

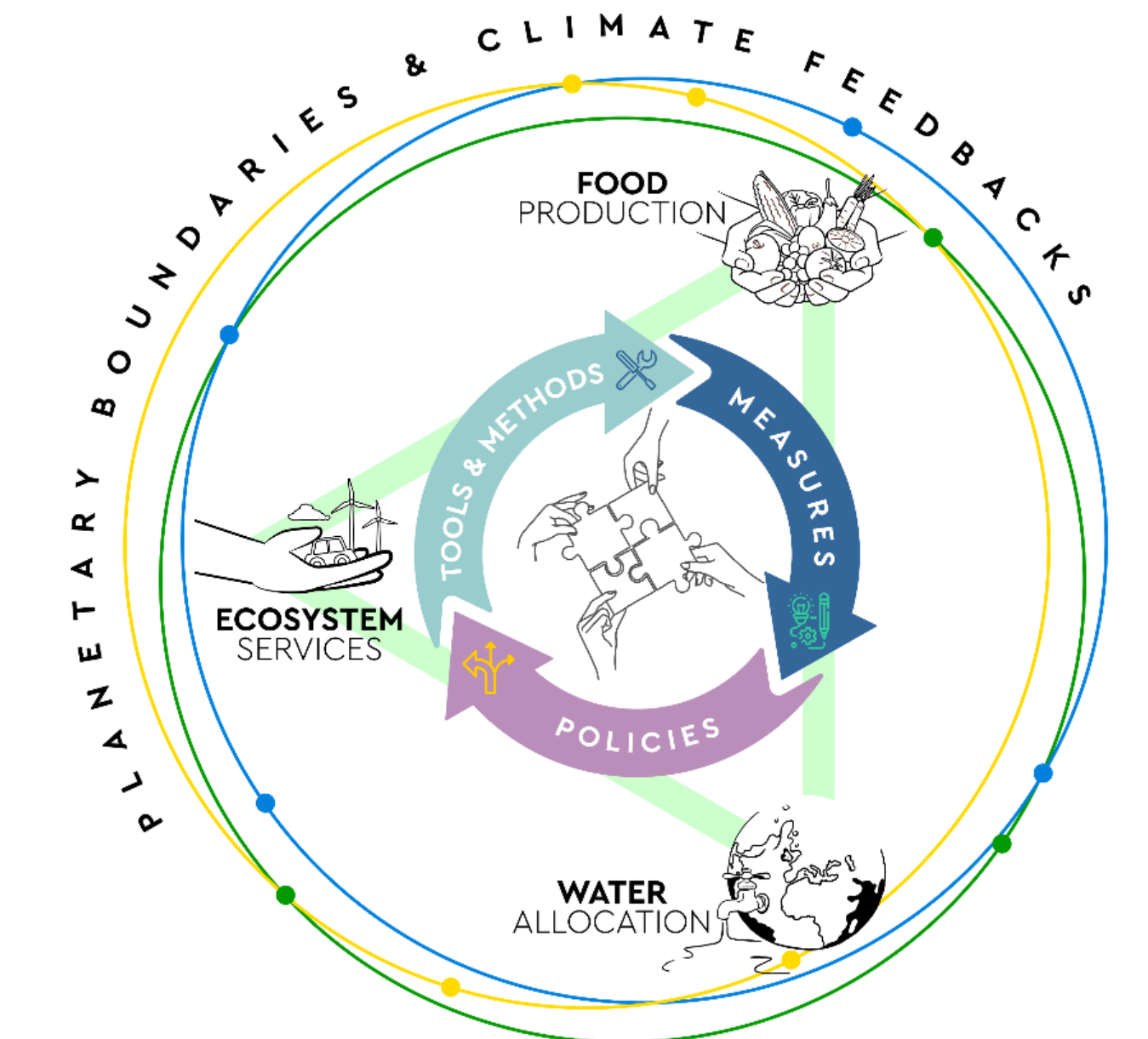


Abstract

The Water-Energy-Food-Ecosystem Nexus is being assessed in systematic way for an Avocado plantation in Crete, Greece in order to minimize the environmental footprint and impact of the operation while maximizing the benefits for the farmer and the environment. A hydrologic and plant monitoring station have been established in an avocado plantation to determine optimal irrigation schemes, the water use efficiency of the trees and ways to improve plant productivity. The station consists of a precipitation and meteorological station, soil moisture profilers near and away from the tree, irrigation flow monitoring, NDVI and PRI cameras for the estimation of the above ground biomass changes. These data that are collected every 15 minutes, together with expert knowledge were used to determine optimal irrigation schemes such as deficit irrigation that will conserve the use of water as well as maximize plant production. To optimize the water component of the Nexus, the plants were irrigated the amount estimated by their evapotranspiration needs. In addition, drip irrigation was not applied in a linear fashion in the field, but in a circle with one-meter diameter from the root of the tree. In this way, the amount of irrigation used was only 30% of the typically prescribed irrigation needs for the plants on an areal basis. Irrigation was applied every 3-4 days based on soil moisture changes in a constant fashion. It has been observed the over-irrigation stresses the plant. The energy component of the Nexus was minimized with the use of photovoltaic panels capable of providing sufficient energy for irrigation. Biomass production was monitored with the NDVI and PRI cameras in order to estimate the above ground production as well as to identify the conditions that plants were stressed. No tilling was practiced in order not to disturb the formation of water stable aggregates and thus the productivity of the soil. Finally, soil organic matter was added by cutting the grass grown in between the trees and leaving the clippings on site and also by not removing the leaves from the avocado. The addition of organic matter in the soil promotes the below ground biodiversity as well as the productivity of the plants. The results of this study illustrate that the WEFE Nexus can be optimized for the benefit of both the farmer and the environment.

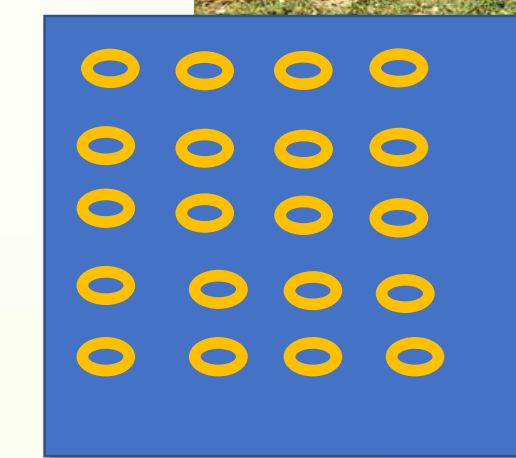
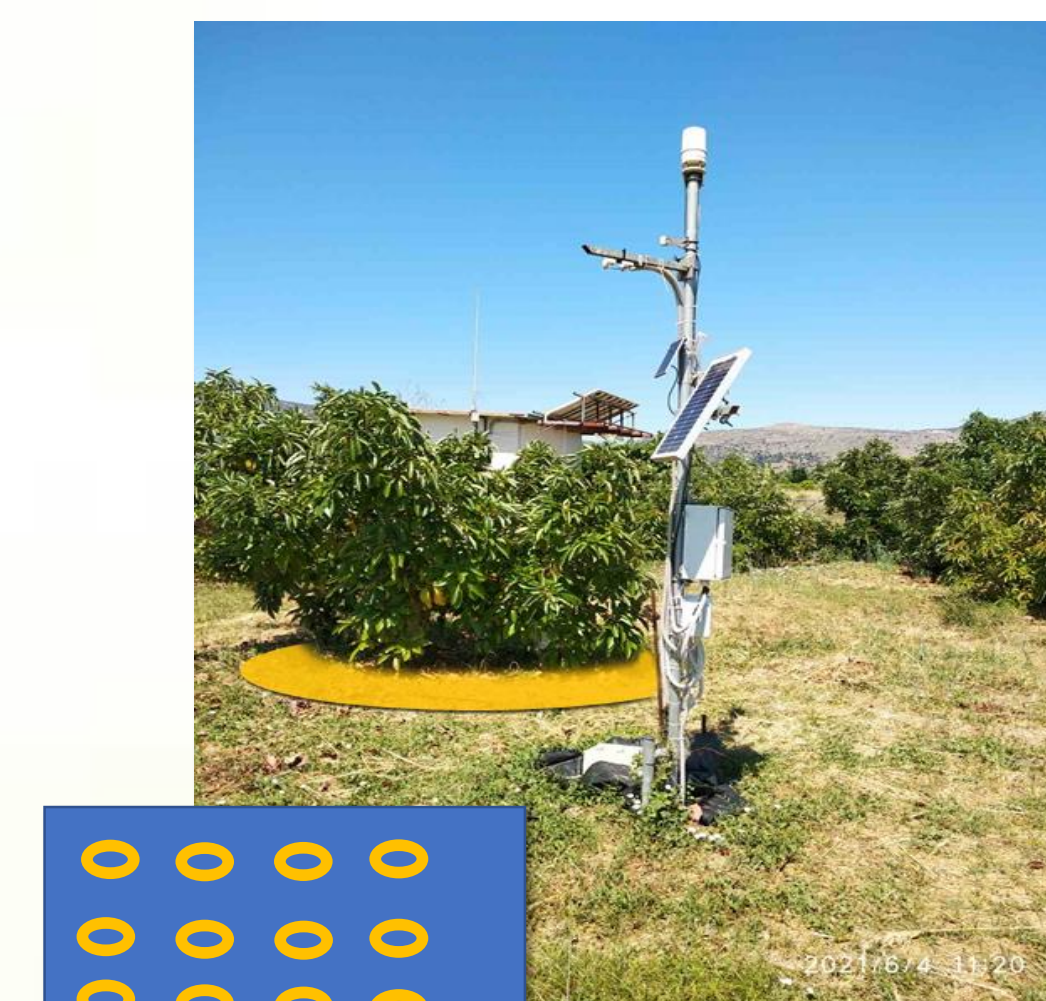
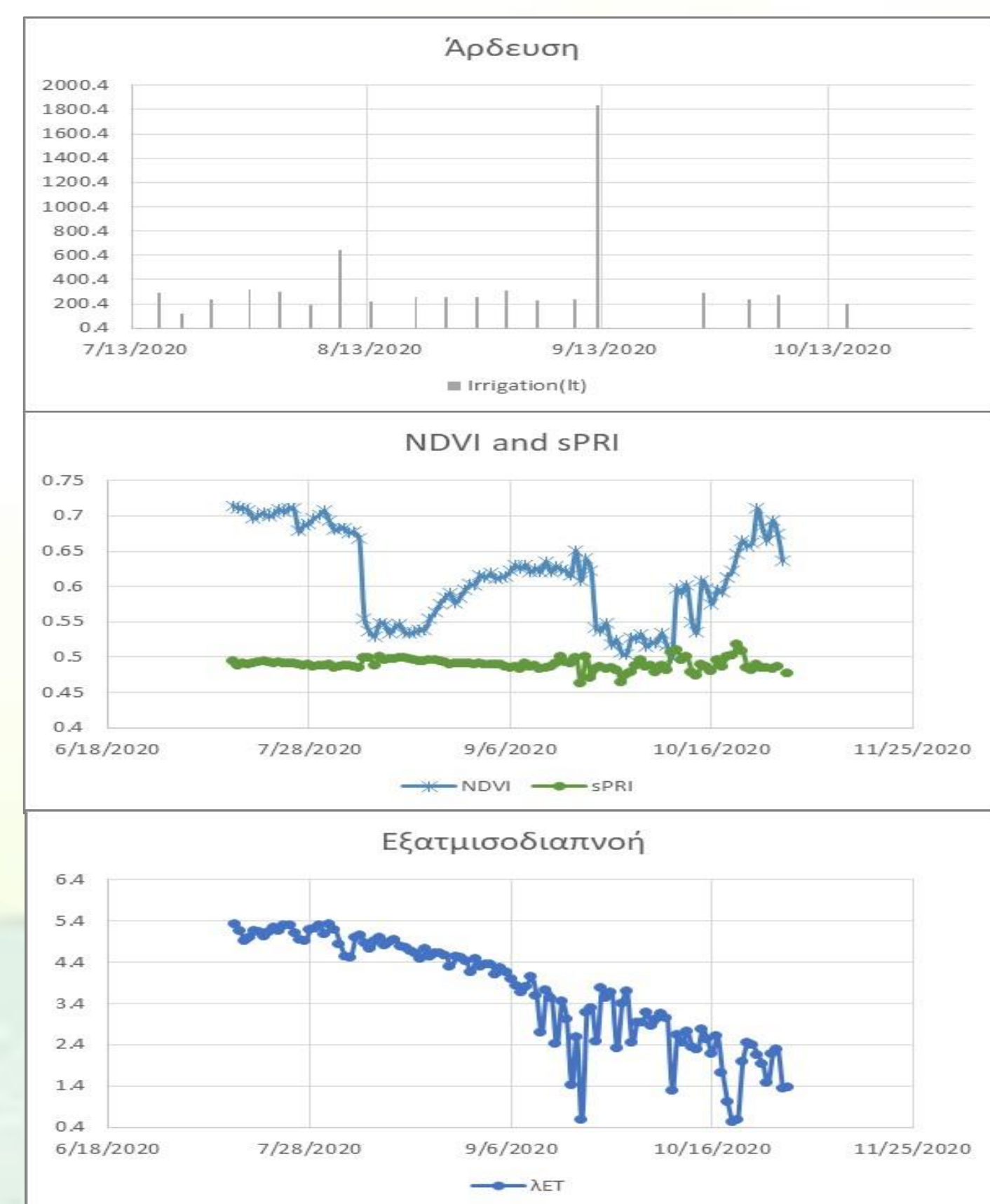
Experimental Setup

The Water-Energy-Food-Ecosystem Nexus is being assessed in systematic way for an Avocado plantation in Crete, Greece in order to minimize the environmental footprint and impact of the operation while maximizing the benefits for the farmer and the environment. A hydrologic and plant monitoring station have been established in an avocado plantation to determine optimal irrigation schemes, the water use efficiency of the trees and ways to improve plant productivity. The station consists of a precipitation and meteorological station, soil moisture profilers near and away from the tree, irrigation flow monitoring, NDVI and PRI cameras for the estimation of the above ground biomass changes. These data that are collected every 15 minutes, together with expert knowledge were used to determine optimal irrigation schemes such as deficit irrigation that will conserve the use of water as well as maximize plant production.

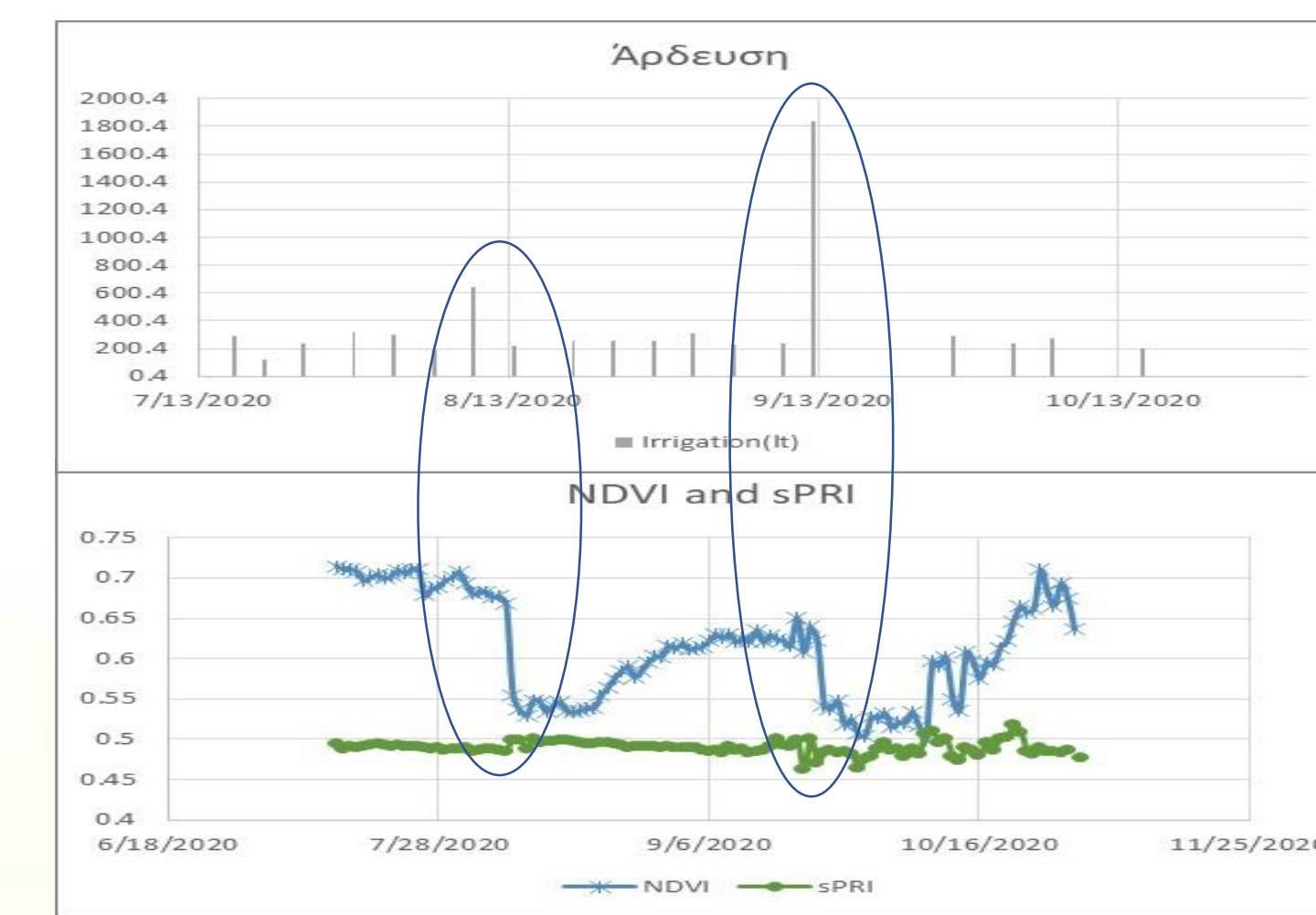


WATER

To optimize the water component of the Nexus, the plants were irrigated the amount estimated by their evapotranspiration needs. In addition, drip irrigation was not applied in a linear fashion in the field, but in a circle with one-meter diameter from the root of the tree. In this way, the amount of irrigation used was only 30% of the typically prescribed irrigation needs for the plants on an areal basis. Irrigation was applied every 3-4 days based on soil moisture changes in a constant fashion.



Reduce irrigation by 2/3

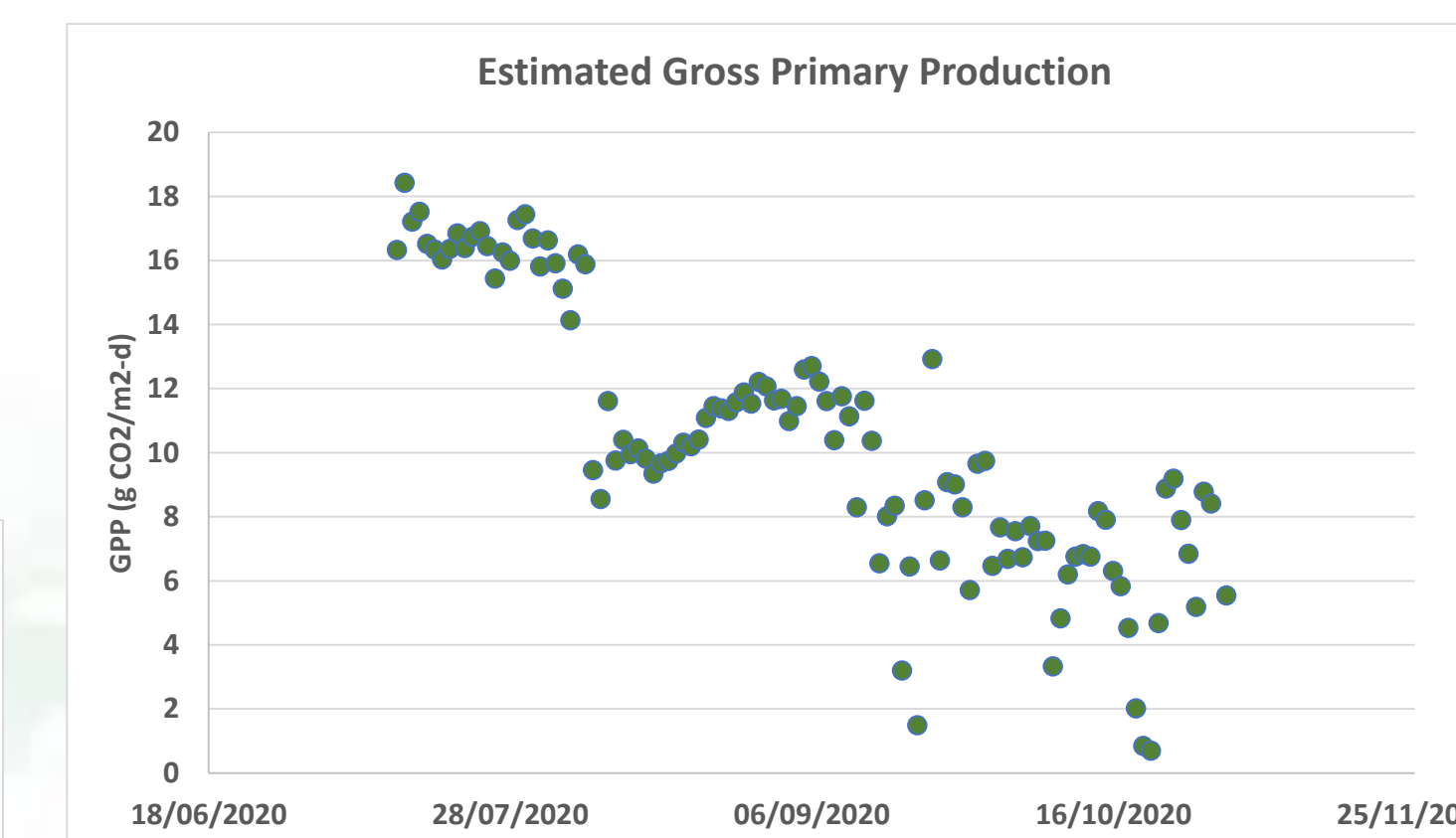
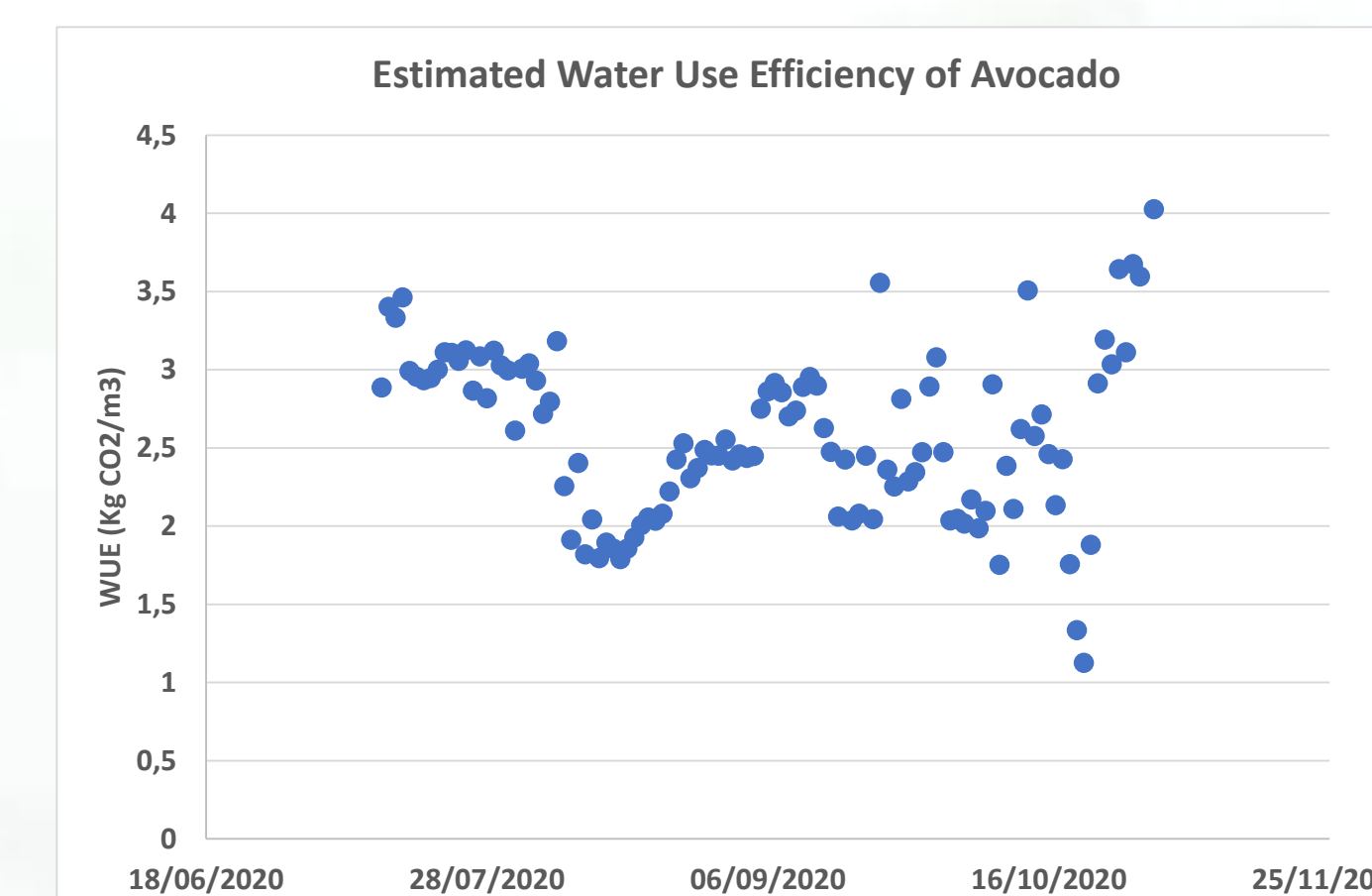


Over-irrigation stresses the plant.



FOOD

Biomass production was monitored with the NDVI and PRI cameras in order to estimate the above ground production as well as to identify the conditions that plants were stressed.



ENERGY

The energy component of the Nexus was minimized with the use of a Solar/Battery Powered Drip Irrigation System.

A set of rechargeable battery cells is used to store energy from the solar panels (1KW), which in turn, driver the water pump.

Area: 2200 m²
Avocado trees: 70



ECOSYSTEMS

No tilling was practiced in order not to disturb the formation of water stable aggregates and thus the productivity of the soil. Finally, soil organic matter was added by cutting the grass grown in between the trees and leaving the clippings on site, by adding manure around the tree and also by not removing the leaves from the avocado. The addition of organic matter in the soil promotes the below ground biodiversity as well as the productivity of the plants.