

Estimation of Greenhouse Gas Emissions of CSF Greek Cotton Production based on CSF Cotton Program

Developed by:

1. Polytsakis Pavlos
Agronomist
2. Gerampinis Kyriakos
Agronomist

On behalf of:



What is CSF program?



Certified
Sustainable
FiberMax®

A Holistic and Sustainable Approach on
Greek Cotton Production

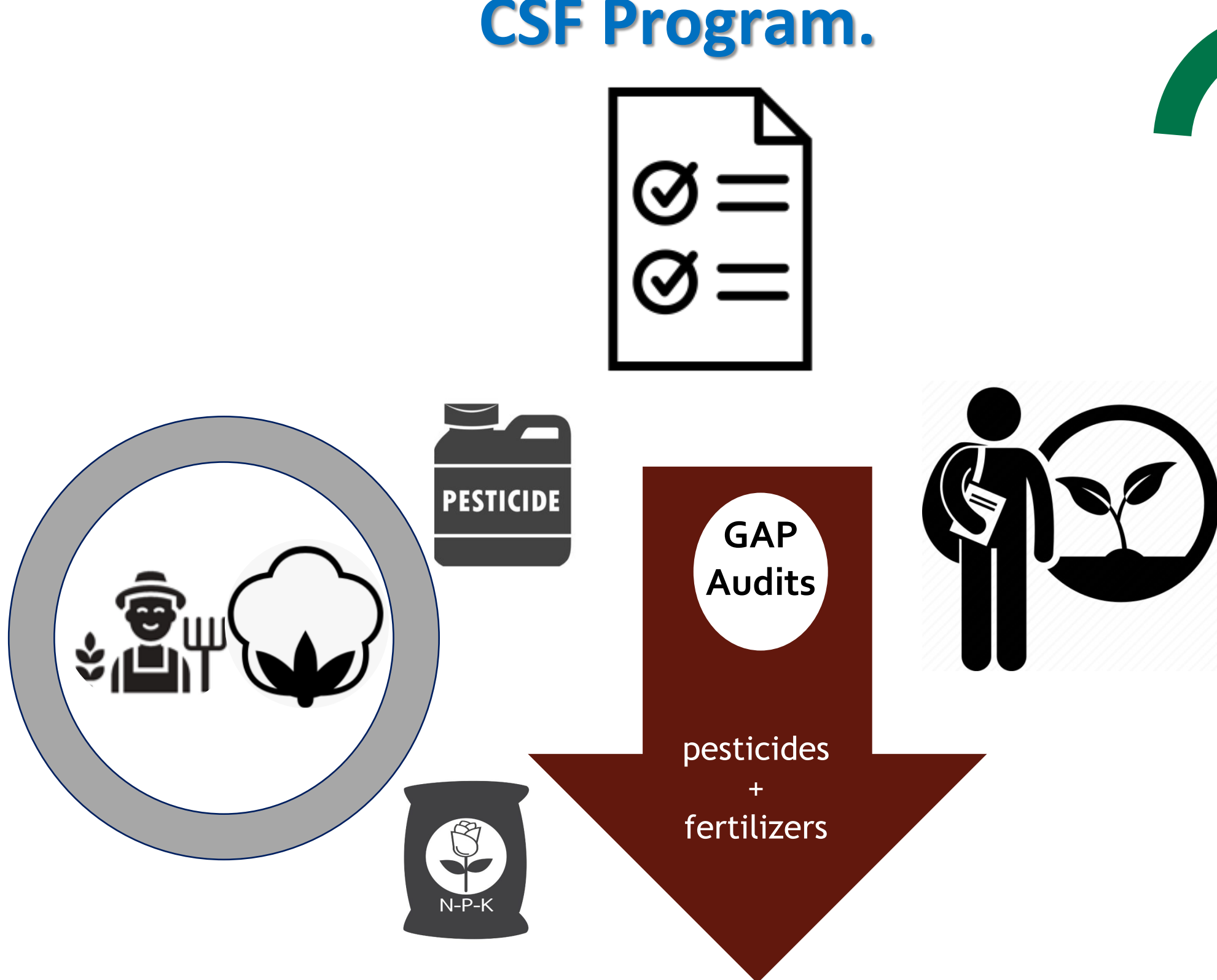


It combines both the exceptional qualitative characteristics of **FiberMax** cottonseed with cultural practices that ensure cotton production is socially equitable, economically sustainable and environmentally responsible. The program is executed by the **implementation body** which is responsible for the training and inspection of the participating growers.

aeiforiki

Implementation Body of CSF program

Aeiforiki S.A. is a consulting company in agricultural sector that performs the implementation and the inspection of the **CSF Program.**



Developed a special protocol that covers:

- ✓ Exclusive Use of Fibermax Cotton Seed Varieties.
- ✓ Mapping of Cotton Fields.
- ✓ Proposal & Implementation of Good Agricultural Practices.
- ✓ Taking Measures for The Conservation Of Biodiversity, Wetlands And Urban Landscape.
- ✓ Taking Measures For Energy Saving In Farms.
- ✓ Taking Measures For Workers Health, Safety And Welfare.
- ✓ Continuous Training Of Participating Growers.
- ✓ Record Keeping Of Crop Inputs And Applications (Soil Management, Sowing, Irrigation, Fertilization, Plant Protection, Harvest).
- ✓ Setting End Monitoring Of Quality Parameters For Cotton Harvest.
- ✓ Traceability (From Cotton Field To Client).
- ✓ Conducting Grower Inspections.
- ✓ In The Process Of Alignment To BCI



Goal & Scope

The purpose of this scope was to quantify the greenhouse gas (GHG) emissions from cradle to farm-gate production of Certified Sustainable Fibermax (CSF) Cotton in Greece.

Functional Units

- Kilograms carbon dioxide equivalents per kilogram of product (lint & seed cotton) on the field process (kg CO₂eq/kg product).
- Kilograms carbon dioxide equivalents per hectare (ha) on the field process (kg CO₂eq/ha).





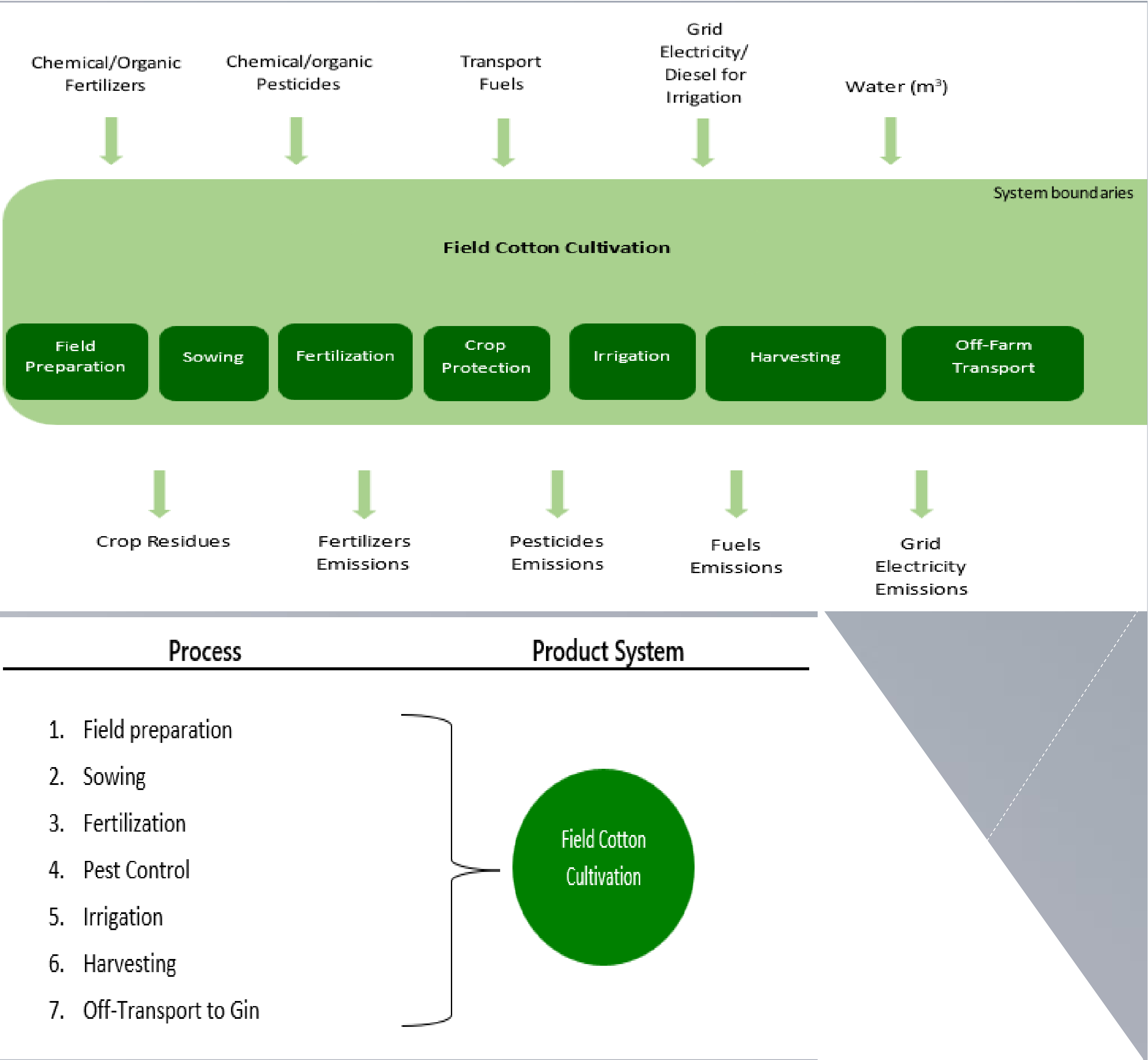
System Boundaries

The boundaries for this project encompassed two main elements:

❖ Cotton Cultivation

Cotton cultivation is consisted of the following tasks:

- ❖ Residue Management
- ❖ Fertilizer Production
- ❖ Soil Fertilizer
- ❖ Crop Protection
- ❖ Irrigation
- ❖ Off-farm Transport



Geographical & Time Coverage

Geographical Coverage

Cotton Cultivation

❖Greece
(Region of Thessaly & Thrace)

Time Coverage

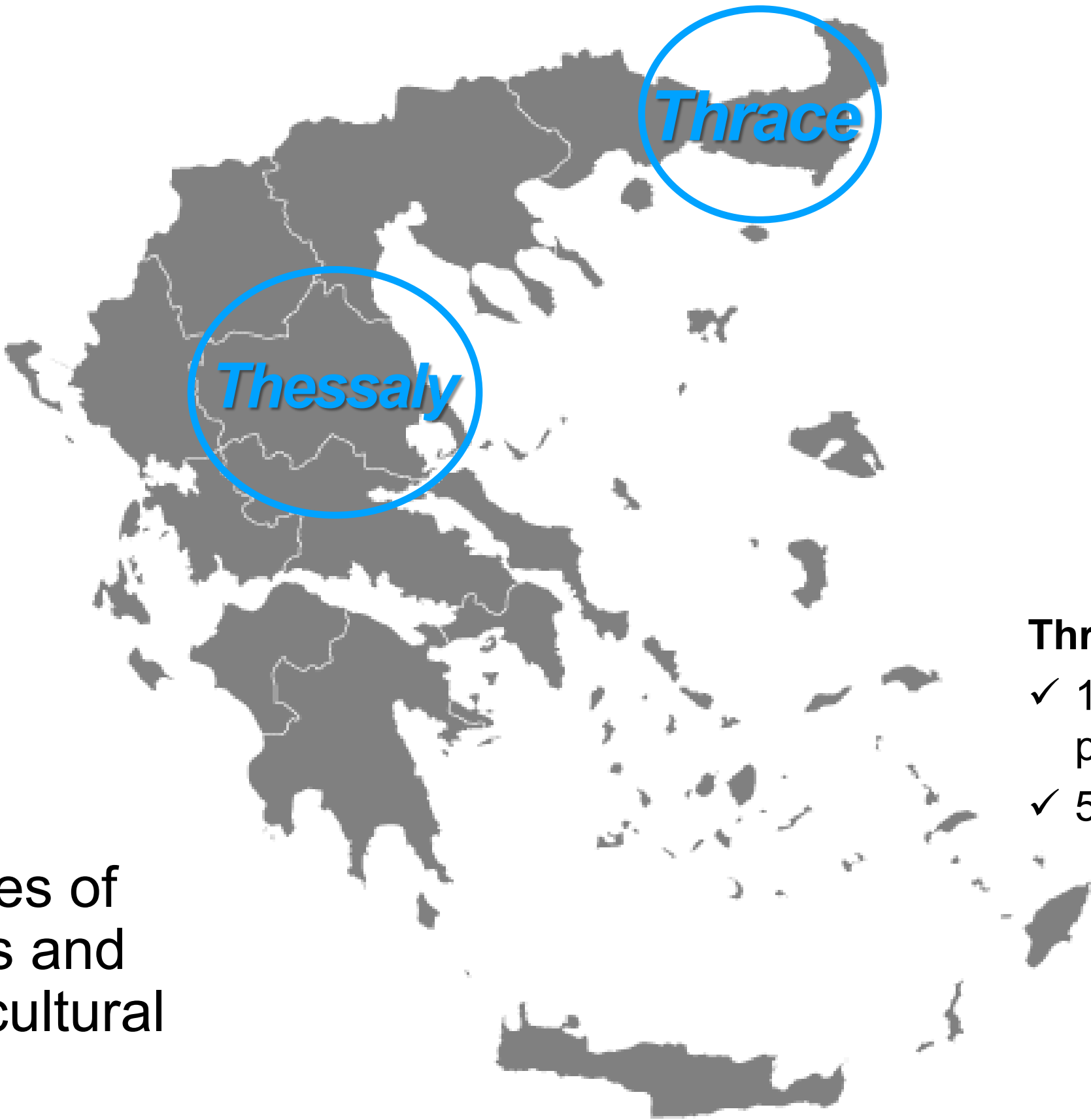
Data was collected by Implementation Bodies of CSF Program through contacts with farmers and ginners and represents the year 2021 (agricultural data).

Thessaly - 2021

- ✓ 48 out of 1.179 producers (= **4%** of CSF program)
- ✓ 354,8 / 9.055,61 ha (= **4%** of CSF program)

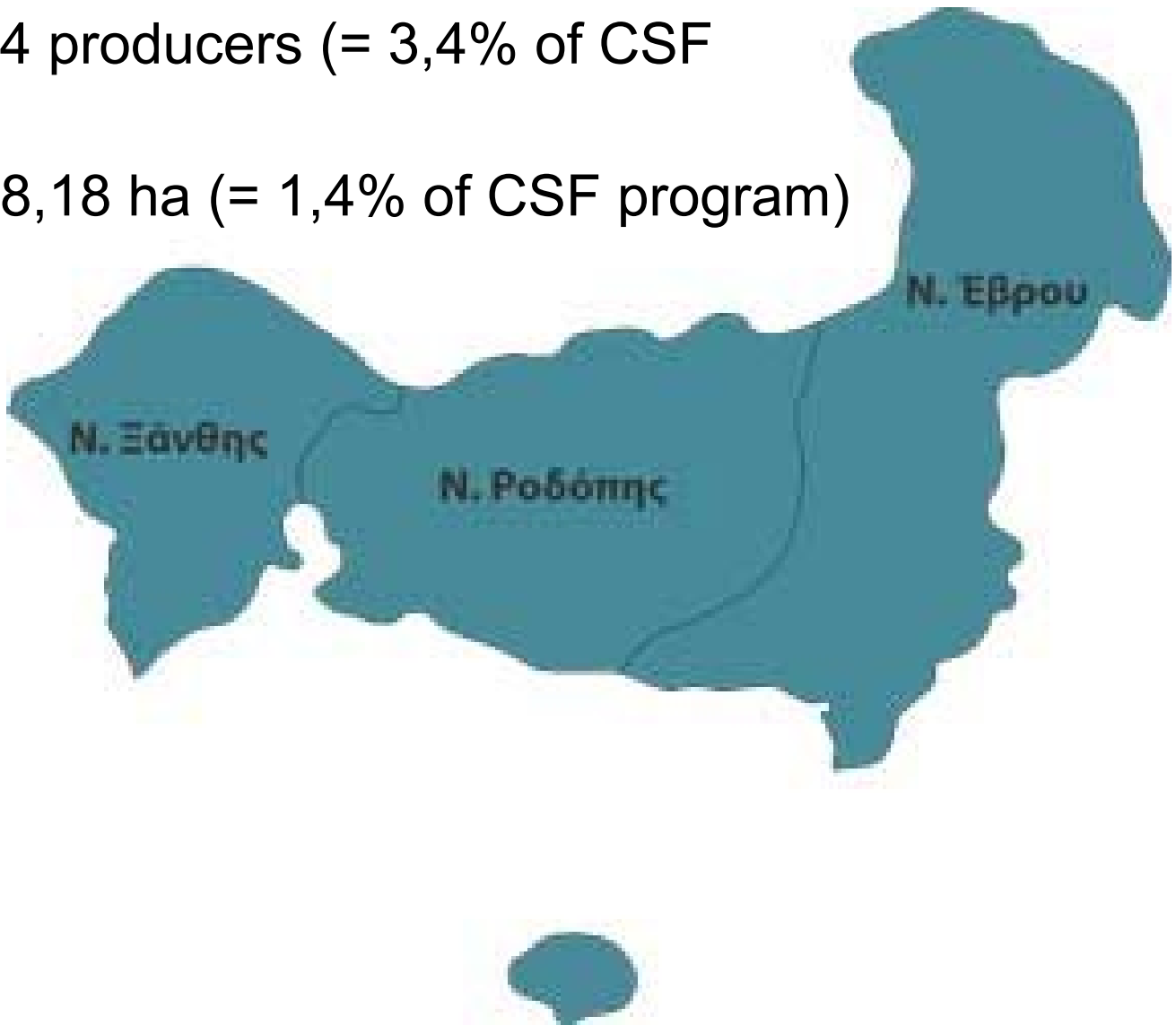


Greece



Thrace - 2021

- ✓ 15 out of 434 producers (= 3,4% of CSF program)
- ✓ 56,32 / 3.978,18 ha (= 1,4% of CSF program)



Methodology

Primary & Secondary Data

- ✓ Special data collection sheet developed
 - ✓ Interviews with farmers
 - ✓ Desk Research
 - ✓ 48 Managers involved
- (33 from Thessaly and 15 from Thrace)

CO₂ Estimation Tool

- ❖ Cool Farm Tool (CFT) v1.0.1



ΤΣΙΑΡΑΣ

Other Crops Cotton Finished product: 49,410 kilograms Yield: 4,980.85 kg / ha

Crop

Soil

Inputs

Fuel & Energy

Irrigation

Carbon

Transport

Results

100% Complete

1. Crop details

Crop name

Cotton

Harvest year

2021

Crop area

9.92

hectares

Harvested amount (total)

49,410

kilograms

Farm-gate ready amount

49,410

kilograms

Assessment name

ΤΣΙΑΡΑΣ

1.2 Crop residue management

Default values for dry matter weights are provided for most crops. If you have better data, you can overwrite the default value.

Residue amount

3,144

kg / ha

Reset Residue Amount

Residue management

Left distributed on field, OR incorporated.

1.3 Co-products

Are there any co-products of this crop which you use or sell?

User notes

Add comments about this section

Back

Save as

Save & continue

Summary

Crop

Cotton

Year

2021

Farm-gate amount

49,410 kg

Yield

4,980.85 kg / ha

GHG emissions

Total

232,722 kg CO2e

Residue mgmt

1%

Soil / fertilisers

3%

Crop protection

0%

Land management

0%

Energy & processing

95%

Water waste

0%

Transport

0%



Data collection form for the calculation of CO2 removal potential on farms

Designed and developed by Aeiforiki S.A.



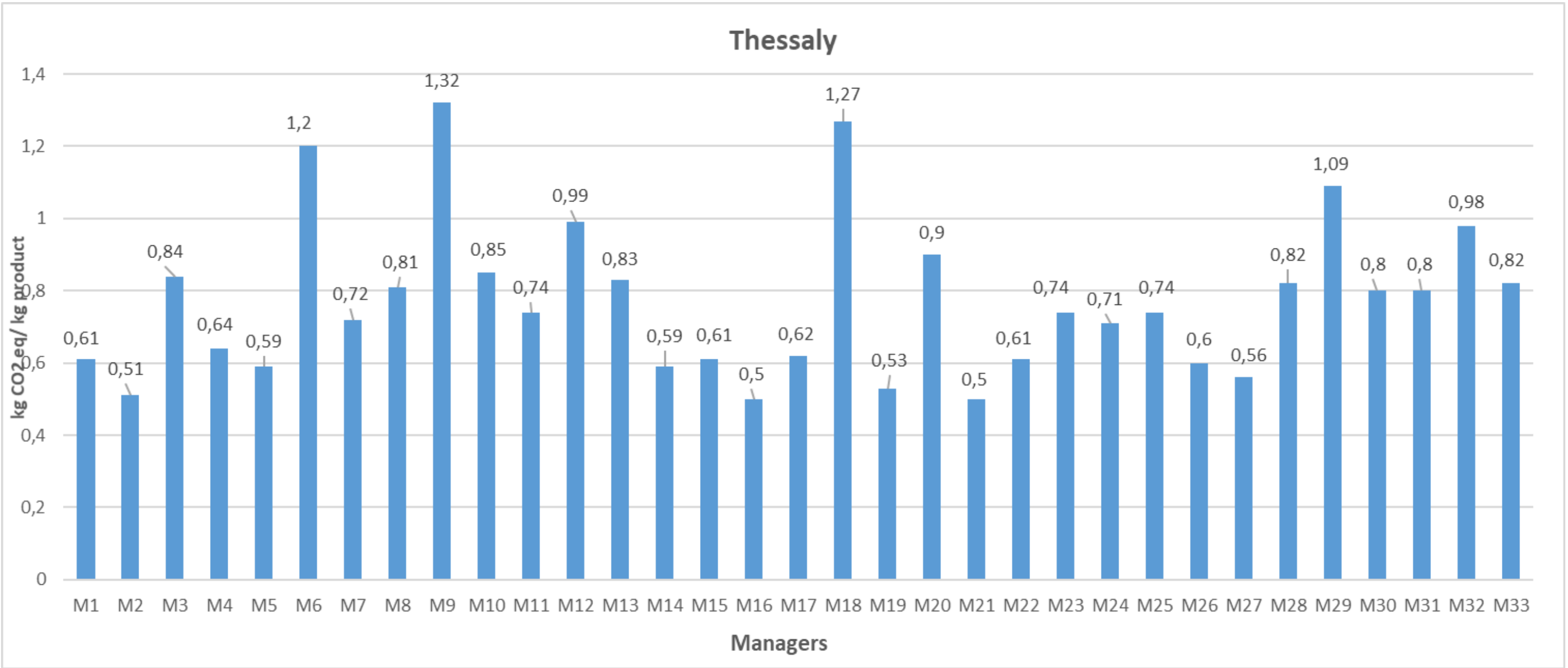
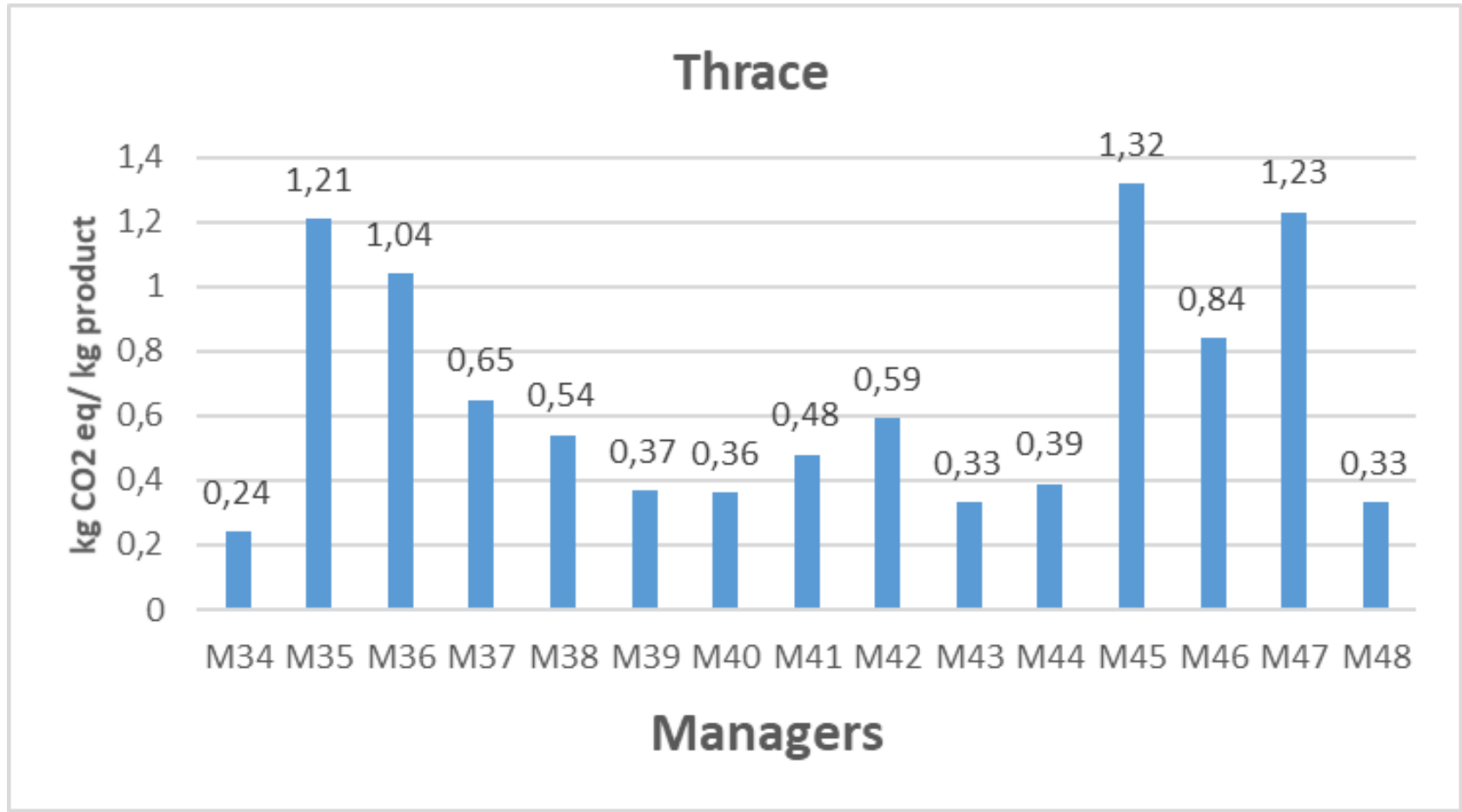
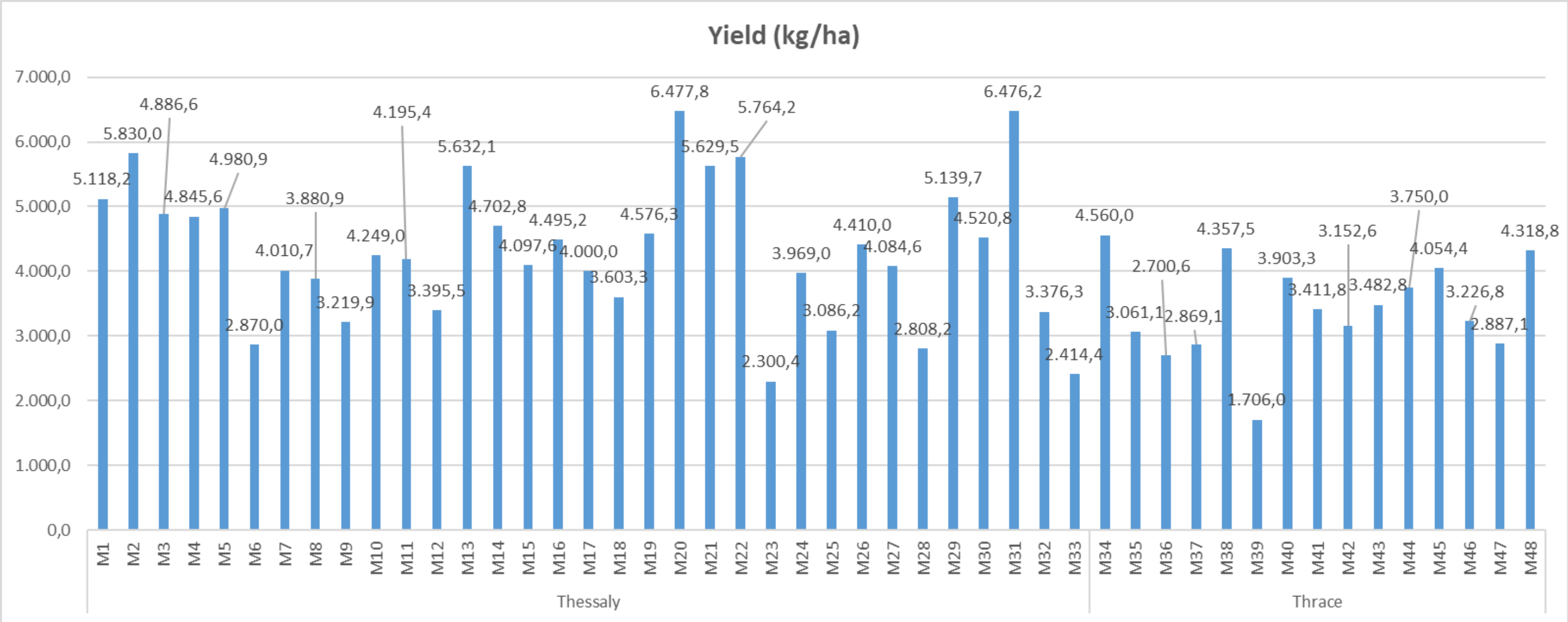
Results & Analysis

Field Process

Comparative GHG Emissions for CSF Greek Cotton in:

- ✓ Thessaly
- ✓ Thrace

No correlation between Yield and CO₂eq/ kg product (R²= 0,0366).



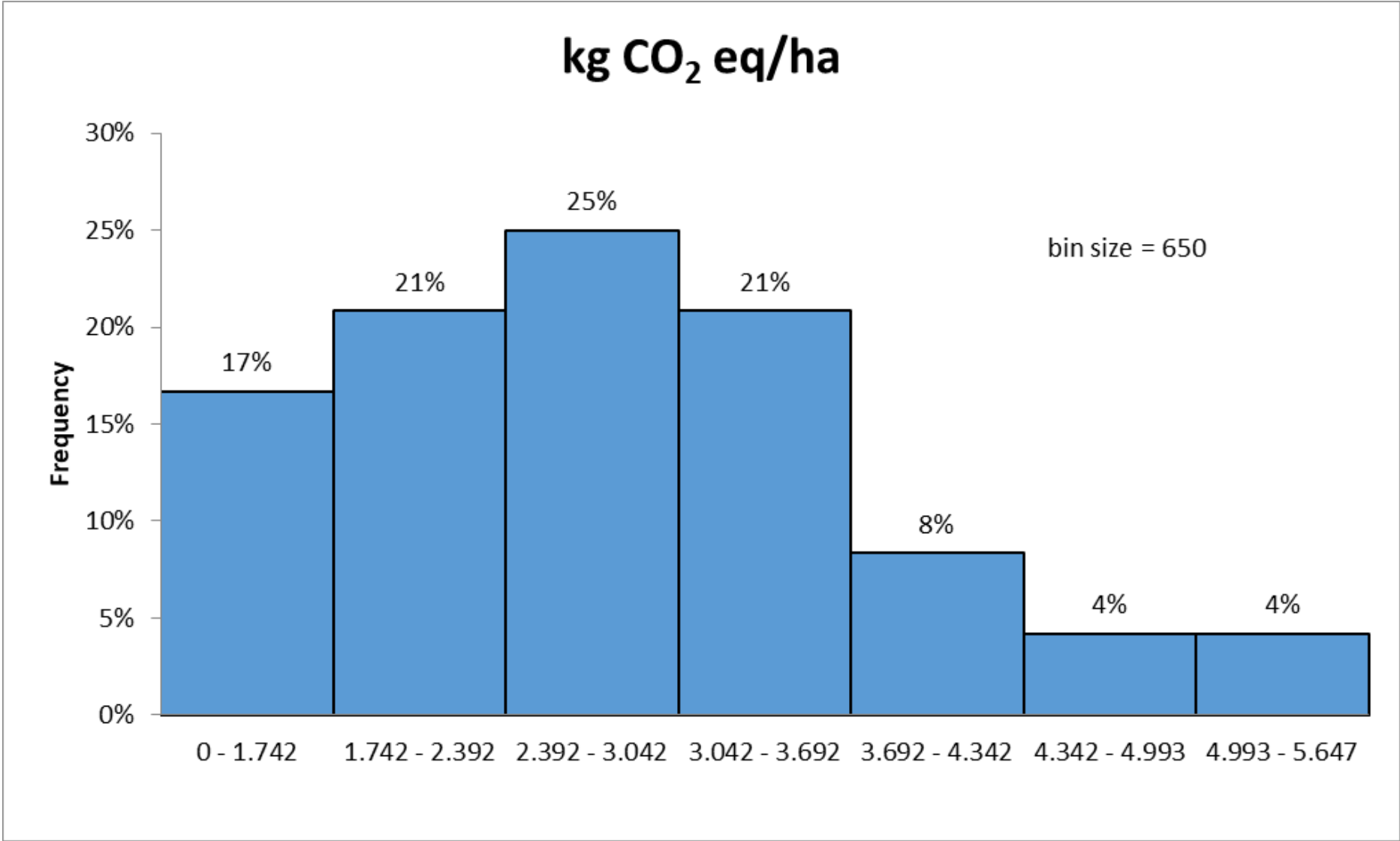
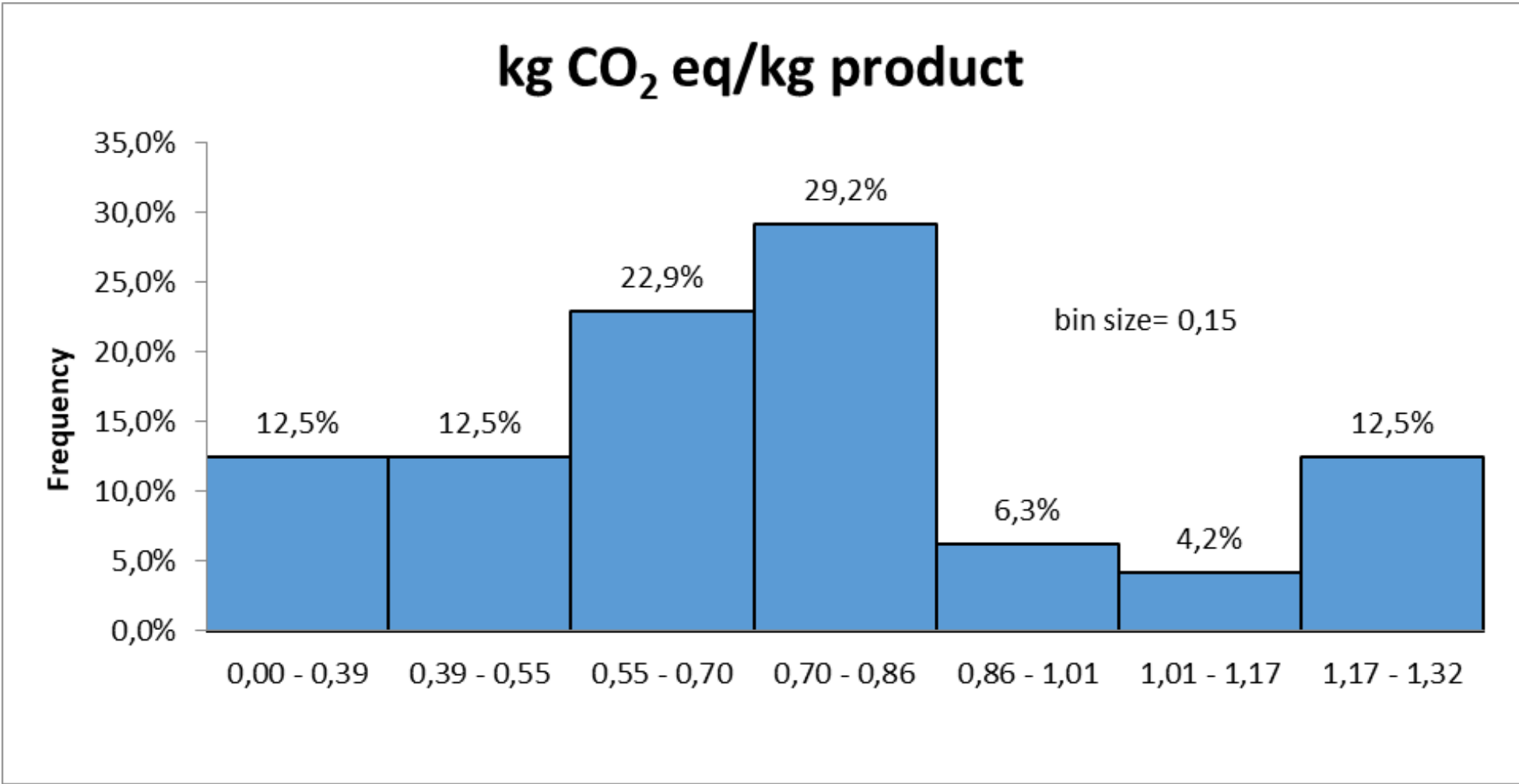
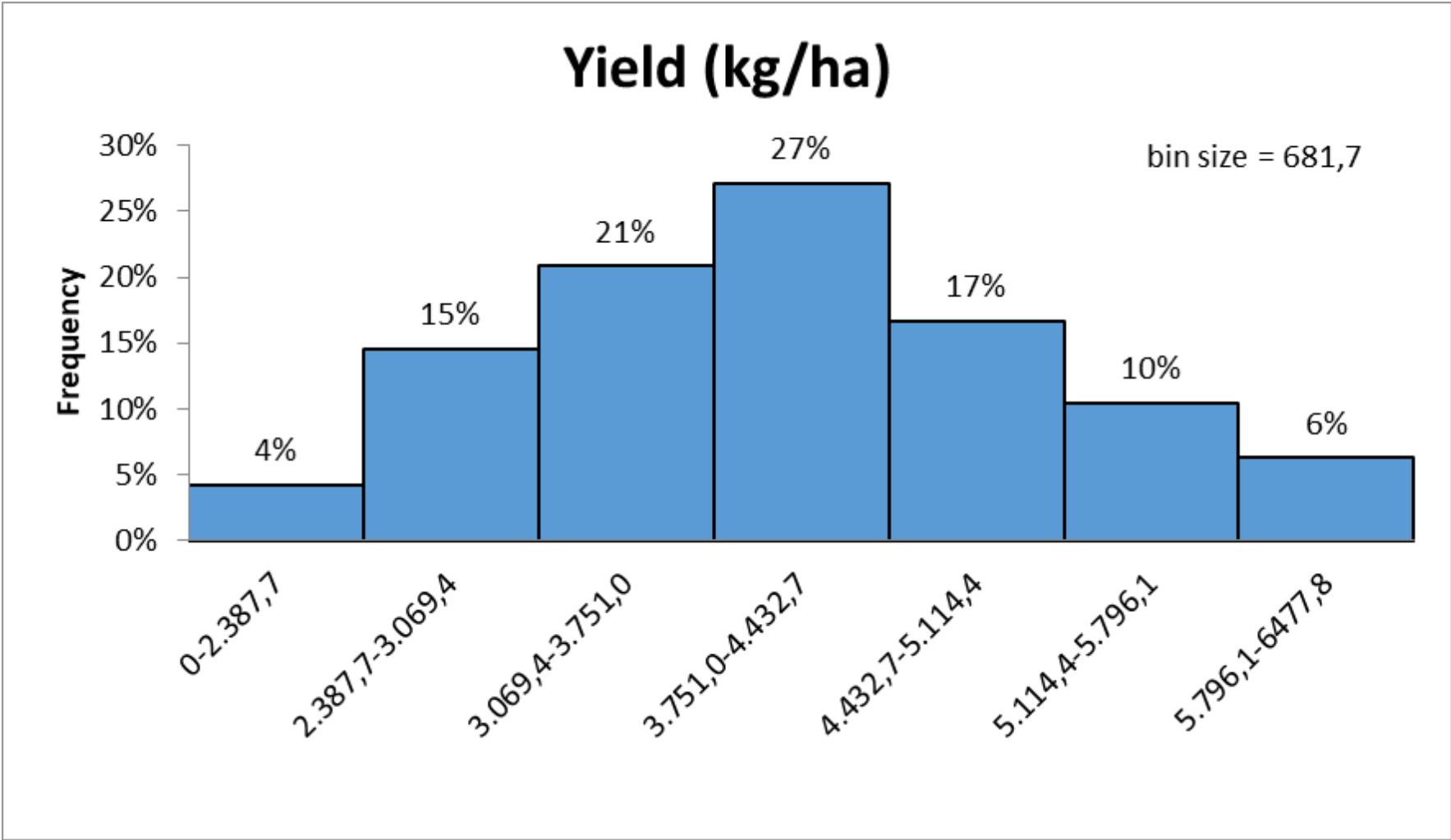


Results & Analysis

Field Process

Relative Frequency Distribution

- ✓ Histograms with the *y-axis* representing the frequency count, and the *x-axis* representing the variable to be measured.
- ✓ Normal Distribution for Yield (kg/ha)
- ✓ Right skewed Distribution for kg CO₂eq/ha
- ✓ Double peaked Distribution for kg CO₂eq/kg product





Results & Analysis

Field Process

The Average Values are classified by region.

The sample size is classified as:

- ✓ 15 Managers in Thrace
- ✓ 33 Managers in Thessaly

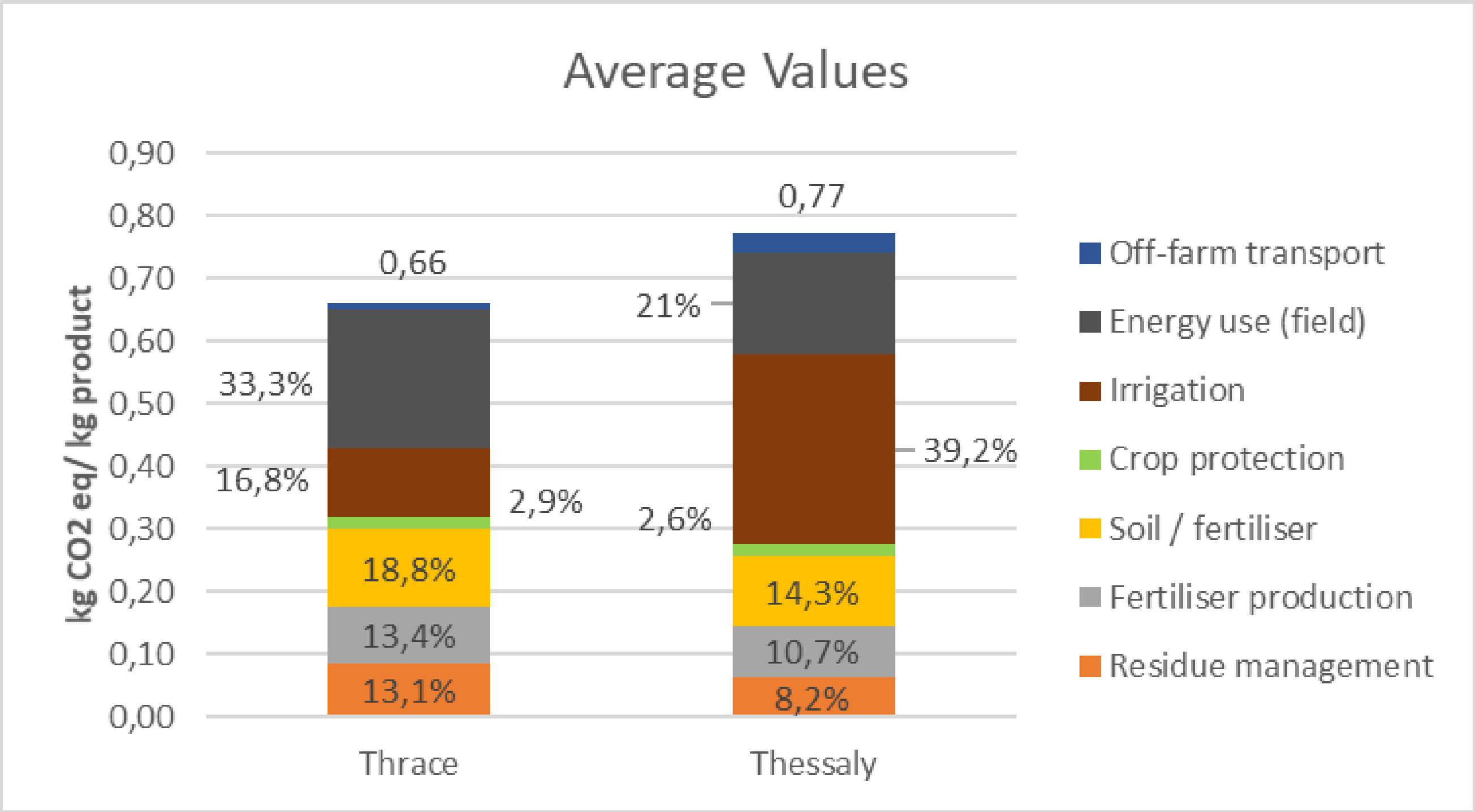
The main source of emissions for the region of Thessaly is:

- ✓ Irrigation (power to pump the water) by 39.2%.

The main source of emissions for the region of Thrace is:

- ✓ Energy Use (acquired energy for Tillage Operations) by 33,3%.

Thessaly has 16,6% higher CO₂ emissions then Thrace.

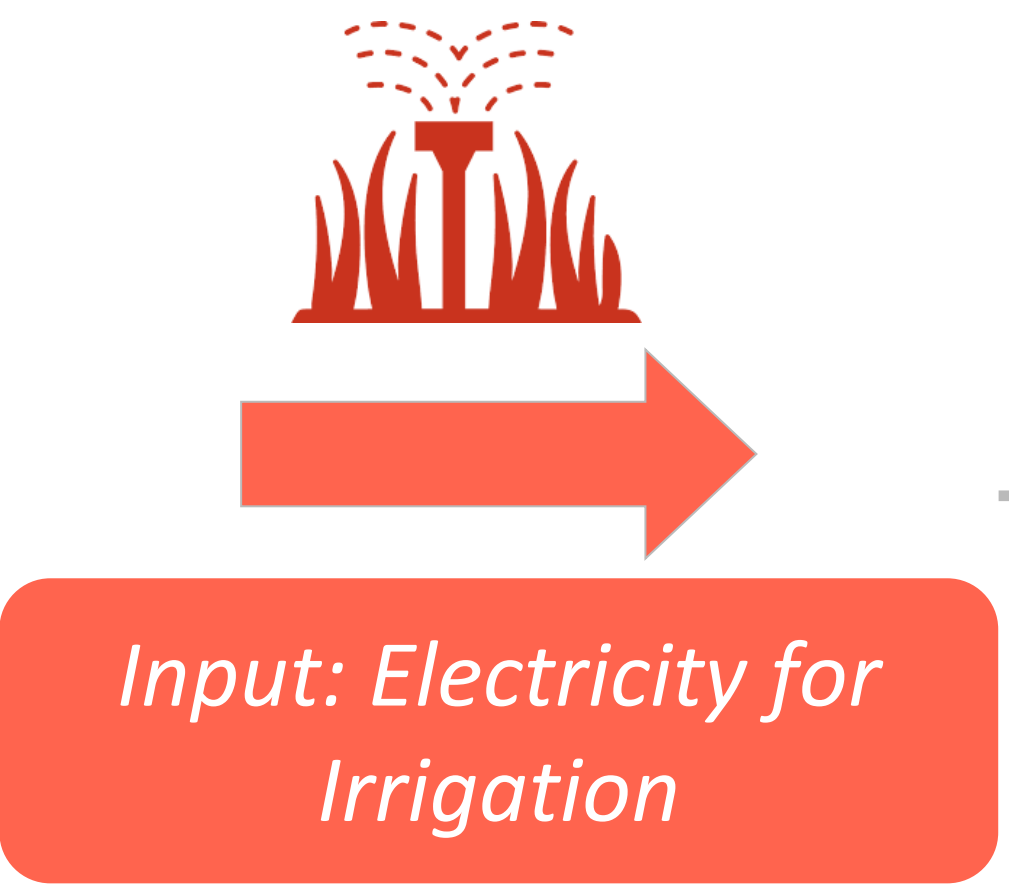




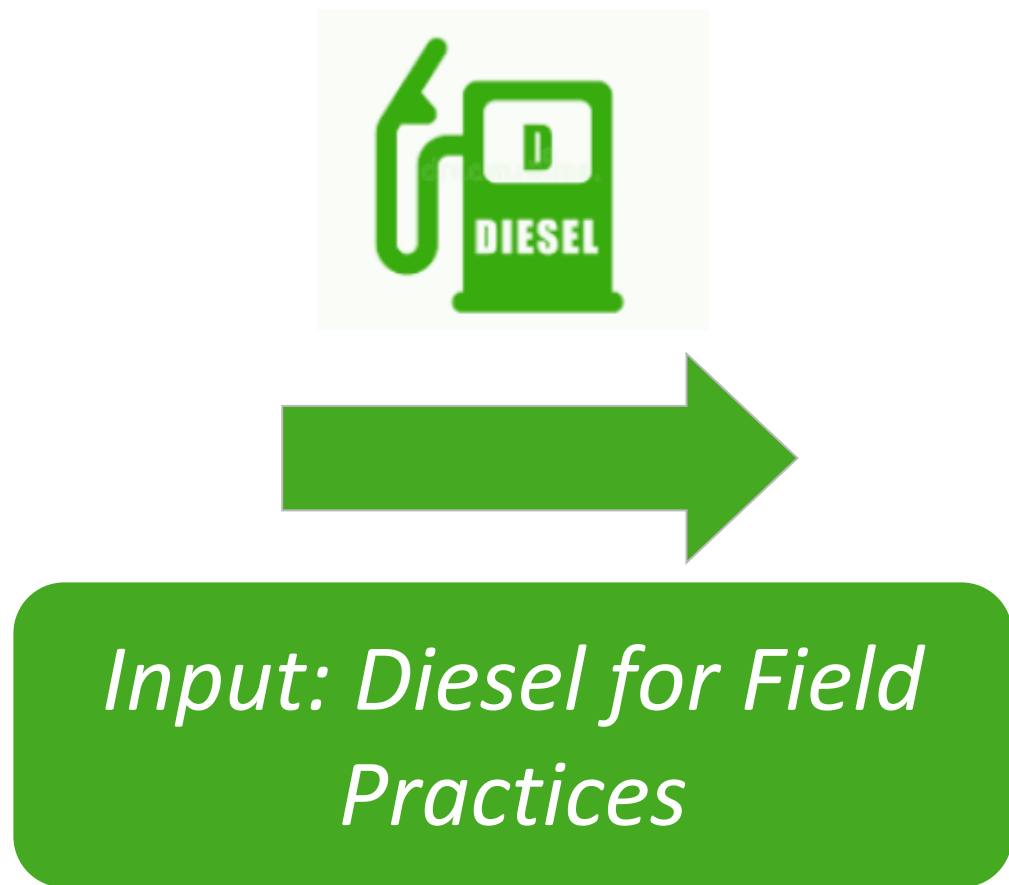
Aeiforiki S.A. (2021)

Thrace Thessaly

Residue management	0,09	0,06
Fertiliser production	0,09	0,08
Soil / fertiliser	0,12	0,11
Crop protection	0,02	0,02
Carbon Stock changes	0,00	0,00
Irrigation	0,11	0,30
Energy use (field)	0,22	0,16
Off-farm transport	0,01	0,03
kg CO2eq/kg product	0,66	0,77



Thessaly (kWh /m ³)	Thrace (kWh/m ³)
0,92	0,62



(liter diesel /kg product)	
0,05	0,09



Results & Analysis

Field Process

Detailed illustration of the **sources** of GHGs Emissions for the Field Process.

Residue Management: Cotton stalks are incorporated on field.

Fertilizer Production: CFT includes fertilizer production emissions and considers different regions of production.

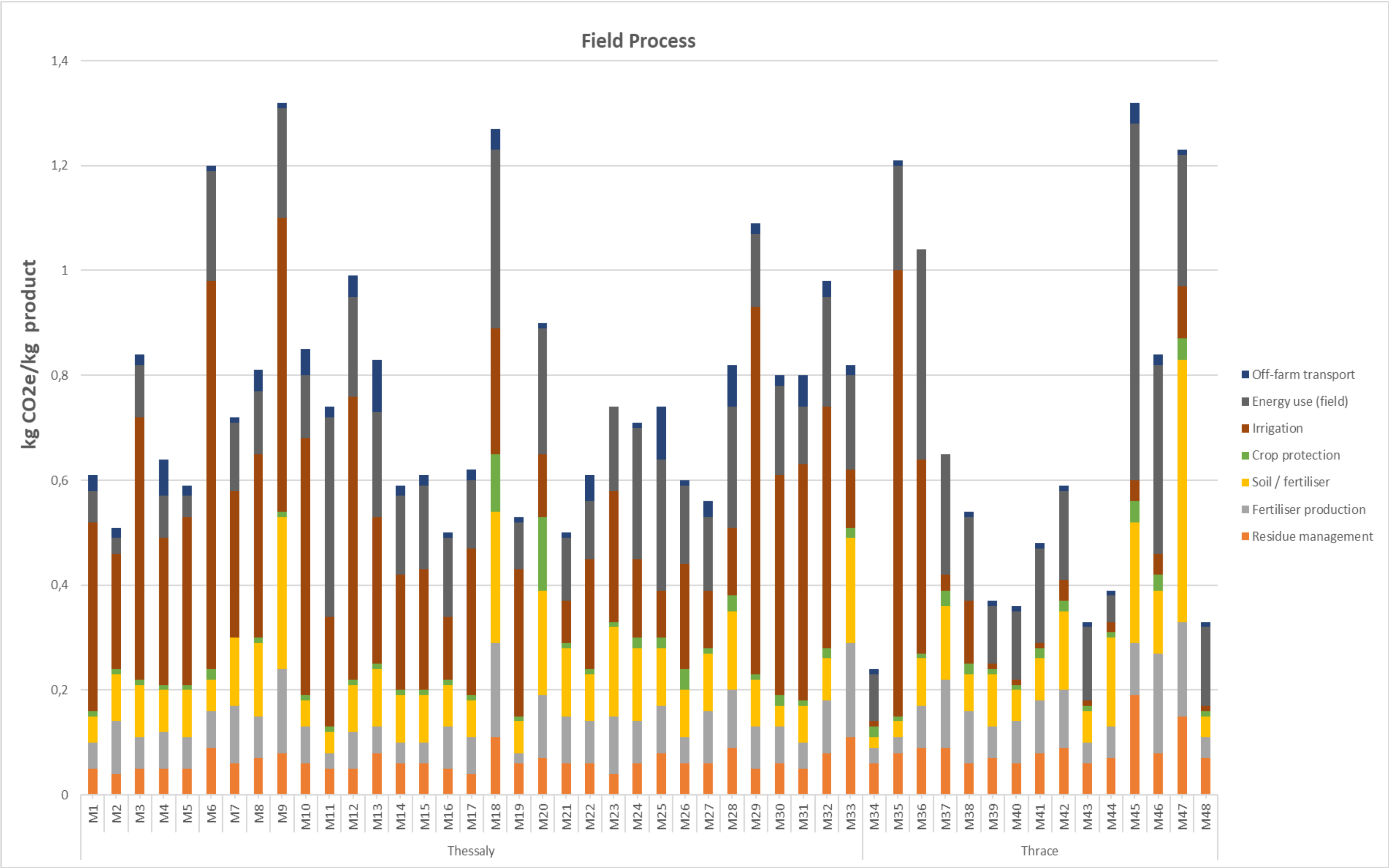
Soil/ fertilizer: Soil characteristics & fertilizer inputs.

Crop Protection: data for applications of pesticides, herbicides etc.

Irrigation: energy use to pump the water

Energy use: Direct energy usage (petrol, diesel) for field operations and on-farm transportation.

Off-farm Transportation: Product transportation from farm-gate to gin-gate





Results & Analysis

Comparative Analysis of Field Process

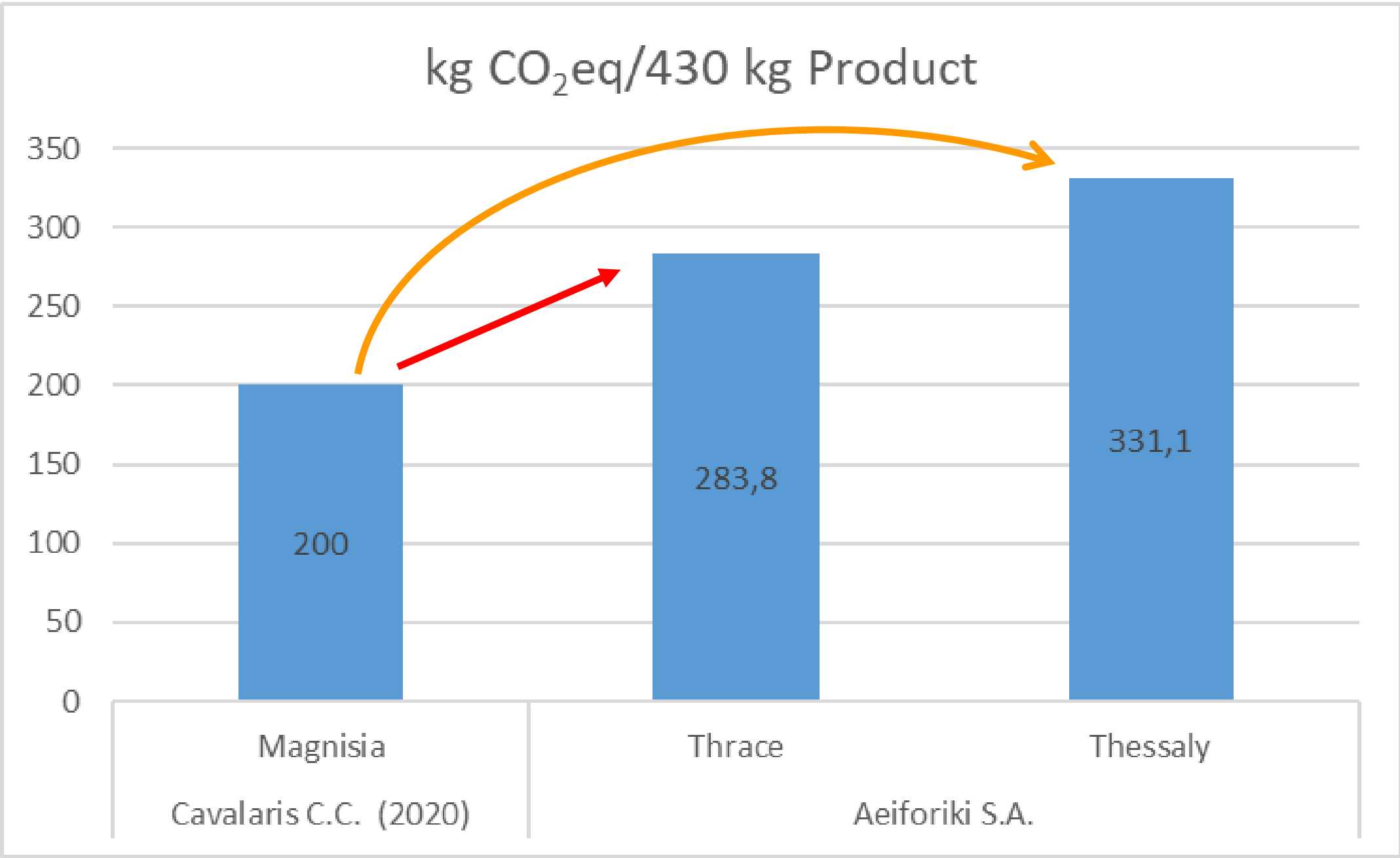
To compare GHG emission of CSF Cotton, a functional unit of kg carbon dioxide equivalents per kg product was applied.

The comparison was based on the reported value of kg CO₂eq/kg product that found in the study of Cavalaris C.C. (2020).

Cavalaris Study: For the production of 430 kg cottonseed, total emissions are calculated by 200 kg CO₂eq.

Aeiforiki S.A. Study: For the production of 430 kg cottonseed, total emission are calculated:

- ✓ Thrace - 283,8 kg CO₂eq
- ✓ Thessaly - 331,1 kg CO₂eq



Differences due to no-tillage methods of Cavalaris study

Results & Analysis

A Study on the Factors Affecting Greenhouses Emissions in Cotton in Greece

Antigolena FOLINA, Ioanna KAKABOUKI, Antonios Mavroeidis, Stella KARYDOGIANNI, Varvara Kouneli, Dimitrios BILALIS*

Department of Crop Science, Laboratory of Agronomy, Agricultural University of Athens, Greece
*Corresponding author, D. Bilalis e-mail: bilalis@aua.gr

Comparative Analysis of Field Process

To compare GHG emission of CSF Cotton, a functional unit of kg carbon dioxide equivalents per kg product was applied.

The comparison was based on the reported value of kg CO₂eq/kg product that found in the study of Bilalis D. (2021), a research received funding from Hellenic Cotton Association.

Total Amount of GHG emissions (kg)	Emissions of GHGs per stremma (kg CO ₂ eq)	Emissions of GHGs per kg product (kg CO ₂ eq)
43,794	327.9	0.77

* The total amount of kg CO₂eqs accounts for an average area of 131.2 stremmas and an average yield of 433.5 kg/stremma.

Source: Aeiforiki S.A., 2021



Total Amount of GHG emissions (kg)	Emissions of GHGs per stremma (kg CO ₂ eq)	Emissions of GHGs per kg product (kg CO ₂ eq)
43,110	283	0.74

* The total amount of kg CO₂eqs accounts for an average area of 150 stremmas and an average yield of 382.4 kg/stremma.

Source: Hellenic Cotton Association

ΕΚΠΟΜΠΗ ΑΕΡΙΩΝ
ΘΕΡΜΟΚΗΠΙΟΥ (CO₂e)
ΣΤΗΝ ΚΑΛΛΙΕΡΓΕΙΑ
ΒΑΜΒΑΚΟΣ

Έτος αναφοράς 2020-2021

Results & Analysis

Comparative Analysis of Field Process

To compare GHG emission of CSF Cotton, a functional unit of kg carbon dioxide equivalents **per hectare (ha)** was applied.



Cotton growers test **new approaches** – Better Management Practices (BMP)

- In Study of WWF India (2013) used:**
- ✓ Cool Farm Tool (CFT) v. 373
 - ✓ Warangal, India
 - ✓ BMP Cotton (Better Management Practices – reduced water usage & pesticides; ethical labor standards; traceable supply chain.)



Low energy contribution

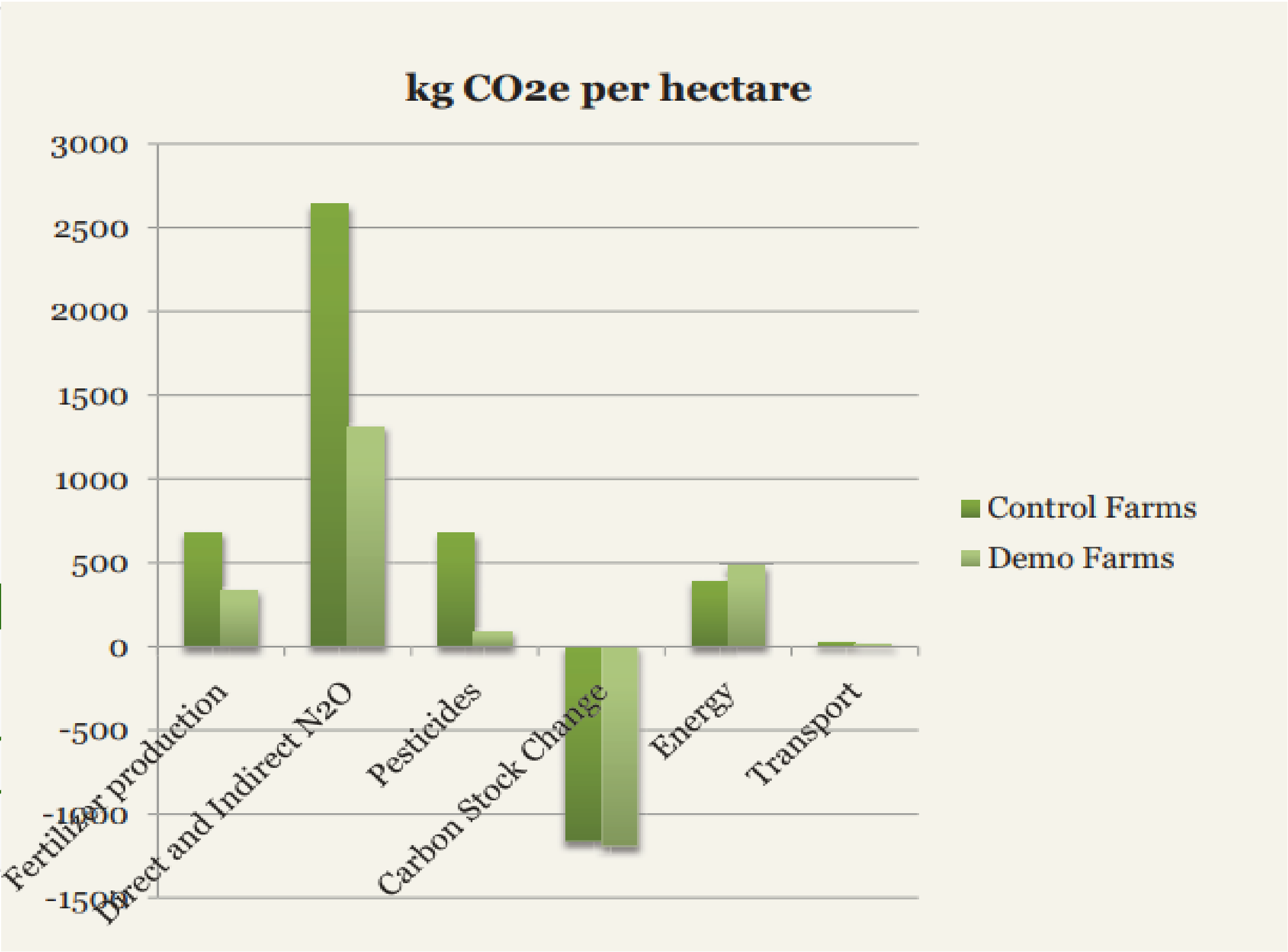


Carbon Stock Change

High Emissions due to N-fertilizers and organic manure



kg CO₂-eq/ ha





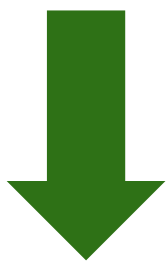
Results & Analysis

Comparative Analysis of Field Process

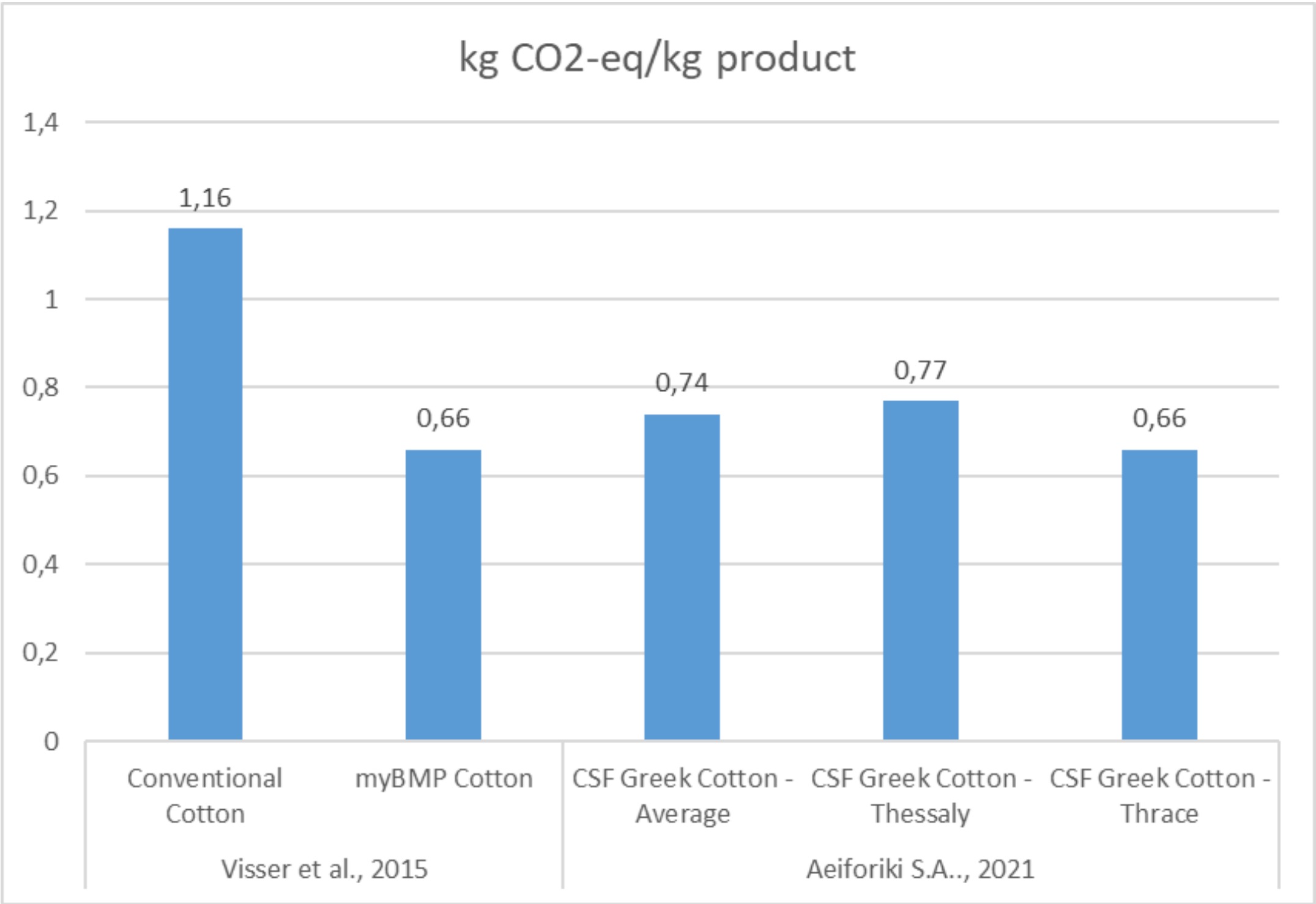
To compare GHG emission of CSF Cotton, a functional unit of kg carbon dioxide equivalents **per kg of product** was applied.



- In Study of Visser et al., (2015) used:**
- ✓ Crop Carbon Progress Calculator (CCAP) was applied
 - ✓ ‘Farm to Ship’ case study in Australia



The Visser Study is an estimation based on a holistic LCA methodology.



incl.

☐ Indirect N2O (like leaching/run-off and atmospheric deposition)

☐ Transport of inputs (seed, fertilizers)

Special Note

☐ No electricity input for irrigation; just diesel

