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Framework Partnership Agreement
for Copernicus User Uptake

The Copernicus User Uptake project is financed by the European
Commission under the FPA no.: 275/G/GRO/COPE/17/10042



Drought impact on Coffee plantation and Biodiversity on both sides of the Pacific Ocean

Copernicus Soil Water Index measures the impact of
droughts on the coffee plantations and biodiversity
in two regions in Guatemala and in the Vietnam
highlands.

Objectives:

Droughts and biodiversity loss are difficult conditions for
agriculture. This situation demands better local and remote sensors
to identify:

- 1) the most affected areas
- 2) potential forest reconnection
- 3) identify the most resilient regions to drought conditions

Fernando Roque fmroque10@gmail.com

Quantic Statistics

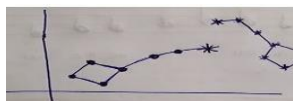
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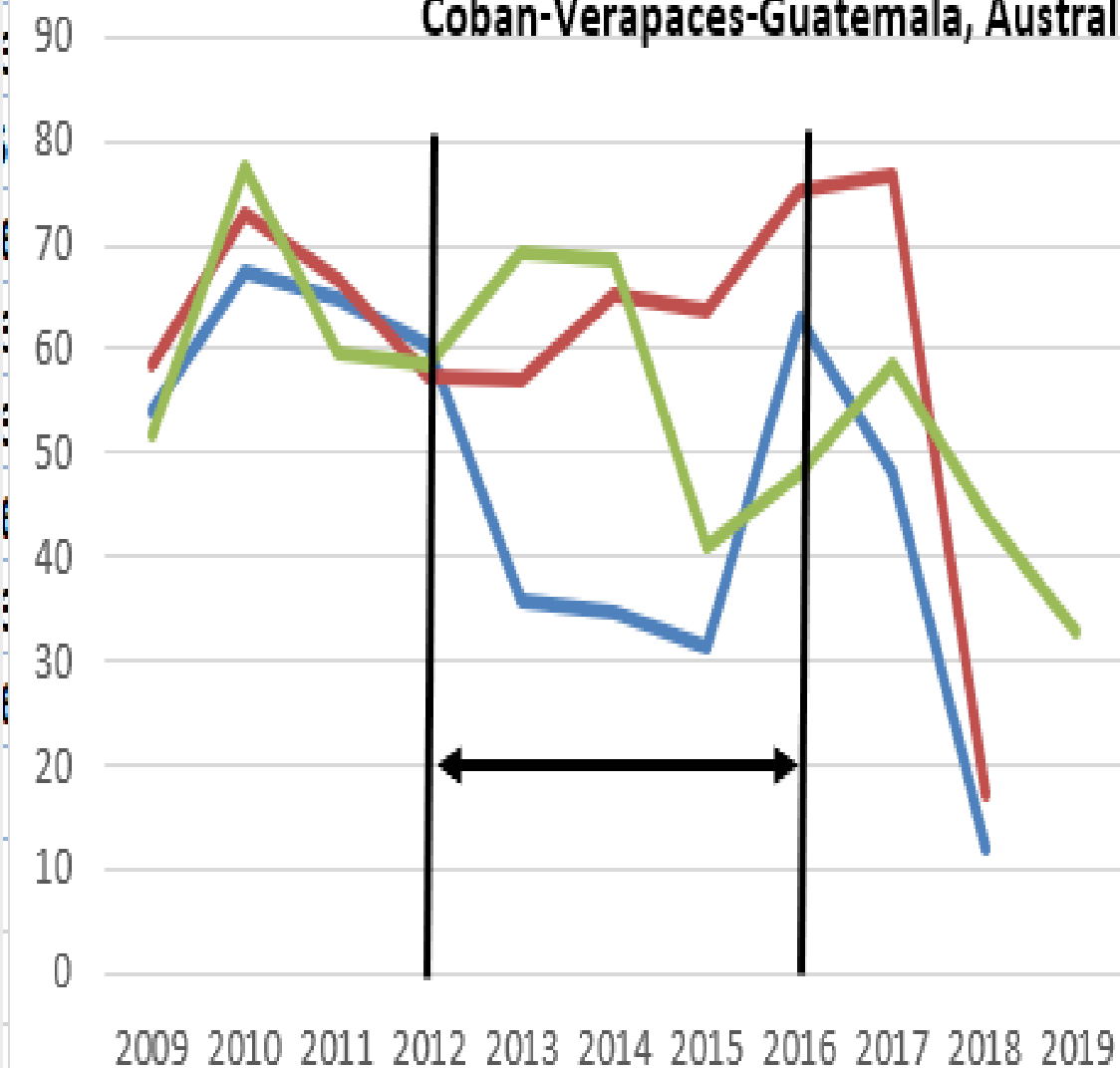
Index

- 1) **Background:** El Nino devastating effects during 2014 and 2015 in coffee plantations in Guatemala and California and Australia droughts.
- 3) Soil moisture during May, at the beginning of rainy season, is critical for coffee plantation flower blossom. Soil Water Index indicates low rainfall rate in May during 2018, 2019, and 2020 in Guatemala and Vietnam.
- 4) Compare Soil Water Index levels during the rainy season for Guatemala and Vietnam to check the thresholds of coffee plantations on both sides of the Pacific.
- 5) NDVI biodiversity and vegetable activity comparison with Soil Water Index for these three regions. NDVI is a very important factor for coffee plantations because they demand a healthy rain forests to deliver good crops. Check Appendix A.
- 6) El Nino neutral, but the Pacific Ocean forms new atypical forms that cause droughts.
- 7) Present and future irregular rainy seasons, create the demand for Soil Moisture remote sensor indicators like Soil Water Index to follow up the agriculture performance.

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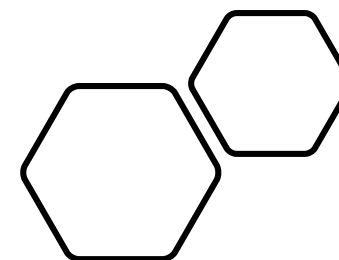
Soil Water Index Rainy Season 2009-2019

Coban-Verapaces-Guatemala, Australia and California



Years ▾ Quarters ▾ DATE ▾

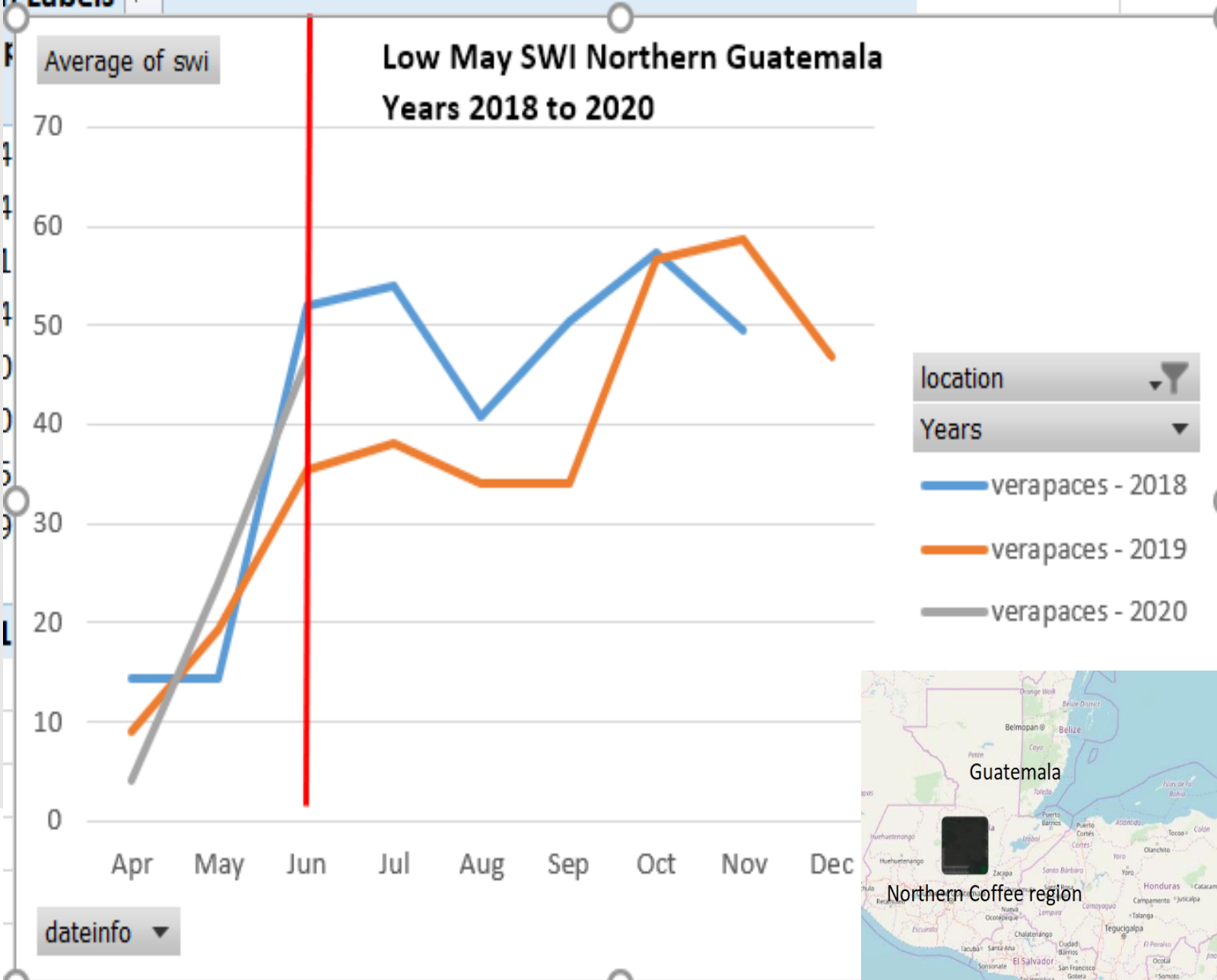
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Background:

El Nino and its devastating effects on both sides of the Pacific Ocean.

The beginning of the crisis in 2013 impacted Australia, California, and Guatemala. The strongest El Nino of the 21st. the century was during 2014-15. See this Copernicus Soil Water Index for the rainy seasons of Guatemala, Australia, and California. The three regions have in common that the drought crisis began in 2013. With the most severe impact in 2014 and 2015 with El Nino. Then, the three regions have relative soil moisture improvement in 2016.



Back to the crisis in 2018 on both sides of the Pacific Ocean.

Copernicus Soil Water Index soil moisture indicator. Coffee plantations require moisture and diverse plants and trees to keep the grain healthy and growing.

The most important factor is the high soil moisture at the beginning of May for a good flower blossom. Since the beginning of the drought crisis in 2013, the May rainfall has been irregular.

This is probably the cause of the coffee rust and low production for Guatemala producers.

The chart shows three-year low SWI for May in the northern coffee region of Guatemala. Years 2018 to 2020.

You can see the relative SWI recovery after June of these years, 2018 to 2020.

Multi-year crisis of coffee low production, food crop losses is probably one of the causes of mass migration of Guatemalans to the United States.

Read this article: Drought And Climate Change Are Forcing Young Guatemalans To Flee To The U.S..

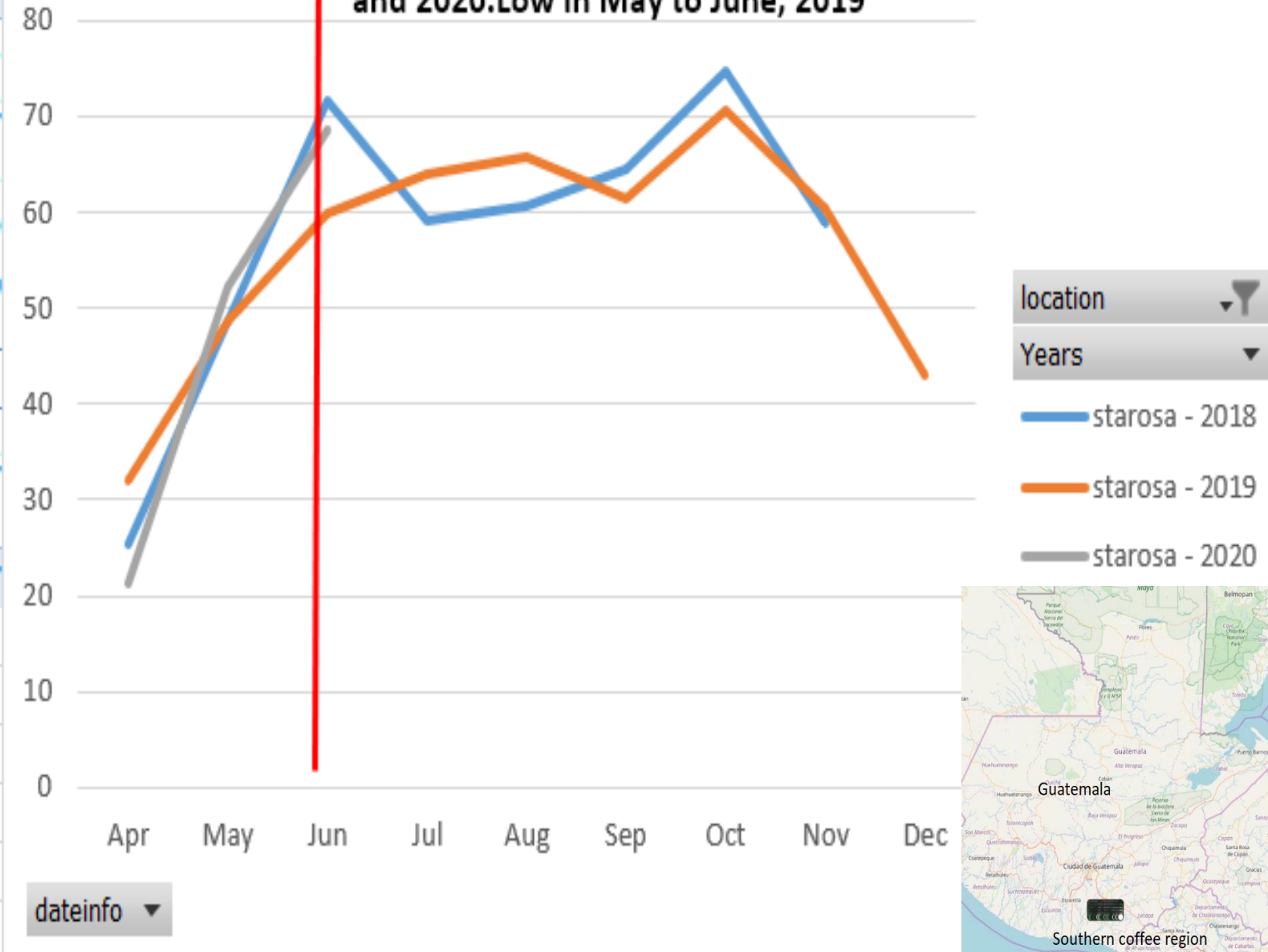
https://www.huffpost.com/entry/climate-change-coffee-guatemala_n_589dd223e4b094a129ea4ea2

The humanitarian problem is worst in 2020 with the Covid-19 virus.

Low SWI for May 2018, 2019, 2020 in Northern Guatemala coffee plantation region

Average of swi

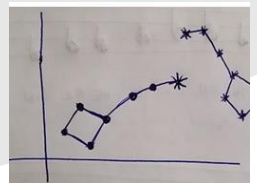
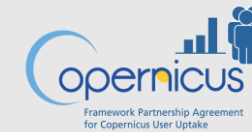
Southern Guatemala. May SWI increase during May in 2018 and 2020. Low in May to June, 2019



Soil Water Index for the Southern Guatemala coffee plantation region.

Comparing with the Northern region, the southern Soil Water Index had a better performance for May in 2018 and 2020. But had a low increase during May to June in 2019, which affected the coffee flower blossom last year.

This chart shows the irregular behavior of rainfall. Also, one bad moisture year like 2019, affects the lifetime of the coffee plantation for the future years.

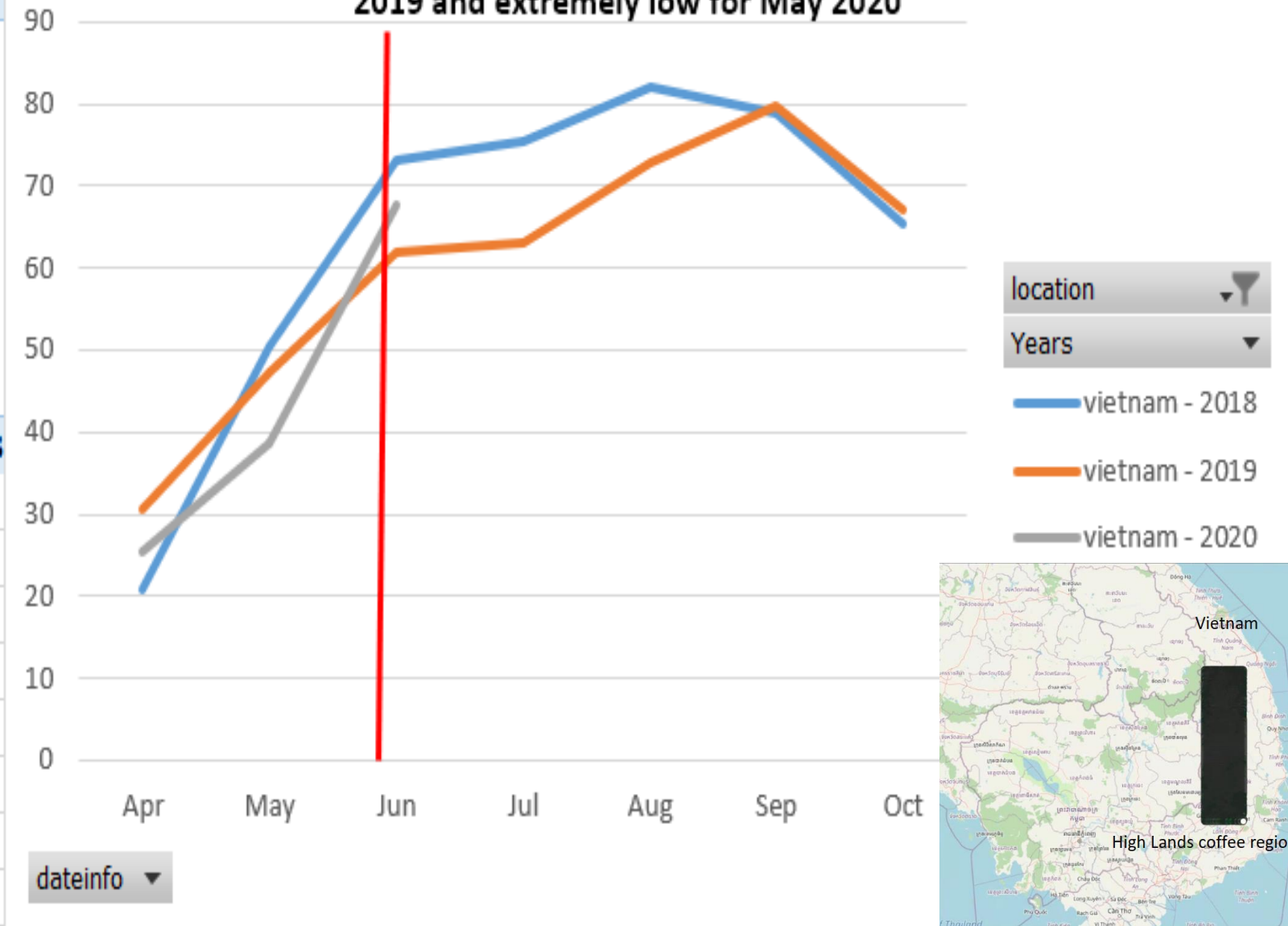


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SWI for May 2018, 2019, 2020 in Southern Guatemala coffee plantation region

Average of swi

Vietnam. May SWI increase during May in 2018. Lower for May 2019 and extremely low for May 2020



Vietnam Highlands coffee plantation region Soil Water Index for May 2018, 2019, 2020

The Soil Water Index for the Vietnam Highlands coffee plantation region increased during May for 2018. Then SWI decreased in the following months which caused damage to the plantation because it requires continuous soil moisture during the rainy season from May to October. Also, review the low SWI May indicator for 2019 and extremely low in May 2020.

Read this article by Roast Magazine-Daily Coffee News about how the coffee growers struggle with droughts and warming climate in the Mekong river region, Vietnam.

<https://dailycoffeenews.com/2019/10/08/mekong-coffee-growers-struggle-with-drought-and-a-warming-climate/>



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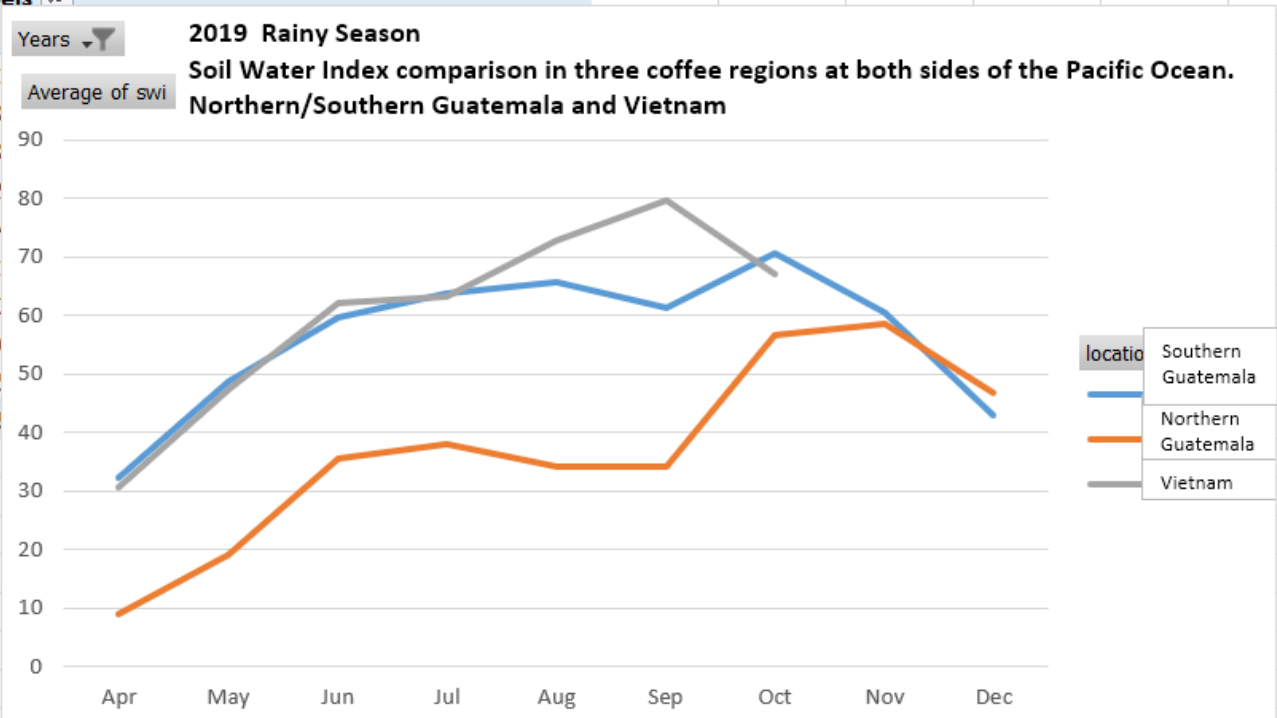
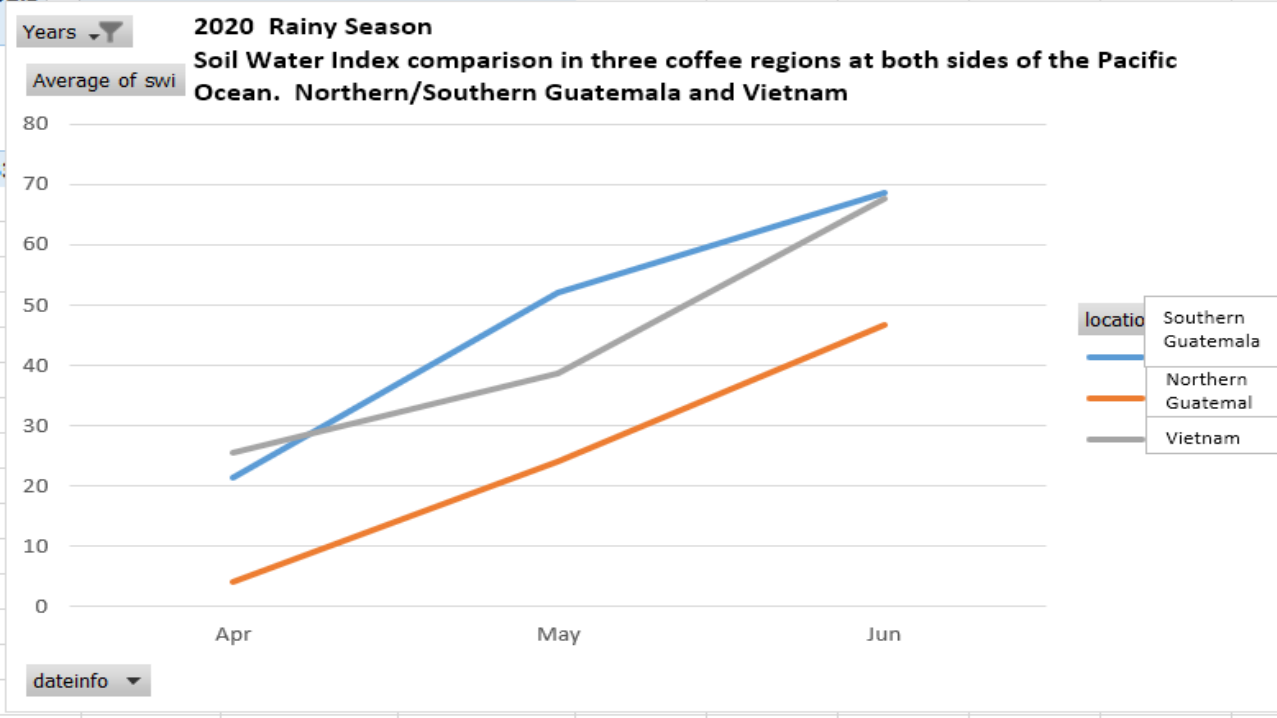
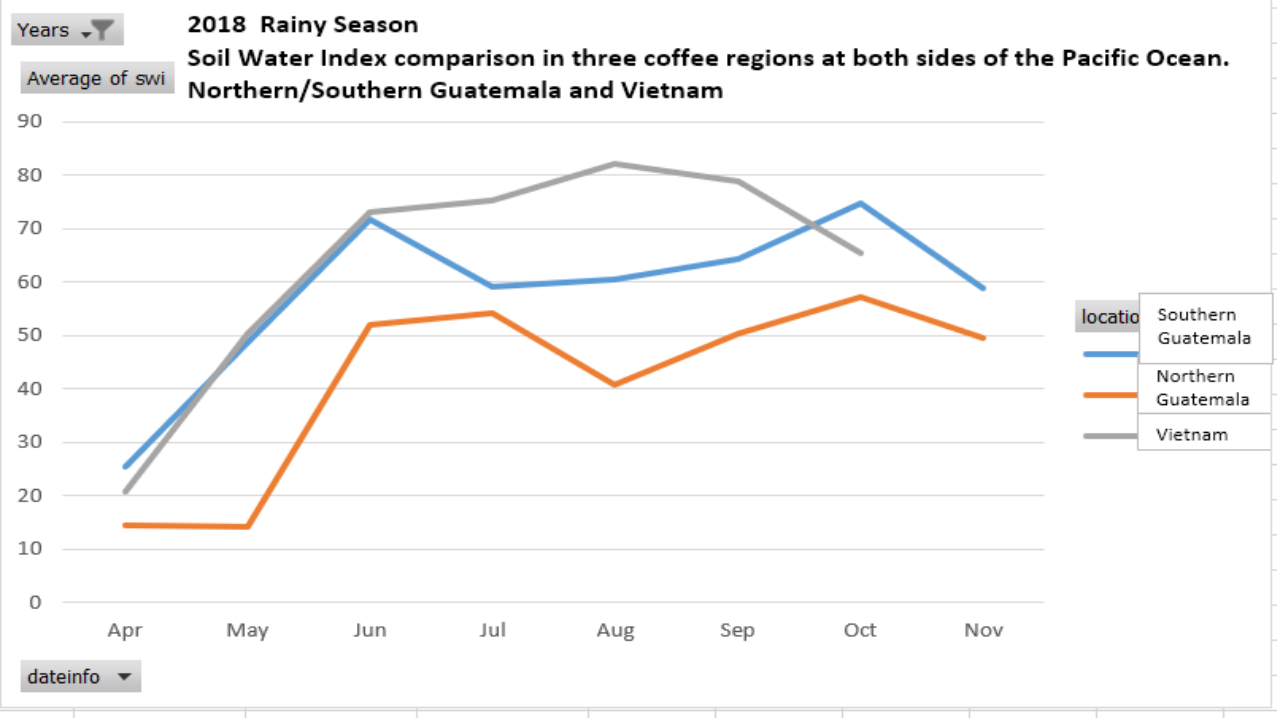
ORIGIN

INDUSTRY

ESPAÑOL

SWI for May 2018, 2019, 2020 in Vietnam Highlands coffee plantation region

Mekong Coffee Growers Struggle with Drought and a Warming Climate

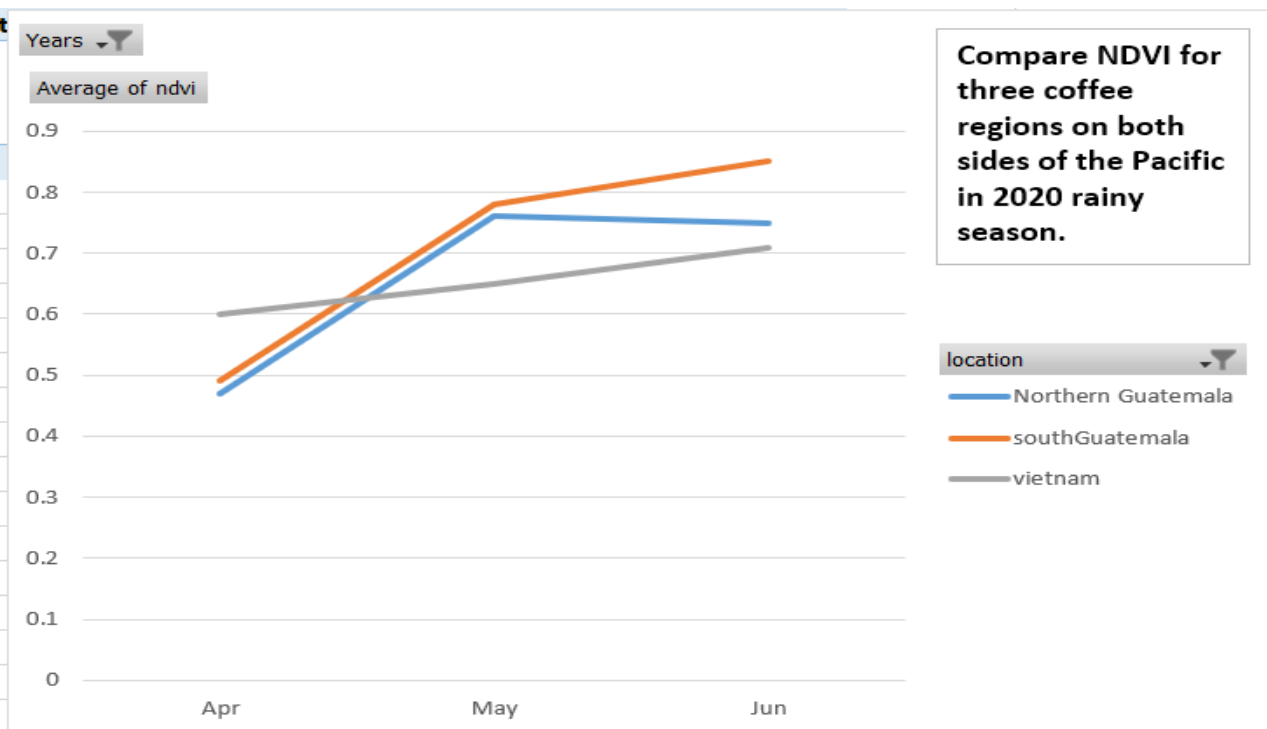
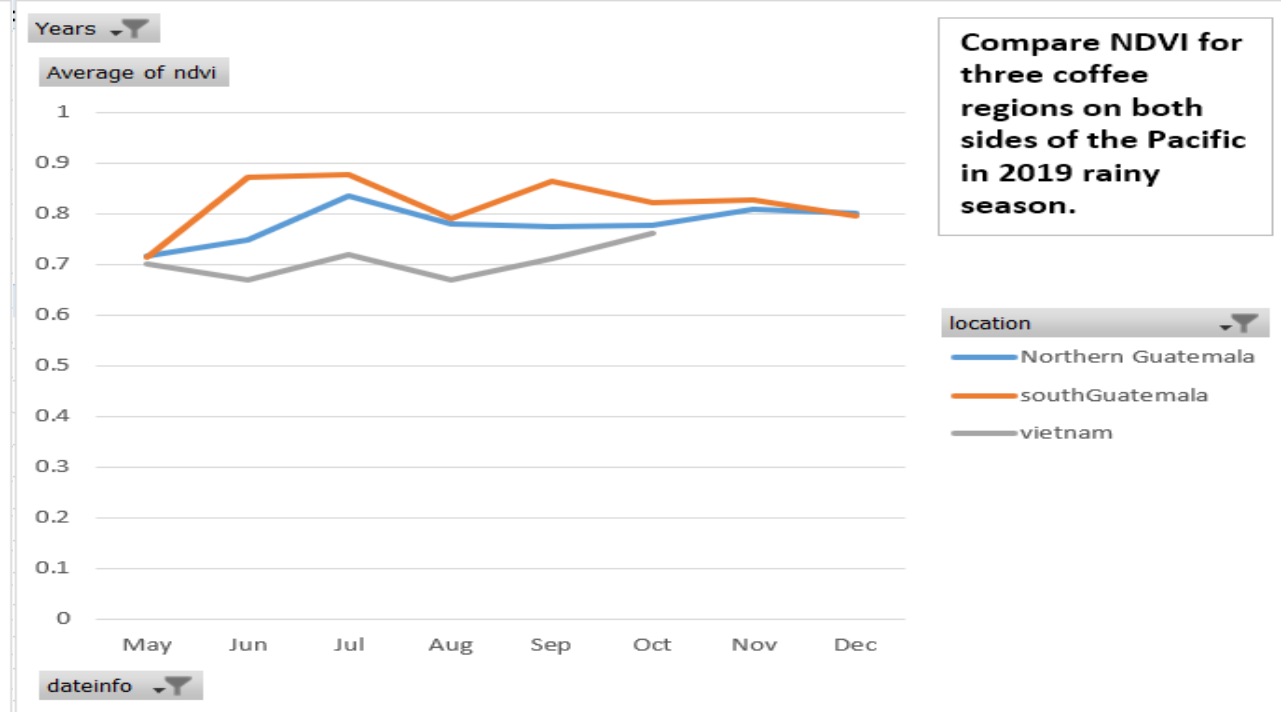
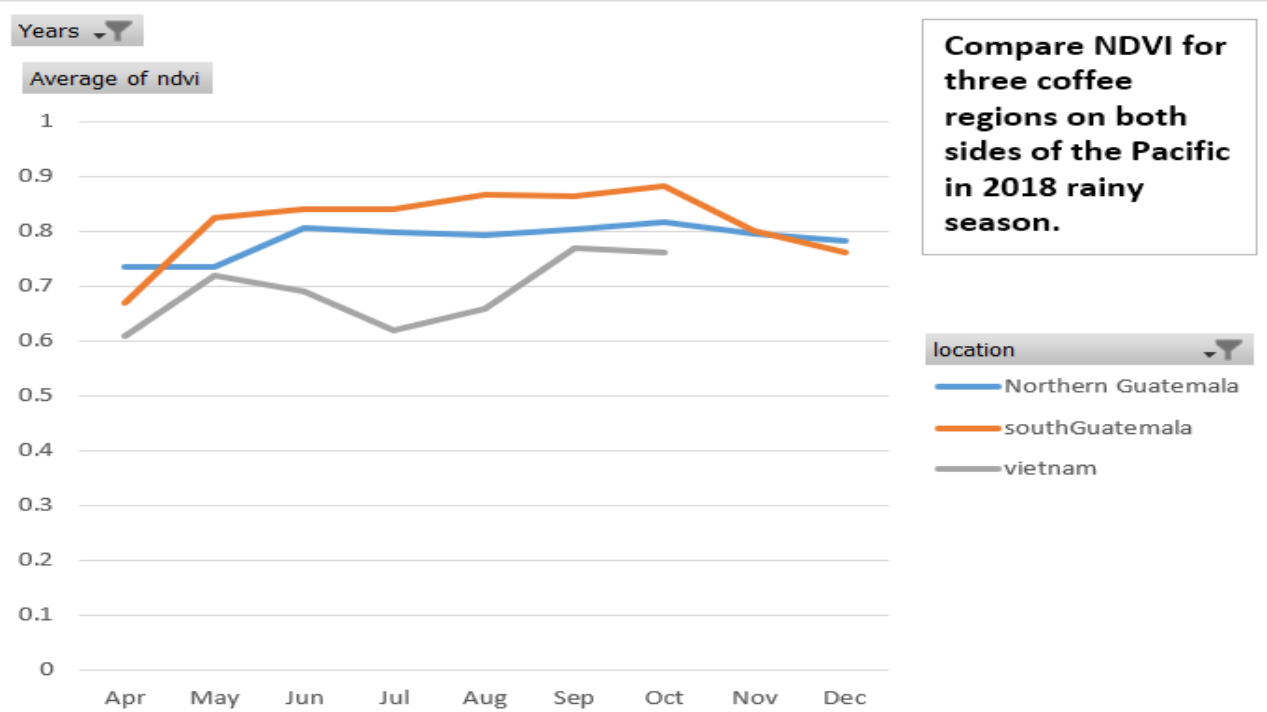


Three years (2018-2020) Soil Water Index comparison for coffee plantation in Guatemala and Vietnam

- Northern Guatemala has the lowest Soil Water Index indicator during the rainy season of the three studied regions.
- Northern highland of Guatemala had a low-level NDVI for May during the three years, impacting the coffee plantation flower blossom.
- Northern Guatemala Soil Water Index did not increase in June, July and August in 2018 and 2019 which could damage the coffee plantation health.
- In 2020 the three studied regions had an increase in Soil Water Index for May and June.

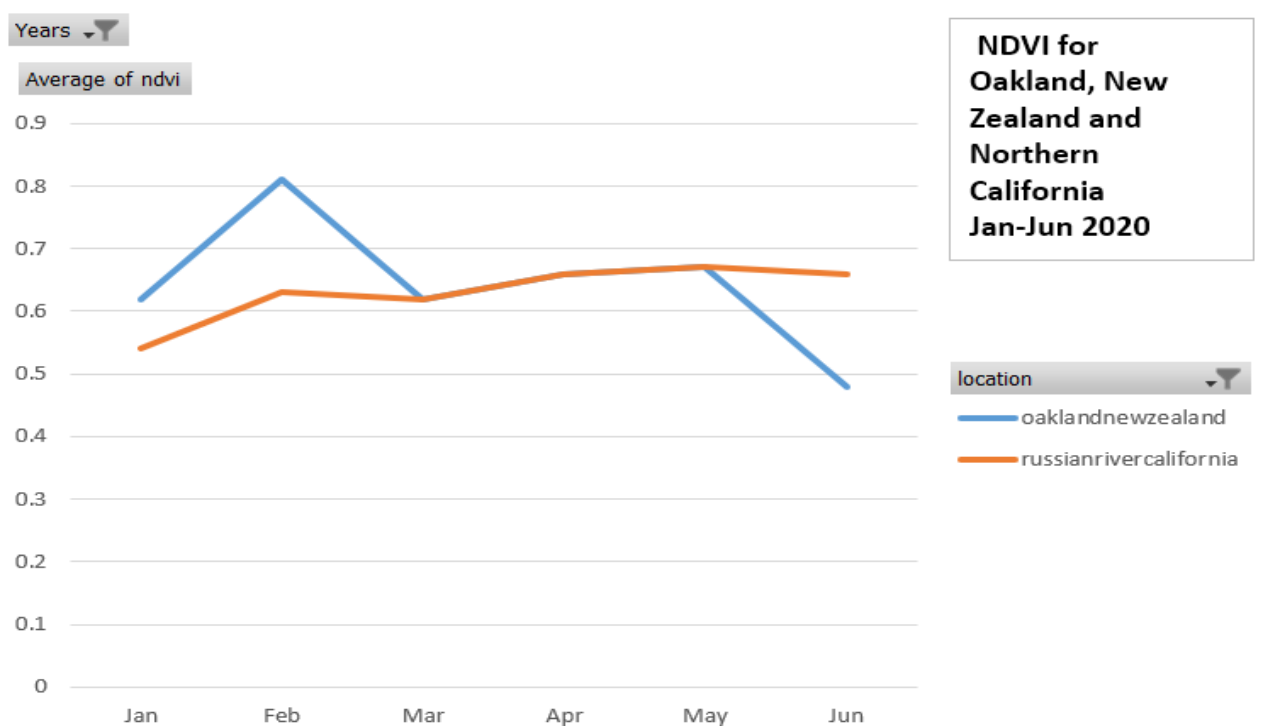
This Soil Water Index measurements show the irregular behavior of rainy seasons with the impact of a highly sensitive plantation like coffee.

Continuous surveillance of the coffee plantation regions with SWI could indicate if the rainy season is enough to keep the plantation health.

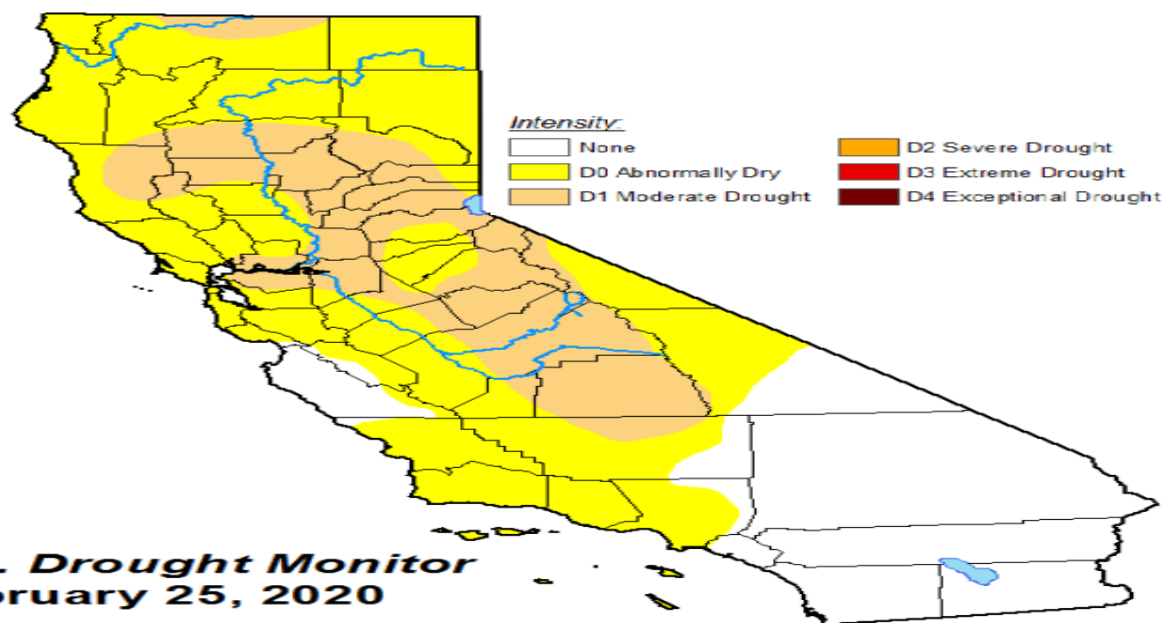


Three years (2018-2020) NDVI comparison for coffee plantation in Guatemala and Vietnam

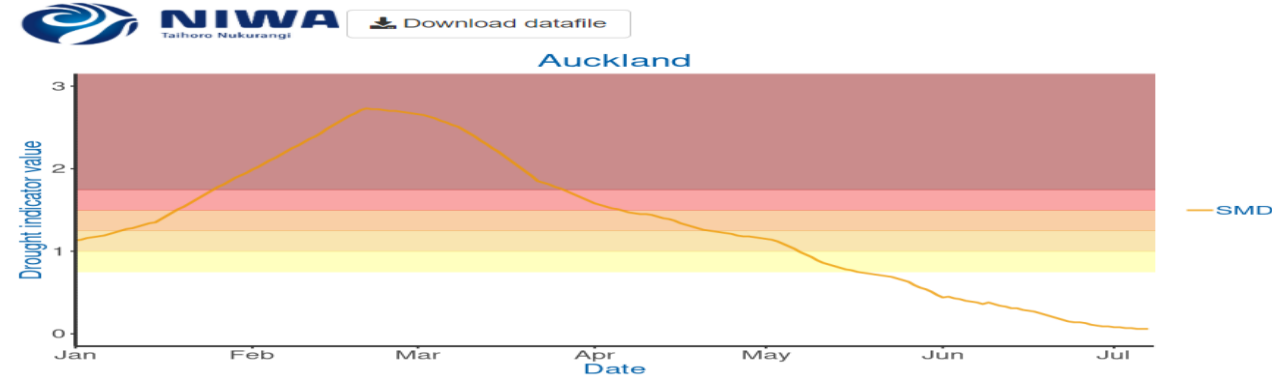
-Vietnam has the lowest NDVI indicator during the rainy season of the three studied regions. Even that Vietnam had a good Soil Water Index performance for these years. NDVI is an indicator of biodiversity and the health of the ecosystem. A very important factor for coffee plantations because they demand a rainy forest to deliver good crops.



California



**U.S. Drought Monitor
February 25, 2020**



Drought 2020 in New Zealand and Northern California

El Niño was neutral, there was an atypical form of El Niño called Modoki.

New Zealand drought monitor chart of Drought indicator value shows an increase during March 2020 while NDVI decreases.

The US drought monitor shows an abnormally dry for Northern California in February 2020. While, the NDVI for this region is low with 0.63 value. February is the middle of the rainy season in California. NDVI Northern Guatemala is 0.72 at the beginning of the rainy season of 2019, a low moisture year.

New Zealand drought monitor in 2020 "Auckland's drought most extreme in modern times" quotes: "Although the El Niño Southern Oscillation was neutral, there was a lean toward an atypical form of El Niño called Modoki. In this form of El Niño, ocean temperature anomalies are larger in the central tropical Pacific than the east, which has flow-on impacts on circulation patterns around the globe. This pattern has been present for the better part of the last two years. There are indications that Modoki events are increasing as part of the climate change signal.". Read the article here: <https://niwa.co.nz/news/aucklands-drought-most-extreme-in-modern-times>

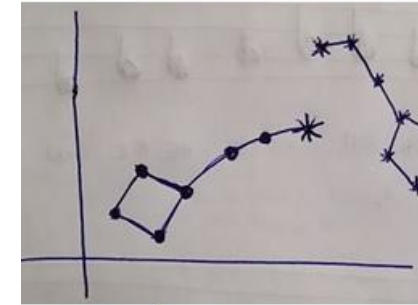
Conclusion:

This creates the need for continuous monitoring of all the regions impacted by El Niño because as we have seen before with the coffee plantations, the soil moisture will be irregular during the future years due the lack of steady rainy seasons. NDVI could be a good indicator of agricultural performance.

Appendix A

NDVI indicator for Guatemala and Vietnam coffee plantation regions for years 2018, 2019, and 2020.

Compare the NDVI levels with the soil moisture indicated by Soil Water Index



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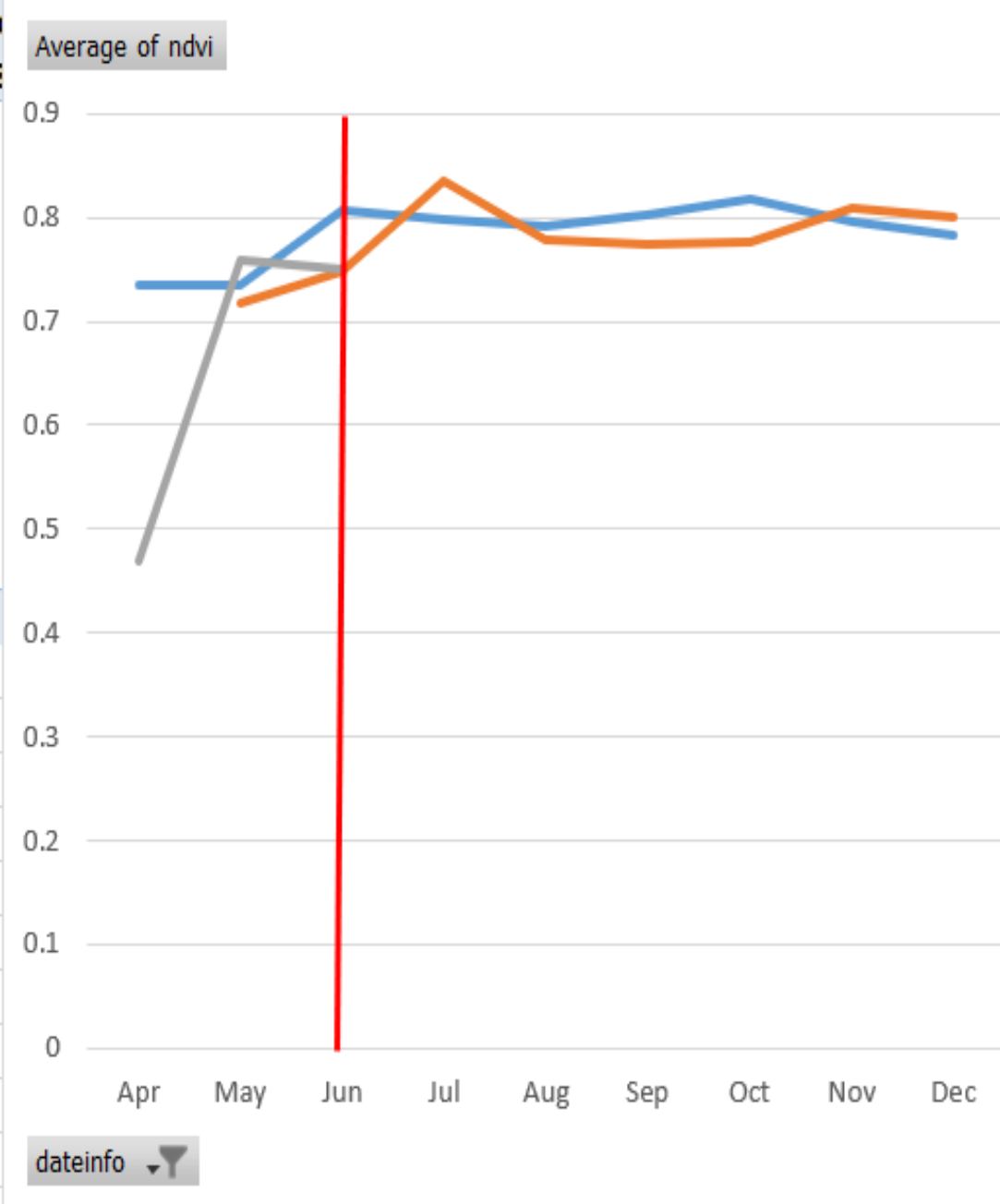
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Low May NDVI Northern Guatemala Years 2018 to 2020



Back to the crisis in 2018 on both sides of the Pacific Ocean.

Copernicus NDVI is also a biodiversity indicator. Coffee plantations require moisture and diverse plants and trees to keep the grain healthy and growing.

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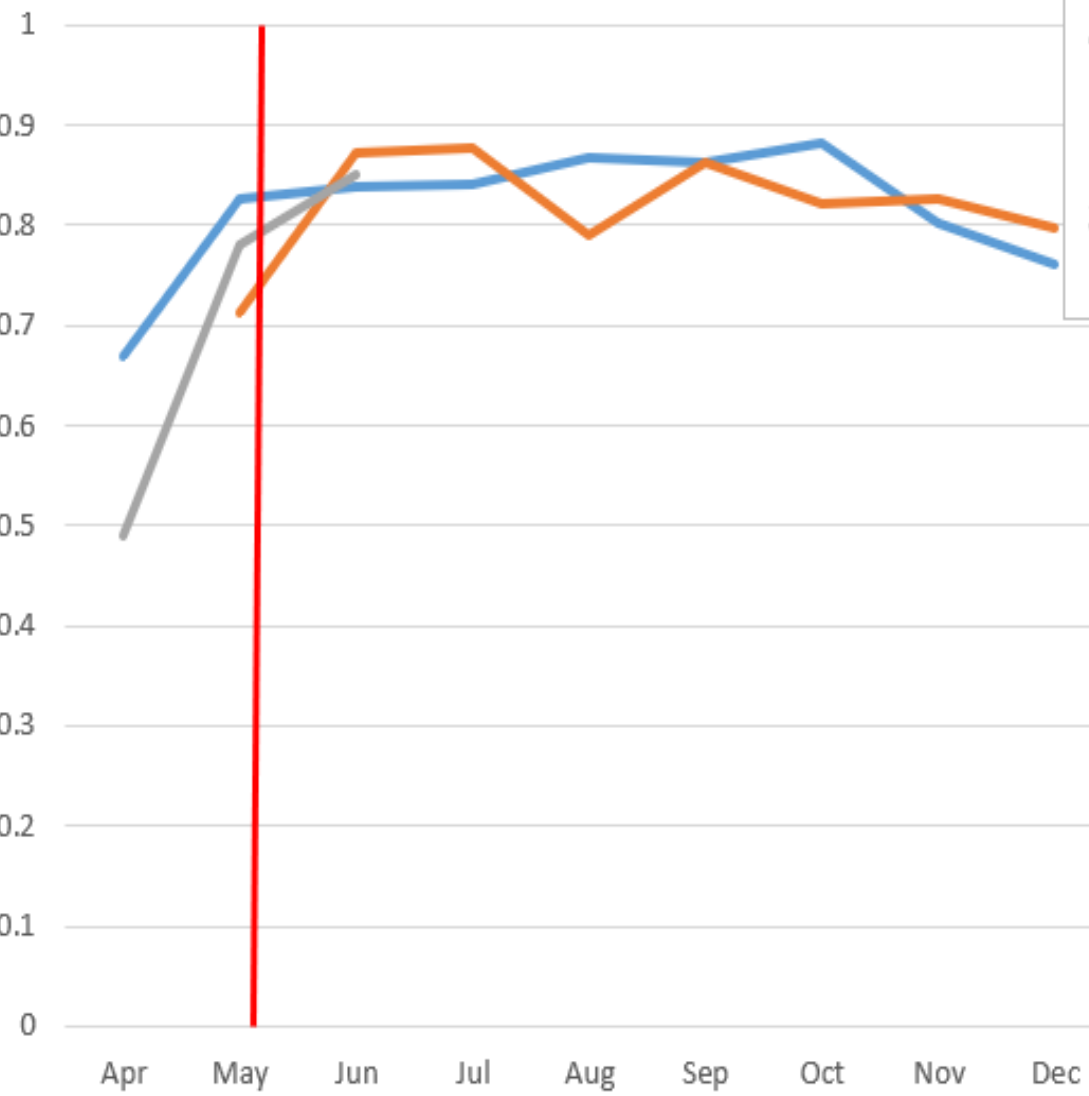
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Low NDVI for May 2018, 2019, 2020 in Northern Guatemala coffee plantation region

Average of ndvi



May NDVI increase during May in 2018 and 2020.
Low in May, 2019.
Southern Guatemala

location

Years

— southGuatemala - 2018

— southGuatemala - 2019

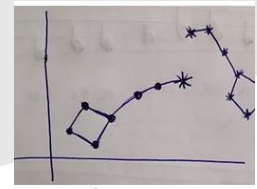
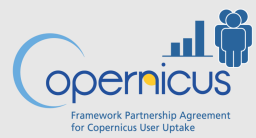
— southGuatemala - 2020



NDVI for the Southern Guatemala coffee plantation region.

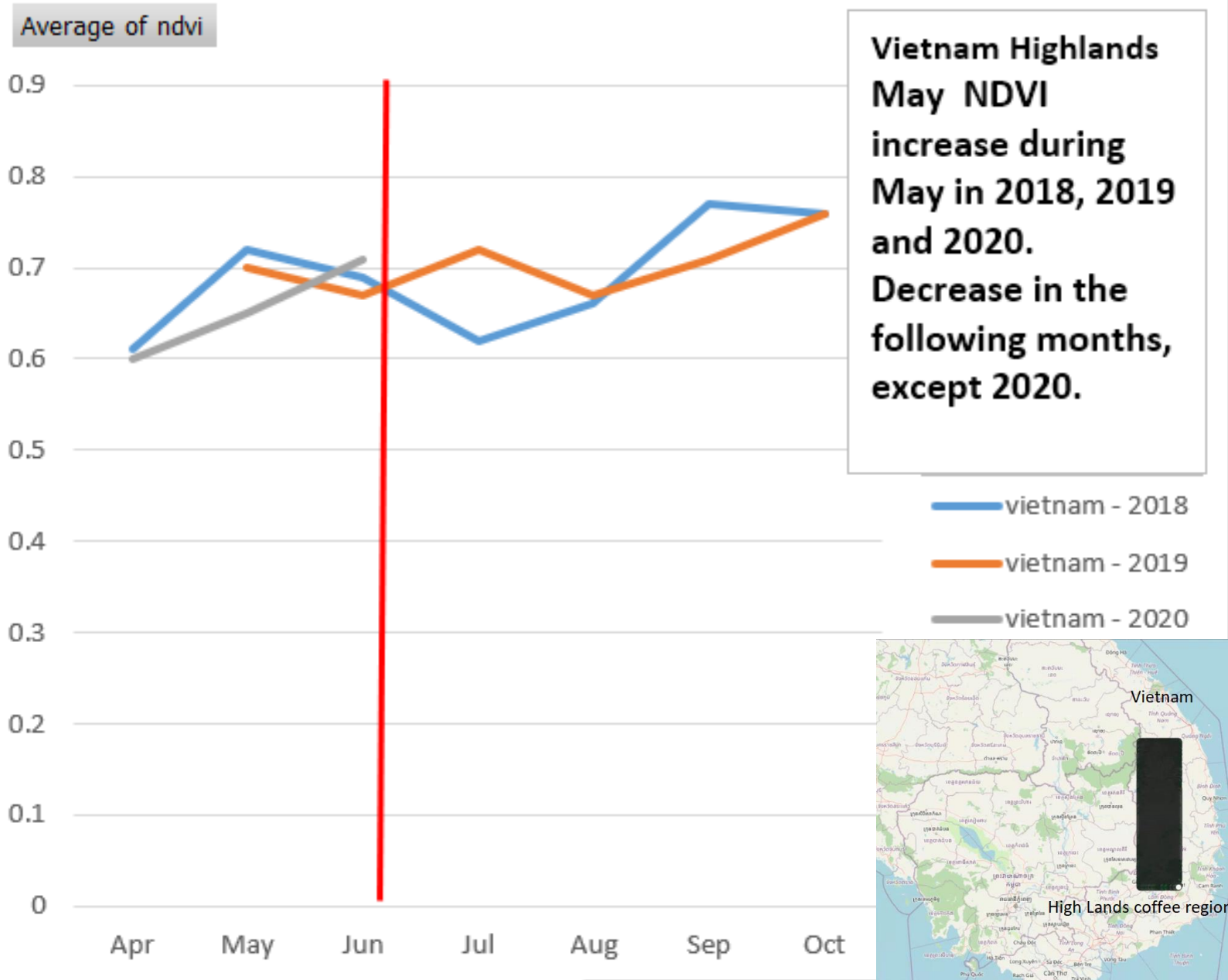
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