove surface soil
Sample at 0-22.5 cm (0-9 in) and 22.5-45.0 cm (9-18 in) depth, separately
Collect from 10-20 places, at random in zig-zag manner



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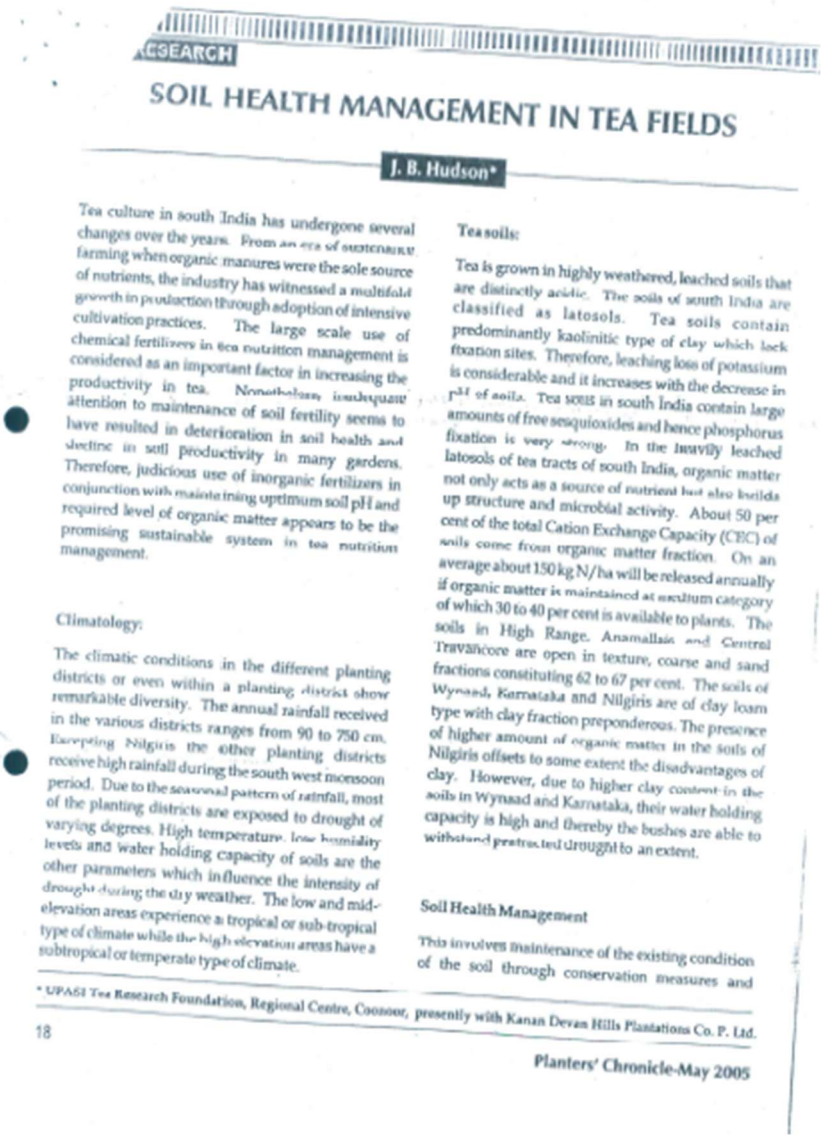
Dry sample in shade, never in hot sun
Draw a representative sample by repeated quartering
Send 500 g for analysis
Pack in clean polythene bag
Information sheet is a must with each sample
Information sheet should not be put along with soil
After packing, keep information sheet separately in the bag and tie it
Another label outside is preferable

SOIL INFORMATION SHEET

Name of the Estate : .....
Division : .....
Field Number : .....
Depth of sampling : .....
Date of collection : .....
Object of testing : .....

For writing label, don't use ink pen; use black-lead pencil or ball point pen

Appendix 7-. Soil Health Management in Tea Fields-



RESEARCH

SOIL HEALTH MANAGEMENT IN TEA FIELDS

J. B. Hudson*

Tea culture in south India has undergone several changes over the years. From an era of sustenance farming when organic manures were the sole source of nutrients, the industry has witnessed a multifold growth in production through adoption of intensive cultivation practices. The large scale use of chemical fertilizers in tea nutrition management is considered as an important factor in increasing the productivity in tea. Nonetheless, inadequate attention to maintenance of soil fertility seems to have resulted in deterioration in soil health and decline in soil productivity in many gardens. Therefore, judicious use of inorganic fertilizers in conjunction with maintaining optimum soil pH and required level of organic matter appears to be the promising sustainable system in tea nutrition management.

Climatology:

The climatic conditions in the different planting districts or even within a planting district show remarkable diversity. The annual rainfall received in the various districts ranges from 90 to 750 cm. Excepting Nilgiris the other planting districts receive high rainfall during the south west monsoon period. Due to the seasonal pattern of rainfall, most of the planting districts are exposed to drought of varying degrees. High temperature, low humidity levels and water holding capacity of soils are the other parameters which influence the intensity of drought during the dry weather. The low and mid-elevation areas experience a tropical or sub-tropical type of climate while the high elevation areas have a subtropical or temperate type of climate.

Tea soils:

Tea is grown in highly weathered, leached soils that are distinctly acidic. The soils of south India are classified as latosols. Tea soils contain predominantly kaolinitic type of clay which lack fixation sites. Therefore, leaching loss of potassium is considerable and it increases with the decrease in pH of soils. Tea soils in south India contain large amounts of free sesquioxides and hence phosphorus fixation is very strong. In the heavily leached latosols of tea tracts of south India, organic matter not only acts as a source of nutrient but also builds up structure and microbial activity. About 50 per cent of the total Cation Exchange Capacity (CEC) of soils come from organic matter fraction. On an average about 150 kg N/ha will be released annually if organic matter is maintained at medium category of which 30 to 40 per cent is available to plants. The soils in High Range, Anamallais and Central Travancore are open in texture, coarse and sand fractions constituting 62 to 67 per cent. The soils of Wynaad, Karnataka and Nilgiris are of clay loam type with clay fraction preponderous. The presence of higher amount of organic matter in the soils of Nilgiris offsets to some extent the disadvantages of clay. However, due to higher clay content in the soils in Wynaad and Karnataka, their water holding capacity is high and thereby the bushes are able to withstand protracted drought to an extent.

Soil Health Management

This involves maintenance of the existing condition of the soil through conservation measures and

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A comparison on various factors between an estate where burial of prunings was carried out regularly and another block where attention on maintenance of organic status was not given is given in Table-7.

Table 7 - The Effect of burial of prunings

Particulars		pH	EC dSm^{-1}	Organic matter content %	CEC m.equ%	WHC%
Estate A	0-9"	4.45	0.25	7.14	8.35	73.4
Burial of prunings carried out	9-18"	4.05	0.28	6.02	9.00	63.0
Estate B	0-9"	4.15	0.20	3.10	4.95	56.8
No burial of prunings	9-18"	4.20	0.14	2.49	4.43	54.4

Source: Pandiaraj - Proceedings of the 19th Area Scientific Meeting of NPA

As could be seen there is significant increase in the CEC of soil and also the water holding capacity in the estate where burial of prunings was carried out regularly. Thus, when organic matter status is maintained at the desired level the efficiency of applied nutrients will be improved and the drought effect too will be reduced.

Though the beneficial effects of burial of prunings is well recognized in many estates there is hesitation to take up the operation due to the labour intensive nature and consequently the high cost involved. However considering the facts that it has to be done only once in a pruning cycle and other beneficial effects it is worth spending for this operation at least in areas where the organic matter status is low.

In fields where the organic matter status is abysmally low, application of organic manures from extraneous sources in addition to recommended conservation measures is necessary to maintain the tilth and fertility of soil. In replanted blocks, application of organic manure @ ½ to 1kg per plant will be useful in good establishment of plants. The organic manure should conform to the following standards.

a) pH (1%) : 6.5 to 7.5 more or less neutral
b) EC (1%) : up to 0.50 dSm^{-1} recommended for young tea up to 1.5 dSm^{-1} recommended for mature tea only
c) Organic matter : should not be less than 20.0 per cent.
d) Carbon : nitrogen ratio (C:N ratio) -10:1 to 15:1
e) Moisture content : should not exceed 25.0 per cent.
f) Pathogens : absent

Correction of soil activity:

Over the years due to continuous application of chemical fertilisers and inadequate liming there has been a shift in soil acidity status from very strongly acidic category to extremely acidic category. This is another factor limiting crop production, as in low pH range, the physical, chemical and biological properties of soil are affected. Even in a crisis period it is not prudent to skip lime application as the retention and availability of nutrients is very much reduced at extremely acidic condition of soil. In some of the estates, liming is done on a blanket basis. This must be avoided and liming must be based on soil pH, yield of the