***"As the agriculture sector strives for sustainability, reducing the GHG footprint through innovative practices becomes an essential part of the solution."* – FAO**

As the climate change poses severe challenge towards the growth and sustenance of Indian Tea Industry, Trustea Sustainable Tea Foundation joined hands with Inhana Organic Research Foundation towards the development of the Trustea Emission calculator (TEC) toolkit in order to assess the sustainability status of Indian tea cultivation and create awareness regarding Regenerative Agriculture Practices specific to tea.

It is a pioneering initiative for the Indian Tea industry for measurement of process GHG emission and its abatement through change of management practice. The TEC toolkit will come in 3 versions, *viz*. (1) Basic, (2) Advanced and (3) Pro version (restricted entry). Advanced and Pro version of TEC toolkit will be more elaborate and measure all possible emission / mitigation points along with sustainable management impact in terms of $CO_2e$. The higher version of the TEC toolkit will also measure other sustainability indices and provide interpretations to assist in the adoption of regenerative agriculture policies.

This TEC Toolkit has been developed based on the Agriculture Carbon Footprint Assessor (ACFA) Version 2.0 (Tea) expounded by Inhana Organization Research Foundation (IORF) and ICAR-ATARI, Kolkata (Zone-V); in association with i-NoCarbon Limited (i-NC), UK (based on relevant IPCC Guidelines and empirical scientific research works).

**Agriculture Carbon Footprint Assessor (ACFA) Version 2.0**

Agriculture Carbon Footprint Assessor (ACFA) is a carbon computing standard for evaluating carbon footprint in Agriculture specially sustainable agriculture considering variable Indian Agro-ecosystems. Agriculture Carbon Footprint Assessor (ACFA ver-2.0) serves as an Indian standard for carbon accounting which provides a common framework for calculating emissions and opportunities for GHG mitigation in sustainable agriculture.

This is perhaps the first comprehensive carbon computing standard for sustainable agriculture developed by Indian Scientists considering varied

conditions *viz*. diversity in agro-ecosystems, variation in cultivation practice, on-farm and off-farm input usage pattern, energy usage, residue management and transport options.

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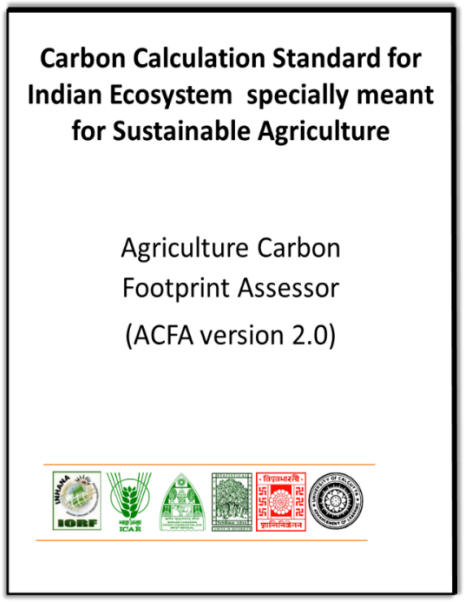
|  | Inhana Organic Research Foundation (IORF), Kolkata developed ACFA ver-2.0 in collaboration with Agricultural Technology Application Research Institute (ATARI), ICAR, Kolkata; with active support from scientists from Visva Bharati University, Bidhan Chandra Krishi Viswavidyalaya (BCKV), University of Calcutta, Indian Statistical Institute (ISI), Nadia Krishi Vigyan Kendra, BCKV, ICAR and i-NoCarbon, UK. |

The initiative towards development of ACFA Standard was started as early as 2021 by Dr. P. Das Biswas, Founder Director, IORF, to evaluate the impact of IBM-IORF Sustainability Project in respect of sustainable agriculture and pesticide free clean food development, through the adoption of Inhana Rational Farming (IRF) Technology.

A group of scientists from different Universities, ICAR Organization and other Research Institutes led by Dr. Ranjan Bera, Chief Scientist, along with other Technical Managers of IORF; engaged in the program, with initial support from IBM-IORF sustainability project.

ACFA (version 1.0) was developed in 2023 utilizing the two years research database, field survey data, and regulatory guidance from i-NoCarbon. It was evaluated by experts from Indian Statistical Institute (ISI), India and by i-NoCarbon, UK; for its suitability and competence as a Carbon Computing Standard for Indian Agro-ecosystems.

ICAR-Agricultural Technology Application Research Institute, Kolkata led by Dr. P. Dey, Director and renowned soil scientist, join hands with IORF for further

development of ACFA with the signing of a Memorandum of Understanding (MoU). ACFA (version 2.0) was developed, with consideration of India specific, tier 3 level data base and field specific information, to enable more realistic carbon computing, suitable for the versatile Indian Agriculture scenario.

To develop the calculation protocol for ACFA-version, several standard protocols were evaluated, but primarily the Intergovernmental Panel on Climate Change (IPCC) guidelines for National Greenhouse Gas inventories (IPCC 2006, IPCC 2019) were followed. Apart from IPCC guidelines, GHG Protocol Agricultural Guidance developed by Resource Institute (WRI) and World Business Council on Sustainable Development (WBCSD), ISO 14064-1 : Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals (ISO 2018), ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines (ISO 2022) and Publicly Available Specifications-2050 (PAS 2050) of British Standard Institution (BSI); were also referred (BSI 2008). According to the available standards, the following structured framework is suggested for carbon footprinting (WRI/WBCSD 2004; Carbon Trust 2007; BSI 2008).

System boundary that includes all possible area of emission/mitigation within the farm/ areas under the study was aligned with SBTI FLAG Guidance (Anderson et al, 2022). The background emission factors ( EFs) used by ACFA (version 2,0) meets the standard norms and is compliant with PACT v2 (WBCSD, 2023).

The ACFA Standard (version 2.0) primarily advocates use of 'Multi-basket Approach' (Under multi basket approach : $GWP_{100\ years}$ value for long-lived Green House gases ($CO_2$ : 1 ; $N_2O$ : 273) and $GWP_{24}$ years for short-lived greenhouse gas viz. $CH_4$ : 75.0) (as per AR6 of IPCC, 2021; Abernethy and Jackson, 2022). However, to meet the statutory requirements of organizations, it provides the result in both conventional methodology (Conventional Reporting with $GWP_{100\ years}$ value of $CO_2$ (GWP : 1), $N_2O$ (GWP: 273) and $CH_4$ (GWP= 27.2 for non-fossil source and 29.8 for fossil source) as per AR6 of IPCC, 2021) as well as in 'Multi – basket Approach'.

Trustea Sustainable Tea Foundation with its newly launched ver3.0 of the trustea Sustainability Code, that imparts focus on soil health and energy management; was searching for a carbon footprint assessment tool appropriate for Tea ecosystem. The objective was to calculate process GHG emission while also taking into account the C- sequestration aspect of the tea plantations; to quantify the Net C- footprint from Cradle to Gate. This led to its partnership with IORF with an aim to augment ACFA ver1.0 with respect to the tea production system (ACFA Version 1.0: Tea), tea agro-ecological zones and agro- inputs and ensure its dynamism through regular data updates, and user feedback.

This alliance has brought forth the Trustea Emission Calculator (TEC). It's Basic and Advanced version will be free to use and demonstrate results for in-house carbon computing and education/ research purpose. TEC (pro-version) will be restricted for carbon computing towards official carbon reporting and certification for the licensed users.

The collaboration will also encompass the aspect of developing and adopting Sustainable / Regenerative Farming Models towards attainment of Net Zero in tea with a tea grower-centric approach. The pre-post evaluation of carbon footprint under these Models using ACFA version-1.0 (later on ACFA Version-2.0) can actually help to demonstrate an effective pathway towards developing Net Zero tea.

Moreover, the diverse field runs and enrichment of Sustainable Agriculture Carbon Computing Standard can enable its utilization by government, educational institutes and corporate entities towards impact assessment of any sustainable agricultural initiative in respect of climate action and attainment of the Sustainable Development Goals of the UN.

**Relevance of ACFA Ver 2.0 for Policy Makers**

Agriculture Carbon Footprint Assessor (ACFA ver 2.0) can assist the Government Agencies and Indian Policy makers in formulation of sustainable blueprint for Indian Agriculture. ACFA (ver 2.0) can help towards

- Measuring Impact of any sustainable initiative in terms of climate change mitigation.
- Calculation of potential climate change impact / possibility of GHG mitigation for any proposed agricultural program
- Help in any carbon offset / Net Zero program in Agriculture.
- Can serve as a guiding tool for carbon credit for farmers adopting sustainable / organic farming.
- Can help in value added marketing / export of Indian agri-commodity through measurement of carbon footprint.
- Can serve as a standard for carbon audit in Agriculture.
- Can also help out in performance assessment of any sustainable activity by any Government agency/ institute.

**Relevance of ACFA Ver 2.0 for Agriculturists & Researchers**

Agriculture Carbon Footprint Assessor (ACFA ver 2.0) can help the Agriculturists and Researchers in many ways :

- Measuring carbon footprint of any agriculture produce.
- Carbon footprint of different experimental models in agriculture.
- Comparative study of different package of practice.
- Comparative study of different farming systems.
- Study of regional variation of carbon footprint in Agriculture.
- Assessing carbon mitigation potential of any sustainable initiative.
- Assessing carbon footprint of any alternate inputs.
- Estimation of net zero target.
- Formulation in any decarbonisation project.

## Team members

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