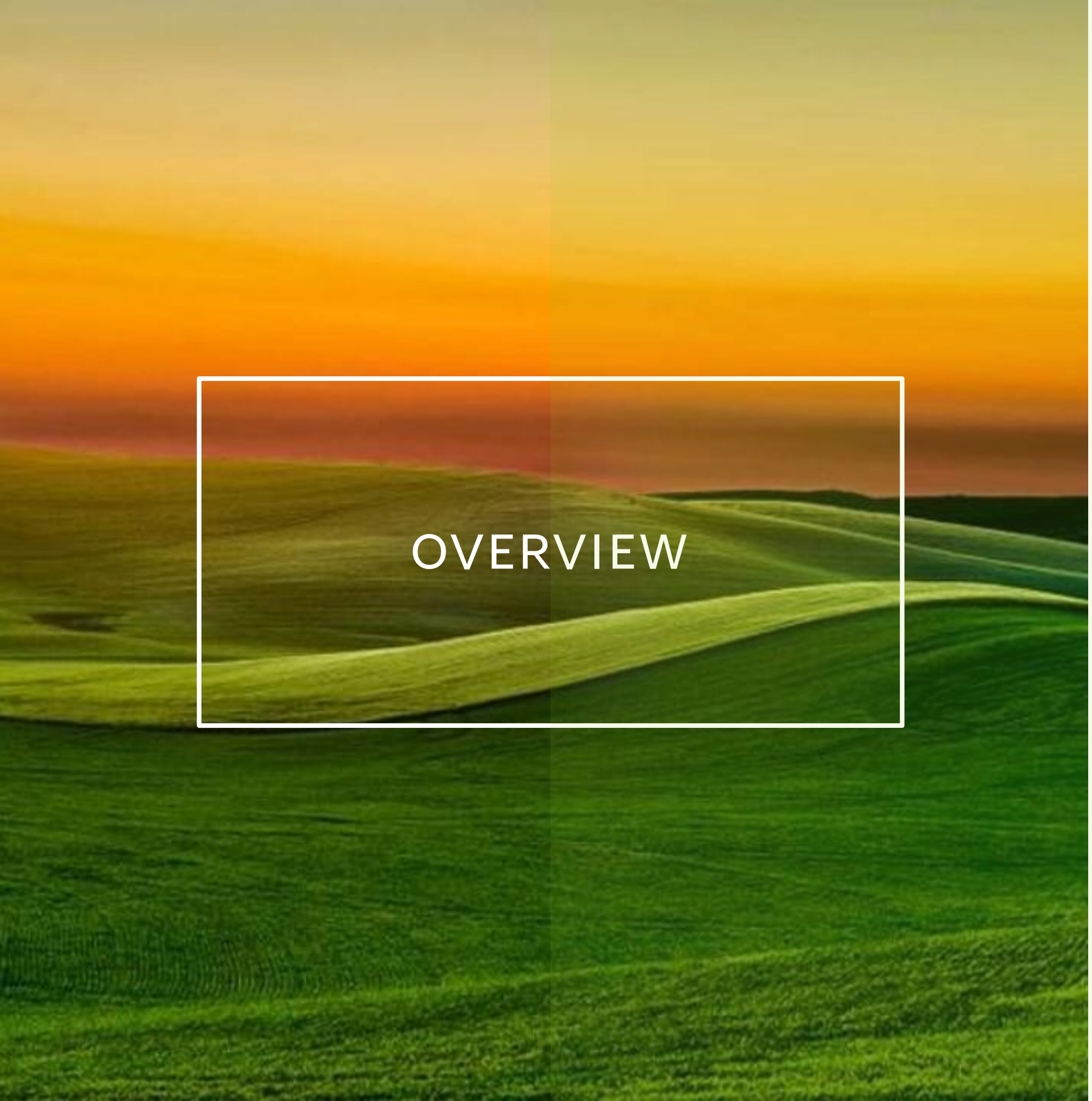
APPLIED CLIMATE SERVICES: MANAGING RISK FOR FOOD PRODUCTION, FIRE MITIGATION, AND ENERGY PRODUCTION IN GUATEMALA

BY DIEGO PONS, PH.D.



OVERVIEW

Case studies

Hydropower

Wildfires

Food Production

HYDROPOWER

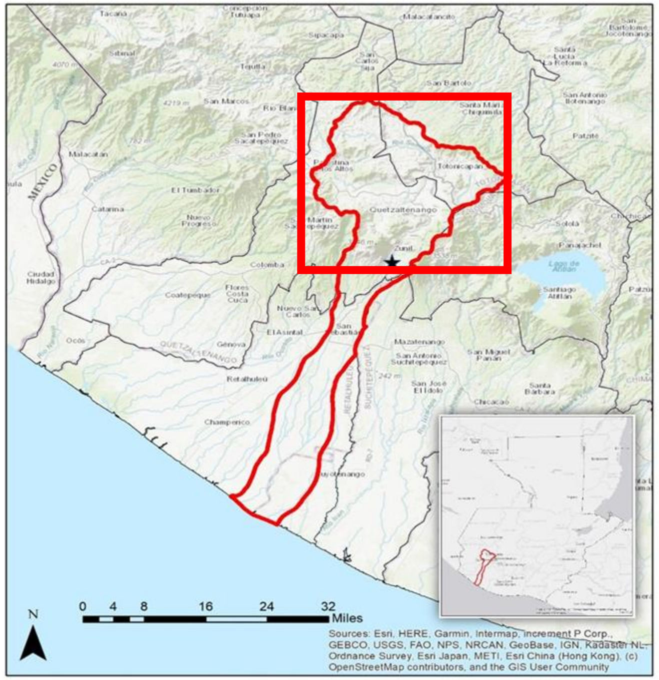
FORECASTING STREAMFLOW IN THE UPPER SAMALÁ RIVER WATERSHED

DIEGO PONS & ASHER SIEBERT

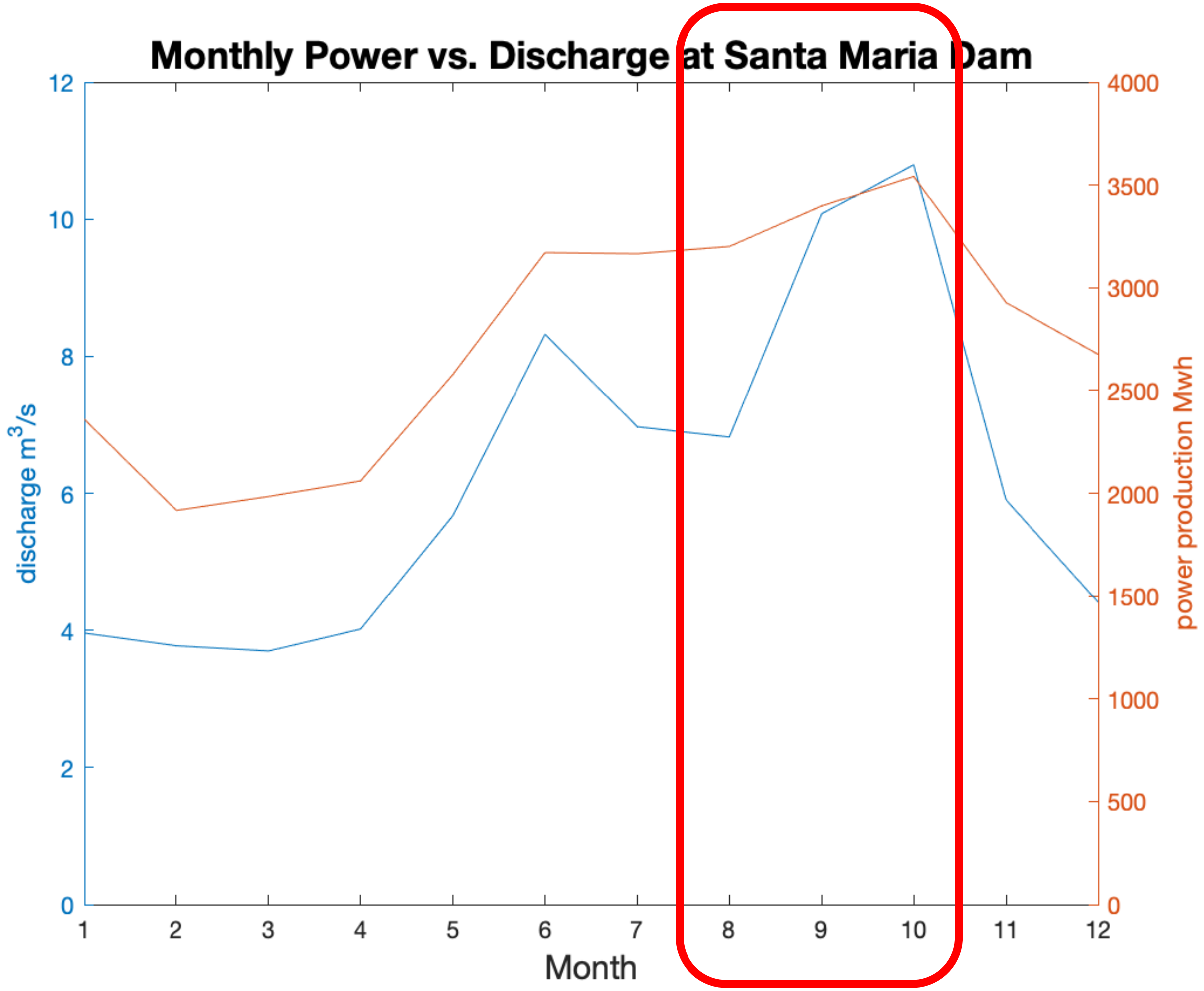
Available in: Safeguarding Mountain Social-Ecological Systems
A Global Challenge : Facing Emerging Risks, Adapting to Changing Environments and Building Transformative Resilience in Mountain Regions Worldwide. Vol 2.

SAMALÁ WATERSHED

Nested hydropower plants in Samalá



Hydropower plant	Installed Power Capacity in MW	Actual Power Production in MW	Elevation in m.a.s.l.
Santa Maria	6.88	4.1	(1,540.00 - 1,426.35)
El Canadá	48.1	47.2	(1,423.50 - 1,016.00)
Monte Cristo	13.5	13	(1,015.99 - 904.01)
El Recreo I	26	26.1	(904.00 - 700.00)
El Recreo II	24.4	24.4	(704.41 - 548.50)

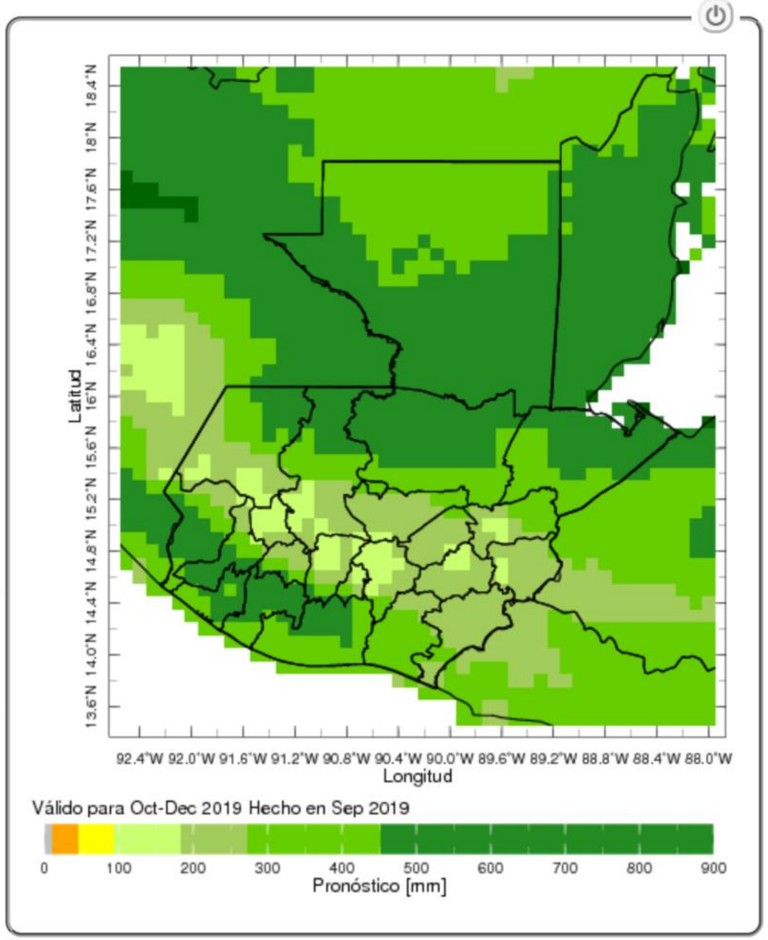


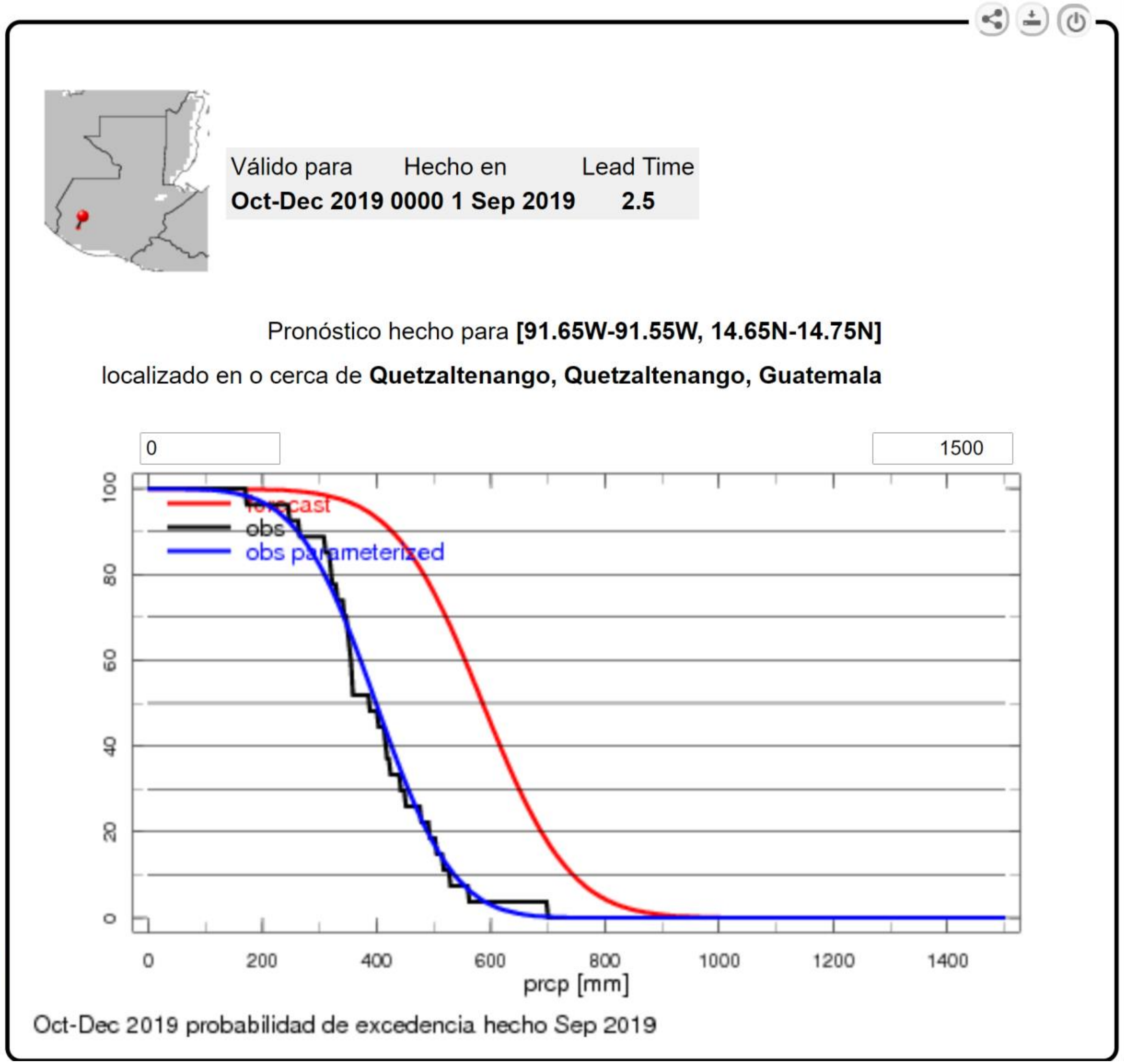
- What are the more critical months for energy production?
- Can we forecast those months and how far back can we do so?
- Is this of any use to decision-makers?

Pronóstico Estacional Flexible de Precipitación NextGen

Los pronósticos probabilísticos estacionales calibrados proporcionan información consistente con las observaciones, y útiles para la toma de decisiones climáticamente inteligentes.

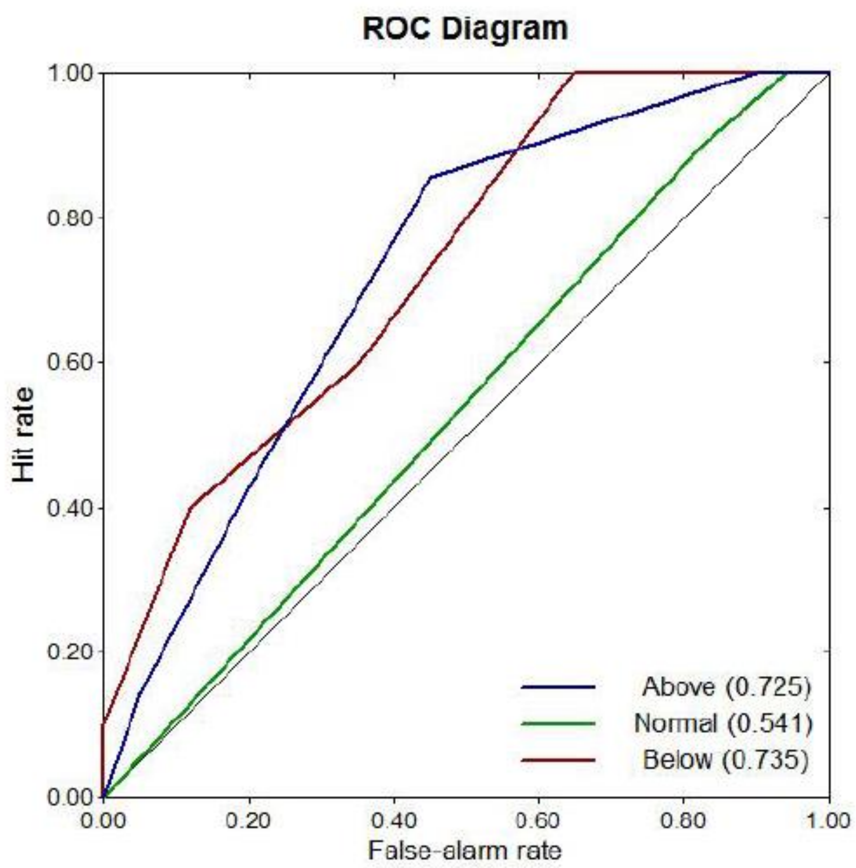
La flexibilidad de estos pronósticos consiste en el uso completo de la función de distribución de probabilidad, permitiendo ofrecer productos para la implementación de mejores servicios climáticos en Guatemala en lo referente a la gestión en materia de agricultura y seguridad alimentaria, agua, reducción del riesgo de desastres, salud y energía. El despliegue de mapas presentado a continuación muestra el pronóstico de precipitación estacional de una manera diferente a la que normalmente estamos acostumbrados a visualizar. El mapa predeterminado muestra, para el último pronóstico realizado, la cantidad total de precipitación estacional más probable para la próxima temporada y para el umbral seleccionado.

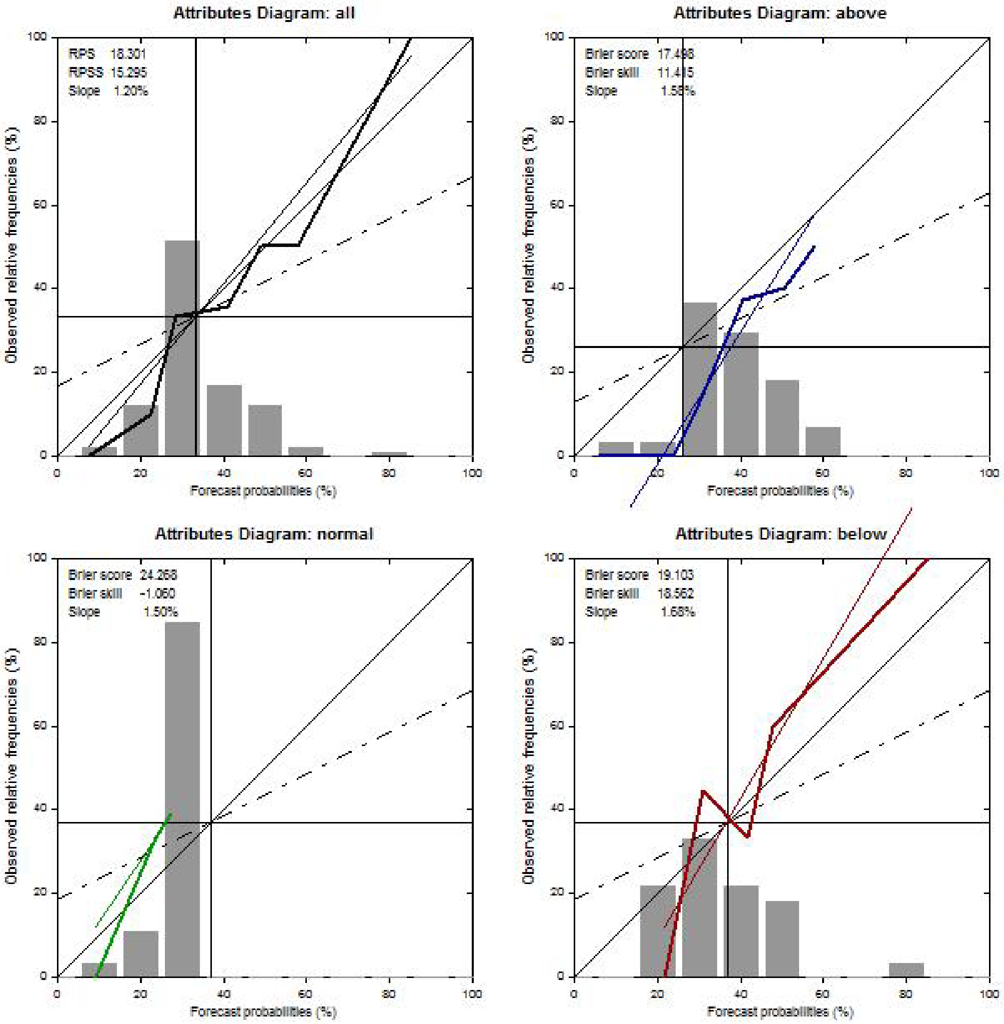




Source: INSIVUMEH

Seasonal Precipitation Forecast for Q estimates





Presentation to users resulted in the identification of actions at the power plant that can benefit the population in this mountains

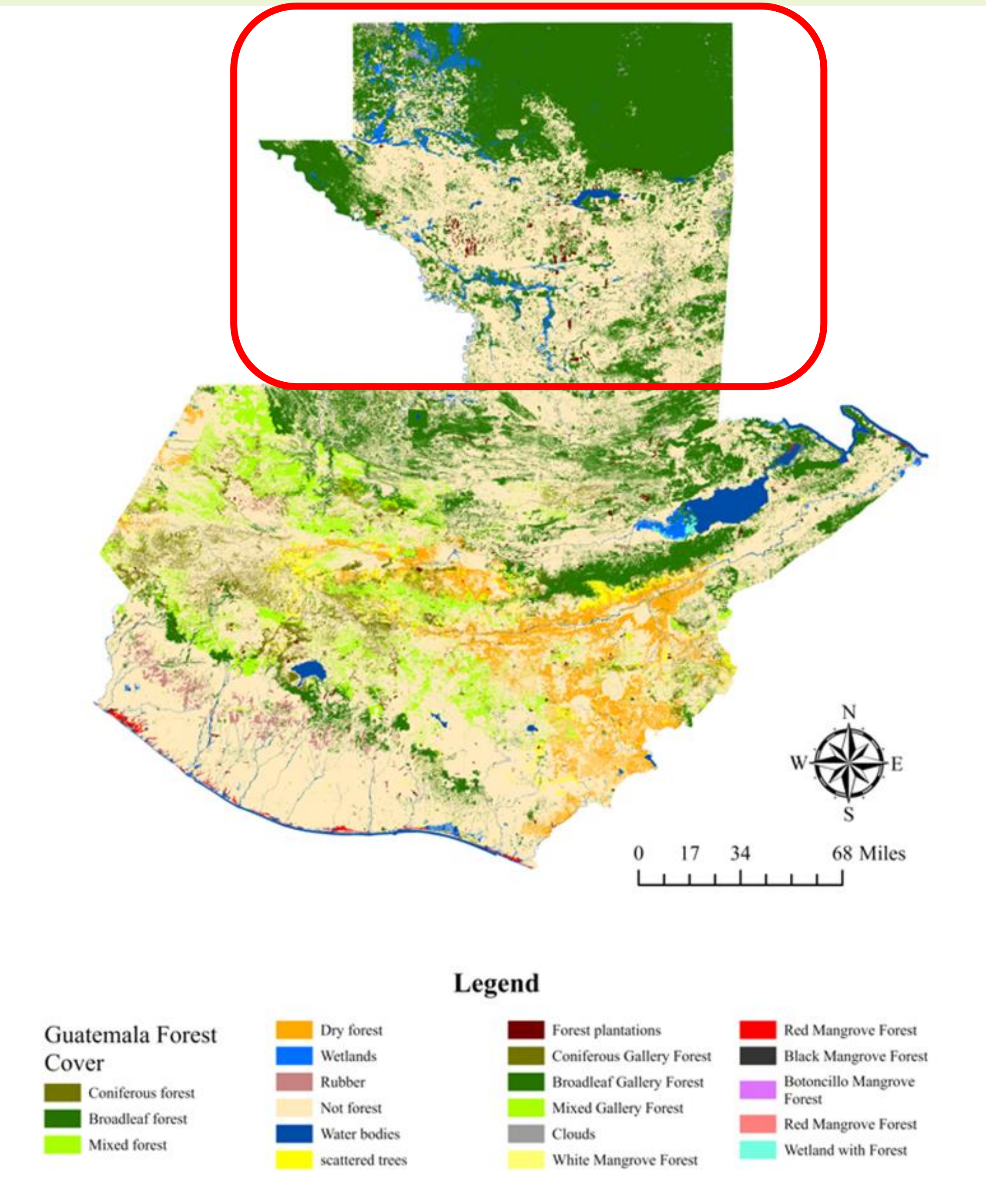
- Estimating seasonal discharge and production
- EWS for above average precipitation which triggers emergency procedures
- Usefulness of Flexible Format to inform these processes.

WILDFIRES

WILDFIRES AND PRECIPITATION IN THE LOWLANDS OF GUATEMALA

TANMOY MALAKER & DIEGO PONS

STUDY AREA



N
W
E
S
0 17 34 68 Miles
Legend
Guatemala Forest Cover
Coniferous forest
Broadleaf forest
Mixed forest
Dry forest
Wetlands
Rubber
Not forest
Water bodies
scattered trees
Forest plantations
Coniferous Gallery Forest
Broadleaf Gallery Forest
Mixed Gallery Forest
Clouds
White Mangrove Forest
Red Mangrove Forest
Black Mangrove Forest
Botoncillo Mangrove Forest
Red Mangrove Forest
Wetland with Forest

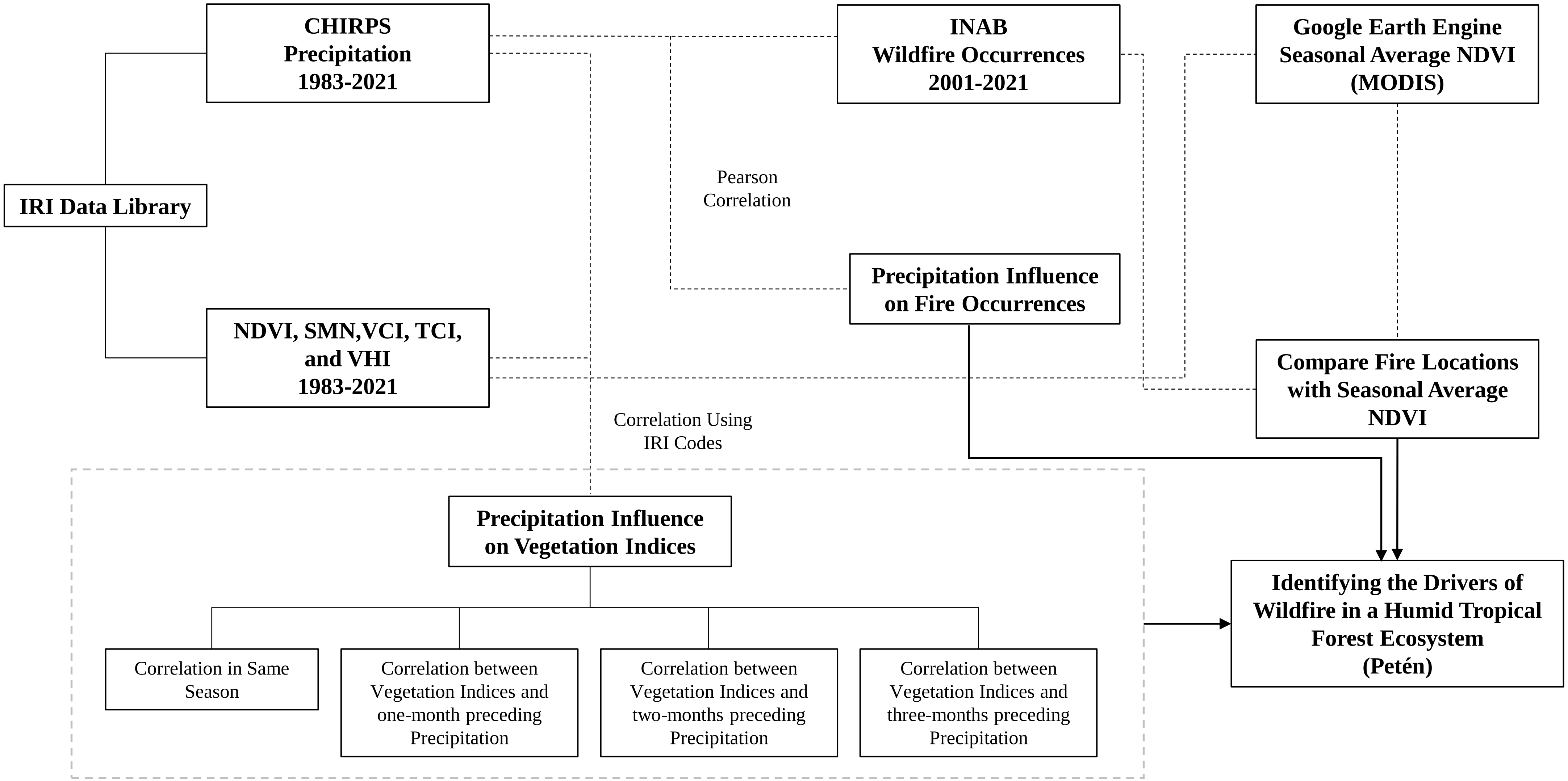
Fire history

- The data on fire occurrences in Petén from 2001 to 2021 (INAB, 2022) show a significant concentration in March-April-May (Fire season). About 95.30 percent of the fire occurrence has occurred in the Fire Season (March-April-May).
- The table also shows how the fire occurrence seasons have spread in recent years, where the fire incidents occur in months or seasons that have not experienced any fire in the last 15-20 years.
- The table includes only the wildfires.

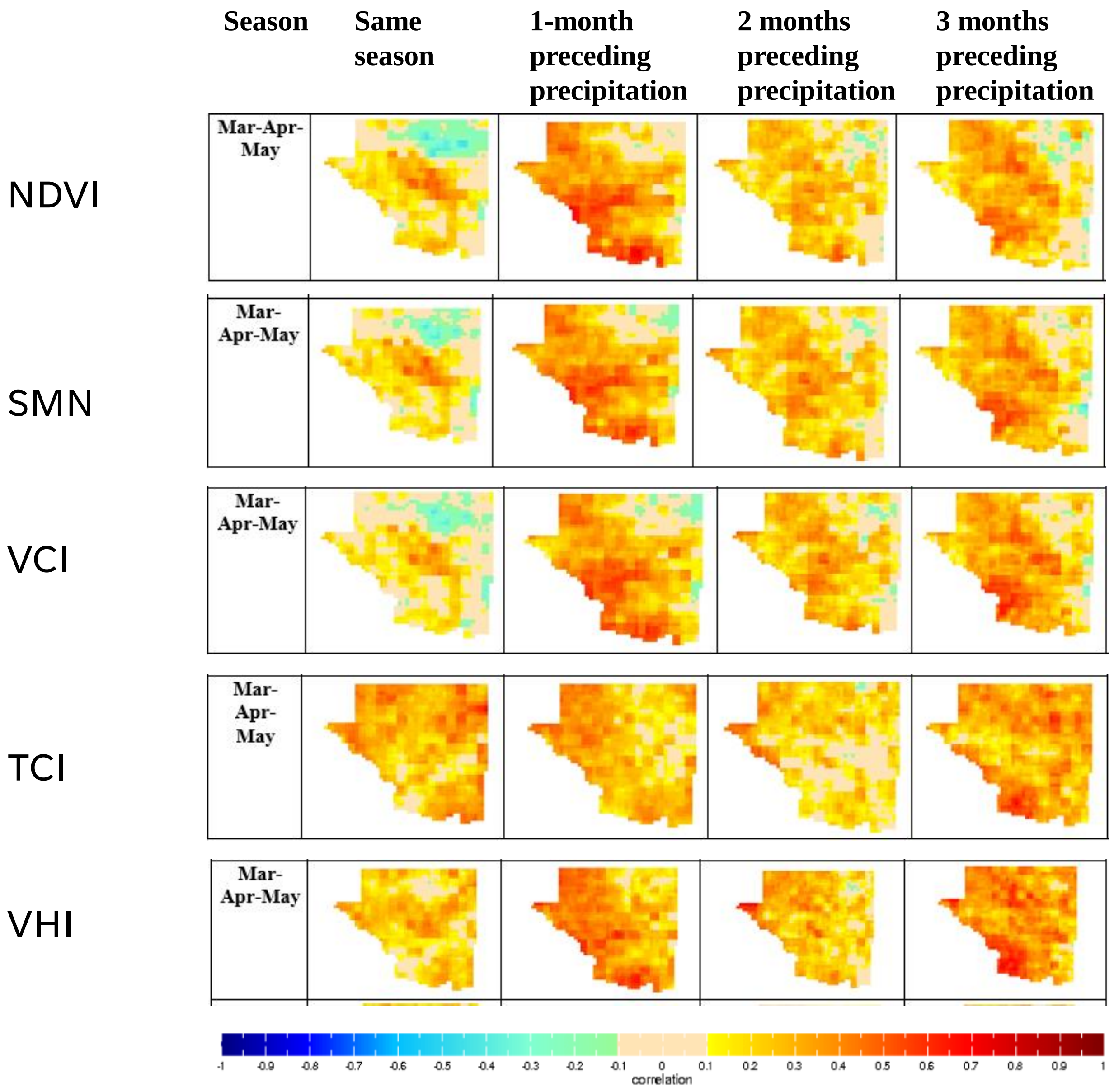
Monthly fire occurrences in Petén from 2001 to2021

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001			2	9	2							
2002				14	21							
2003		5	71	5	42							
2004				3								
2005	1		29	24	3	1						
2006			1	8	13							
2007			1	25	43							
2008				5	12							
2009	3	2	11	47	11							
2010	2		15	12		1						
2011		1	9	41	26	2						
2012		1	5	22	34							
2013				14	5							
2014			5	21								
2015				10				1				
2016		2	5	52	70	5						
2017		3	16	84	4							
2018	1	2	6	9	6							
2019		1	16	30	29							
2020	2	3									1	1
2021		1	4	13	9	3	1	1		1		

Analysis

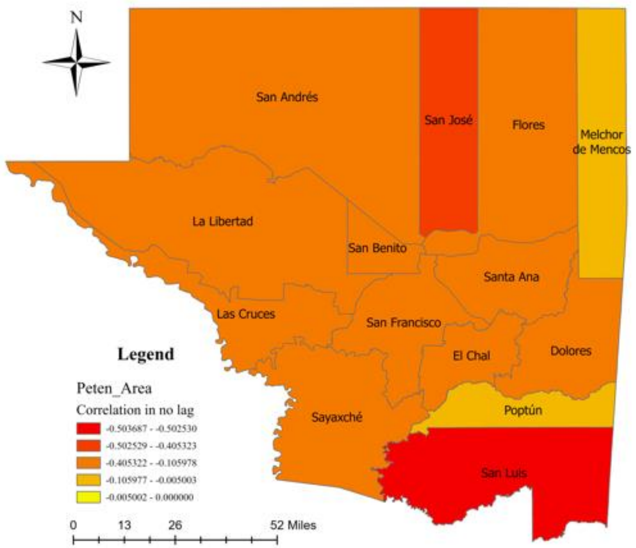

CHIRPS
Precipitation
1983-2021
INAB
Wildfire Occurrences
2001-2021
Google Earth Engine
Seasonal Average NDVI
(MODIS)
IRI Data Library
Pearson
Correlation
Precipitation Influence
on Fire Occurrences
NDVI, SMN,VCI, TCI,
and VHI
1983-2021
Compare Fire Locations
with Seasonal Average
NDVI
Correlation Using
IRI Codes
Precipitation Influence
on Vegetation Indices
Identifying the Drivers of
Wildfire in a Humid Tropical
Forest Ecosystem
(Petén)
Correlation in Same
Season
Correlation between
Vegetation Indices and
one-month preceding
Precipitation
Correlation between
Vegetation Indices and
two-months preceding
Precipitation
Correlation between
Vegetation Indices and
three-months preceding
Precipitation

The figures show the correlation between precipitation and NDVI, SMN, VCI, TCI and VHI from 1983 to 2021 in Petén. The scale below the table represents the level of correlation between the indices and Precipitation.

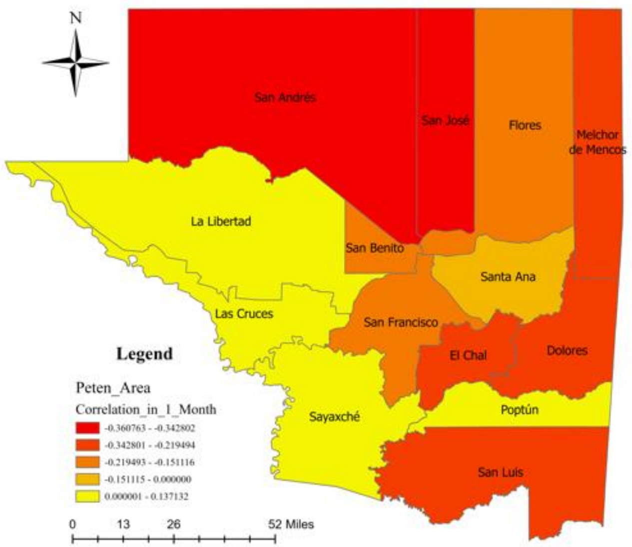


Fire Occurrence and Seasonal Accumulative Precipitation

The maps represent the correlation between Fire Occurrences and Seasonal Accumulative Precipitation from same season (lag-0) to 3 months of preceding seasonal precipitation of the fire season.



A



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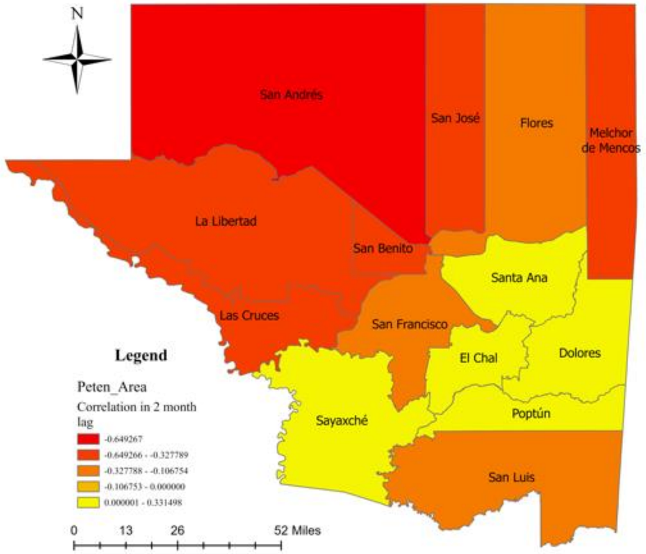

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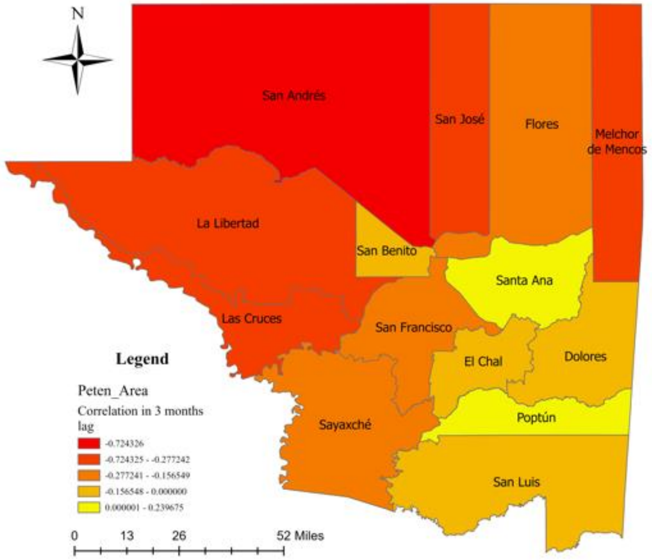


D

Fire Occurrences and Seasonal Accumulative Precipitation A-D (0 to 3 moths of preceding precipitation Consecutively).

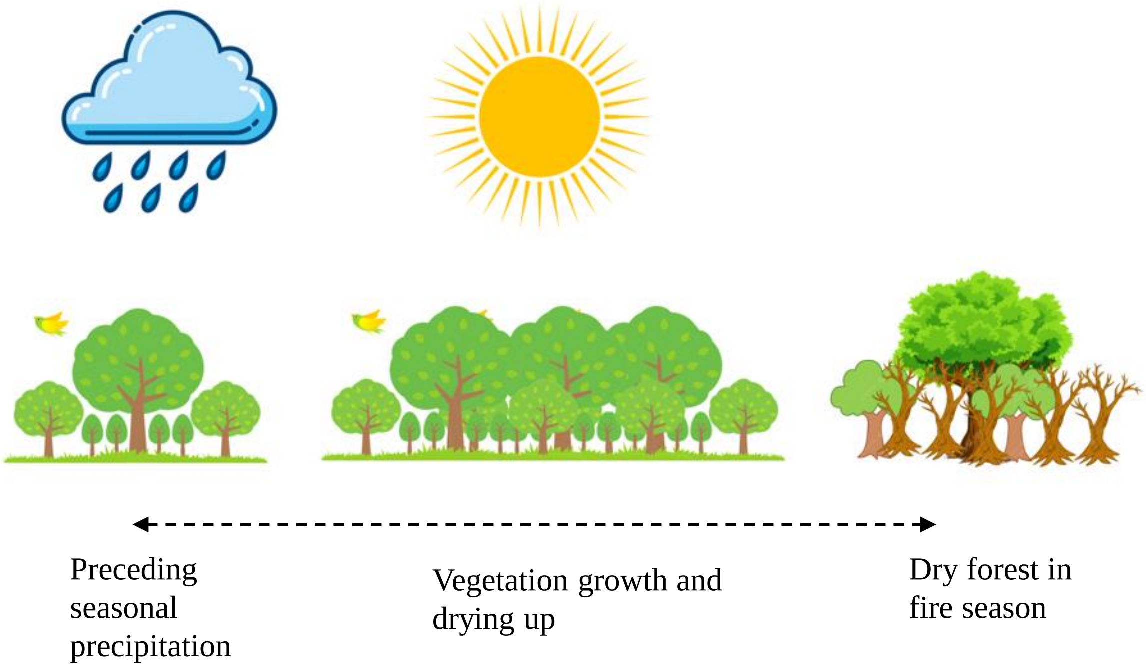
Fire Occurrences and Precipitation

The analyses indicate that precipitation may play a crucial role in the occurrence of forest fires in Peten.

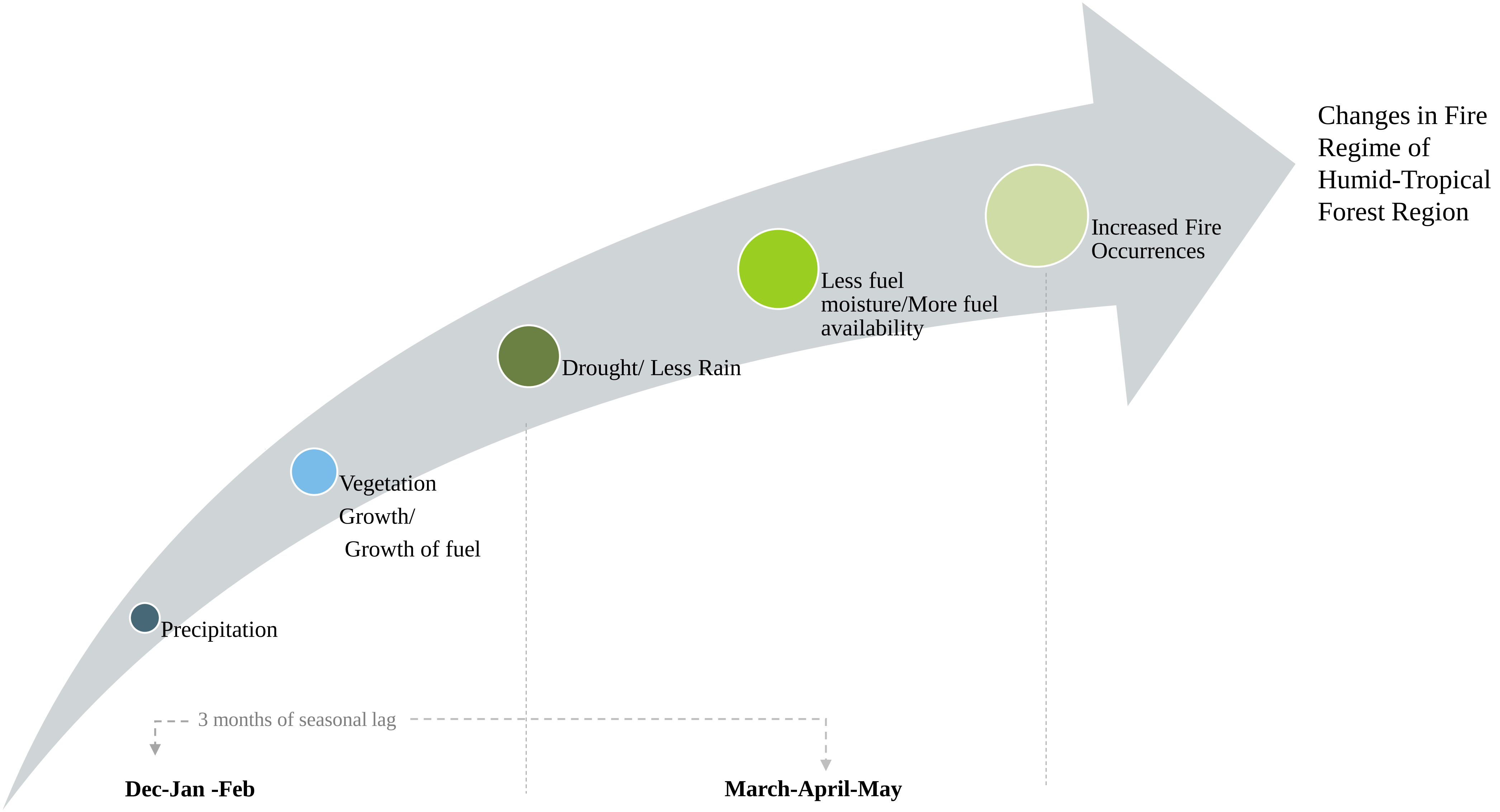
While increased precipitation during the same season decreases the frequency of fires, precipitation in preceding seasons appears to have a positive impact on fire occurrence.

This could be attributed to the growth of vegetation resulting from previous seasonal precipitation.

Additionally, the dry period between precipitation and fire seasons may contribute to drying out the vegetation, making it susceptible to ignition.



Conclusion

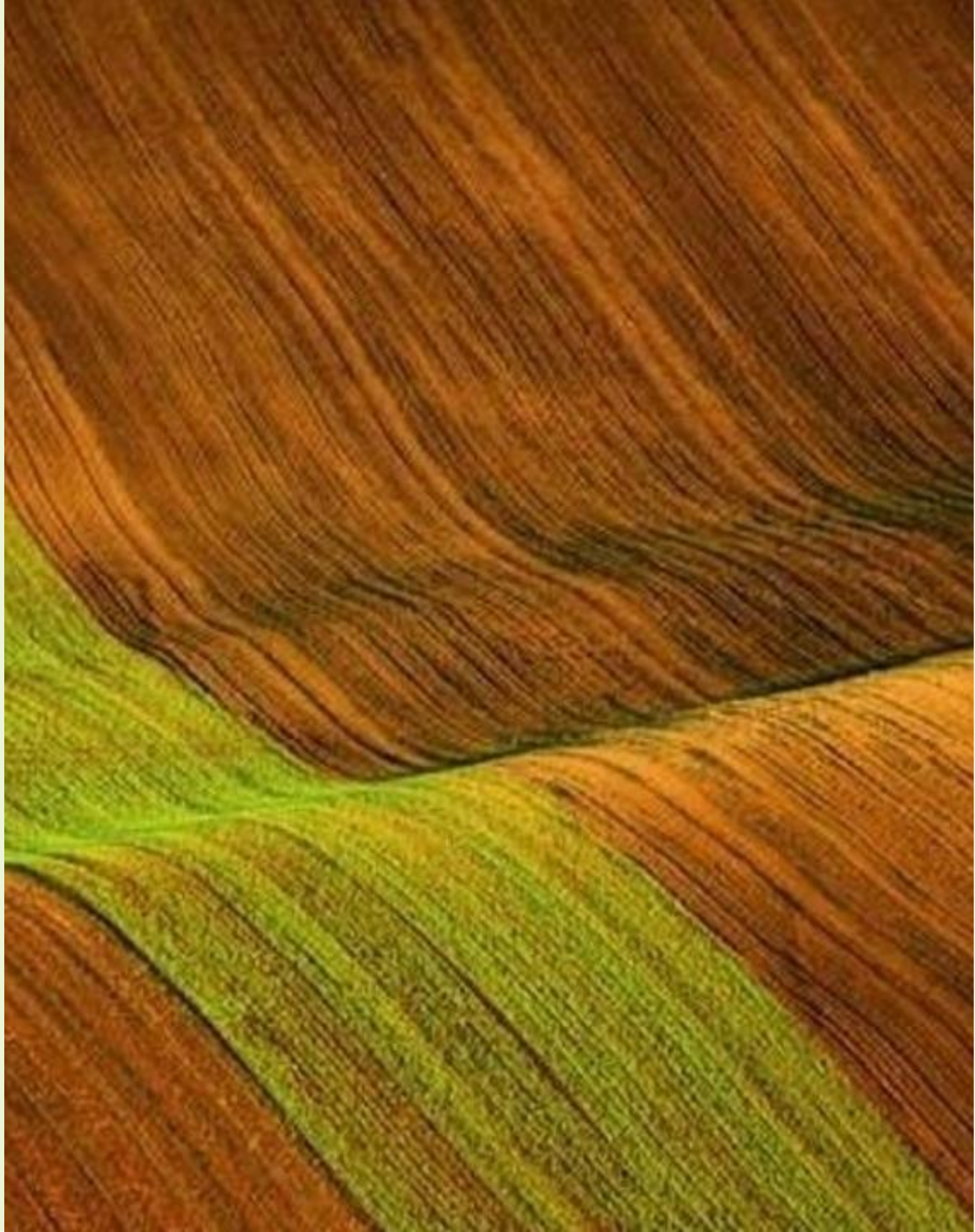


Changes in Fire Regime of Humid-Tropical Forest Region
Increased Fire Occurrences
Less fuel moisture/More fuel availability
Drought/ Less Rain
Vegetation Growth/ Growth of fuel
Precipitation
3 months of seasonal lag
Dec-Jan -Feb
March-April-May

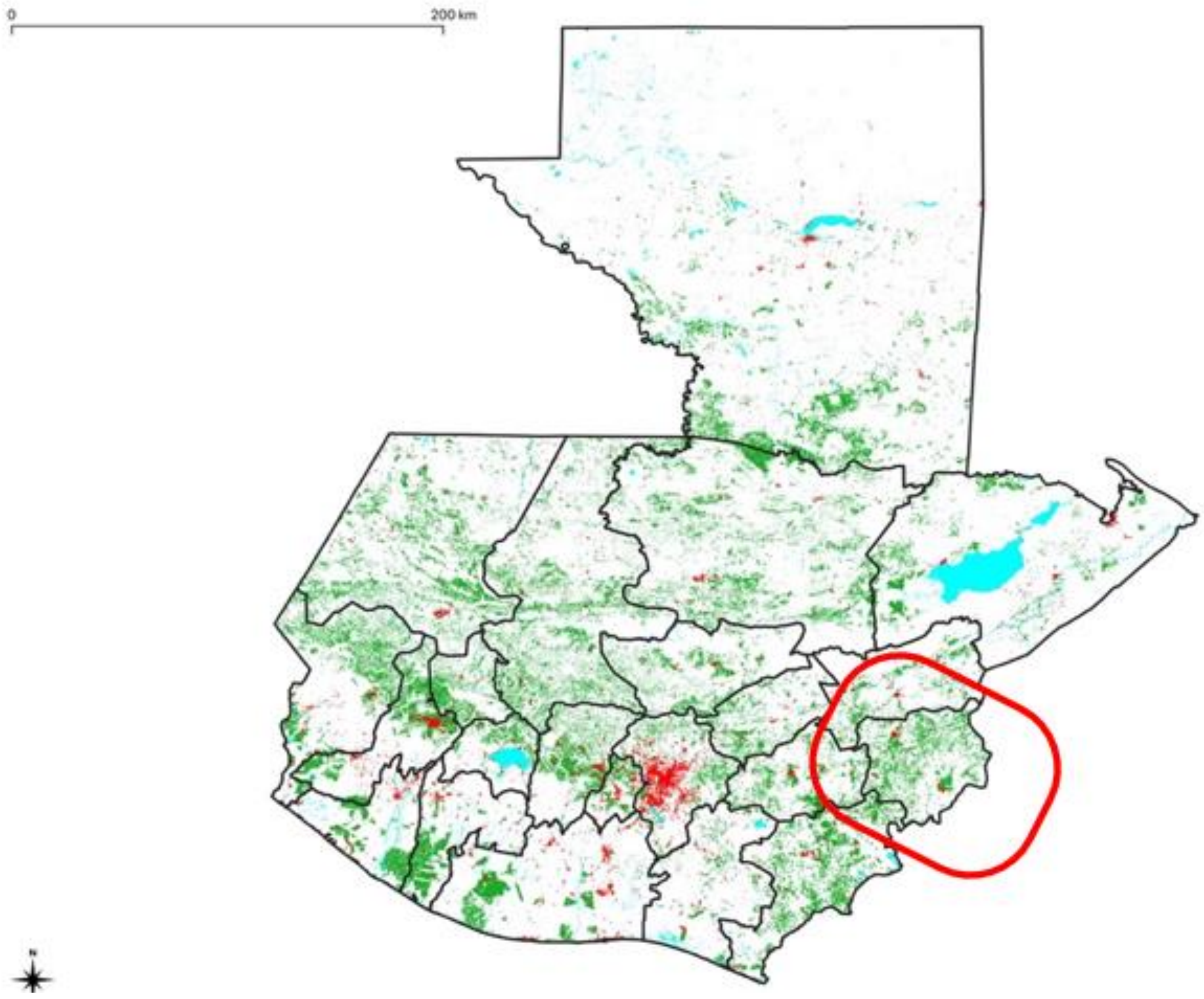
FOOD PRODUCTION

WFP ANTICIPATORY ACTIONS IN GUATEMALA'S DRY CORRIDOR

DIEGO PONS

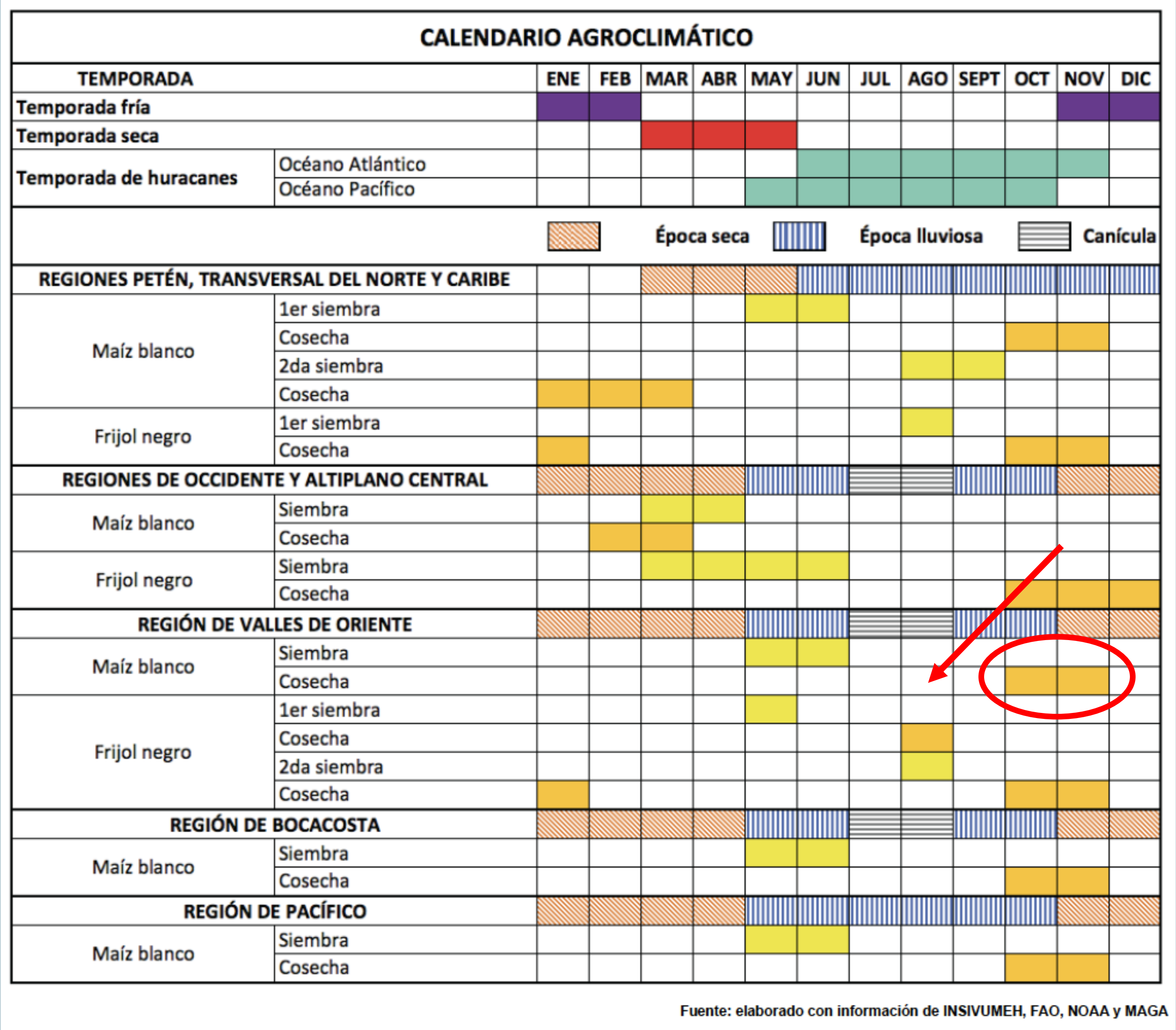


STUDY AREA



VALIDATING PHENOLOGICAL STAGES FOR MAIZE

This is the most critical step in a data-depleted context for assessing the usability of satellite-derived vegetation indices as proxies for Maize production.



Total loss of VT-R1 stage (corn filling)

Source: WFP 2019

MAIZE PRODUCTION AT THE DEPARTMENT LEVEL IN GUATEMALA

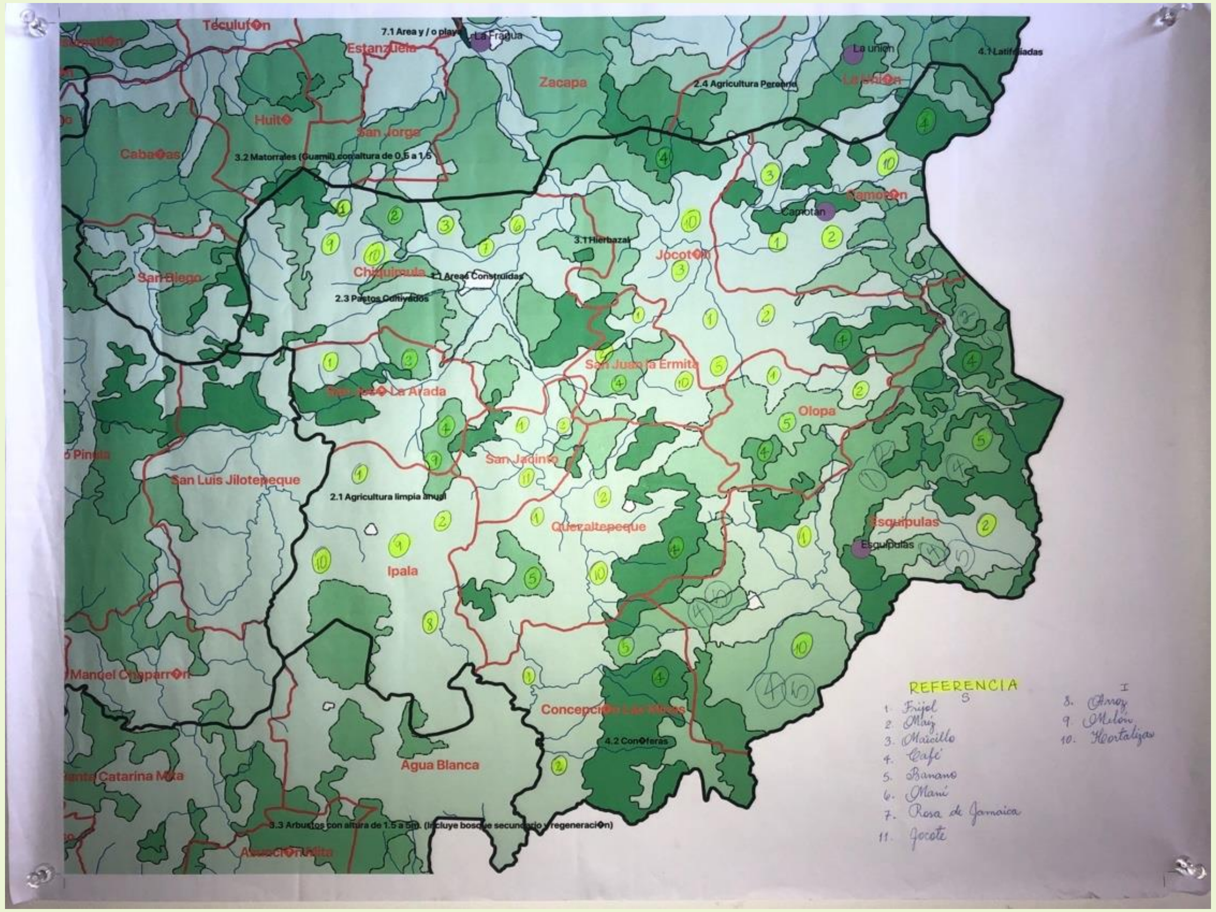
Producción nacional de la cosecha 2016-2017

Producción de maíz blanco (quintales)					
No.	**Departamento**	**1ª. Cosecha**	**2ª. Cosecha**	**Total**	**Porcentaje**
1	Guatemala	461,443	332,279	793,722	2.1
2	El Progreso	233,239	167,953	401,192	1.1
3	Sacatepéquez	140,051	100,848	240,899	0.6
4	Chimaltenango	805,273	579,866	1,385,139	3.7
5	Escuintla	940,189	677,017	1,617,206	4.3
6	Santa Rosa	1,171,158	843,335	2,014,493	5.3
7	Sololá	268,878	193,615	462,493	1.2
8	Totonicapán	298,643	215,048	513,691	1.4
9	Quetzaltenango	697,796	502,473	1,200,269	3.2
10	Suchitepéquez	848,700	611,137	1,459,837	3.9
11	Retalhuleu	1,213,562	873,869	2,087,431	5.5
12	San Marcos	957,345	689,371	1,646,716	4.4
13	Huehuetenango	994,804	716,345	1,711,149	4.5
14	Quiché	1,265,624	911,358	2,176,982	5.8
15	Baja Verapaz	449,310	323,542	772,852	2.1
16	Alta Verapaz	2,295,226	1,652,760	3,947,986	10.5
17	Petén	4,502,729	3,242,352	7,745,081	20.6
18	Izabal	804,995	579,666	1,384,661	3.7
19	Zacapa	401,849	289,366	691,215	1.8
20	Chiquimula	724,797	521,916	1,246,713	3.3
21	Jalapa	657,003	473,098	1,130,101	3.0
22	Jutiapa	1,776,476	1,279,216	3,055,692	8.1
Total República		**21,909,090**	**15,776,430**	**37,685,520**	**100**
Porcentaje sobre la producción nacional		**58.14**	**41.86**		
Perdida aproximada de la primera (qq)		**6,707,279**			
Porcentaje de pérdida sobre la producción de la primera cosecha		**30.61**			
Porcentaje de pérdida sobre la producción nacional				**17.80**	

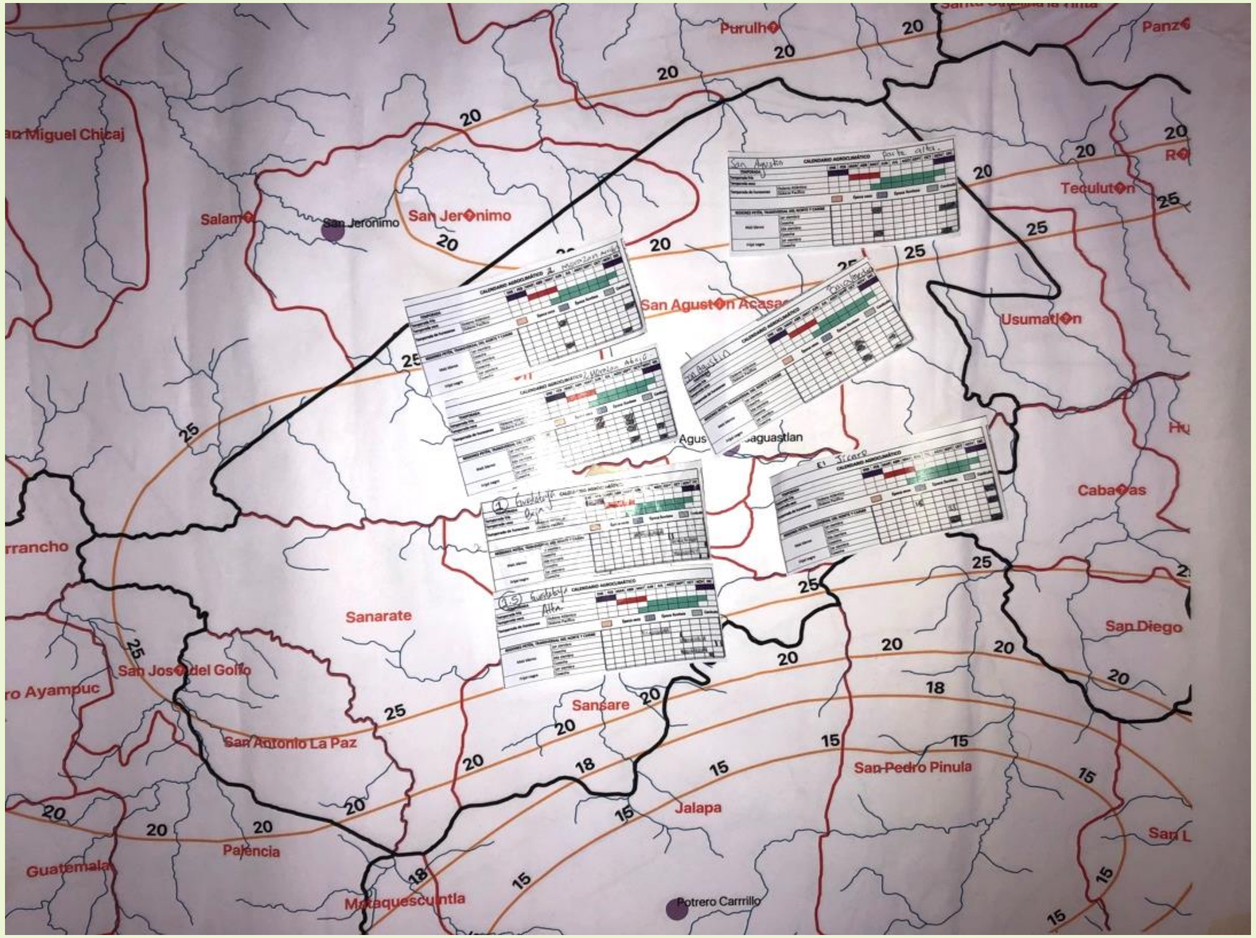
Fuente: Informe de situación del maíz blanco, septiembre de 2017. DIPLAN/MAGA

IDENTIFICATION OF STAPLE AND CASH CROPS IN EL CHIQUIMULA

IDENTIFICATION OF STAPLE AND CASH CROPS IN CHIQUIMULA



IDENTIFICATION OF AGROCLIMATIC CALENDARS



DETERMINING HYDROLOGICAL DEMAND OF MAIZE

Only once the agricultural calendar is fully understood then hydrological demand can be assessed and the proper season for forecasting established.

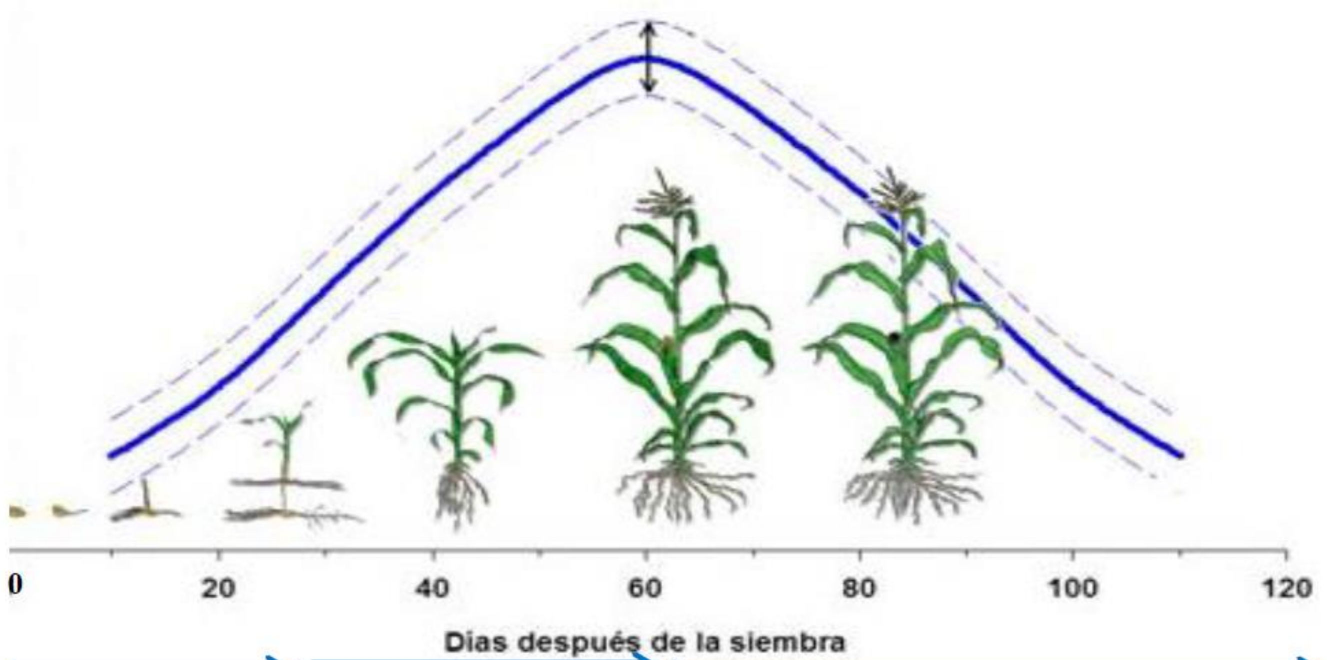
Chronological stages of Maize and their respective minimum water requirements. Modified from Yonts, C.D. et al., 2008 for 112 days maturity corn. Sowing date derived from participatory processes in each of the departments in the eastern dry corridor of Guatemala, namely: El Progreso, Zacapa, and Chiquimula.

Phenological Stage	DAS*	Calendar date (2020)	mm/ day	Total days	Total water demand in mm
VE	5	May 20th	2.032	5	10.16
V4	9	May 24th	2.54	4	10.16
V8	12	May 27th	4.572	3	13.716
VT	55	July 9th	6.604	43	283.972
R1	59	July 13th	8.128	4	32.512
R2	71	July 25th	8.128	12	97.536
R3	80	August 3th	8.128	9	73.152
R4	90	August 13th	6.096	10	60.96
R5	102	August 25th	5.08	12	60.96
R6	112	September 4th	2.54	10	25.4
Total			**53.848**	**112**	**668.528**

Monthly water demand as a percentage of total requirements for 112 days maturity corn.

Month	Total water demand as a percentage of total
May	6.5
June	29.7
July	28.4
August	33.8
September	1.5
Total	**100.0**

IDENTIFYING POTENTIAL EFFECTS OF PRECIPITATION DEFICITS ON MAIZE IN THE DRY CORRIDOR AREA OF GUATEMALA



	25 de mayo -21 de junio	22 de junio -21de julio	22 de julio- -21 de septiembre
	Fase Vegetativa 0-- 28 días	Fase Pre y Floración 29 - 60 días	Fase Reproductiva 61 -120 días
Requerimiento de agua	300 mm	200 mm	200 mm
% de pérdida si el cultivo no cuenta con el agua requerida	25% pérdida	50% pérdida	25% pérdida

Gustavo García/FAO/2018 ICTA B7

Drying Maize in V4 stage in Guatemala's dry corridor area.

Maize in healthy V6 stage in Guatemala's dry corridor area.

Source: WFP 2019

Dried Maize in VT-R1 phenological stage in Azacualpa Village, Chiquimula

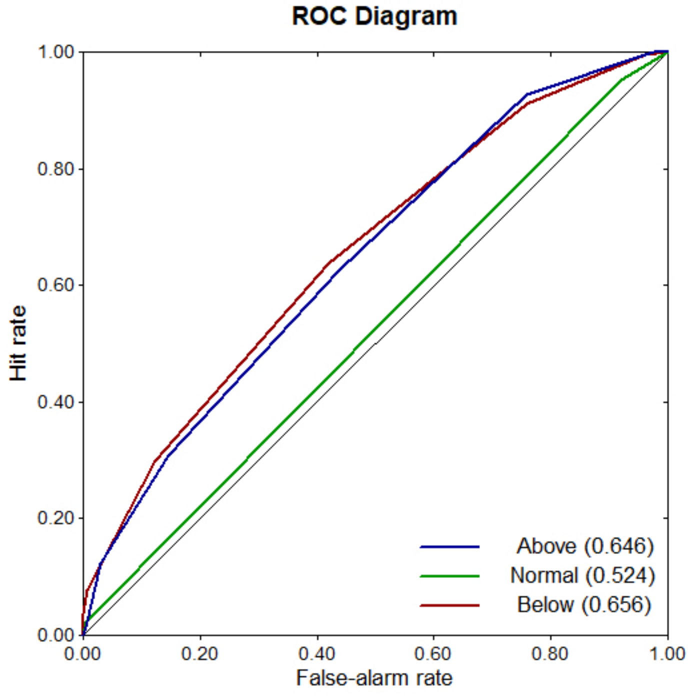
Total loss of R1 stage (corn filling) in El obreaje village in Ipala, Chiquimula.

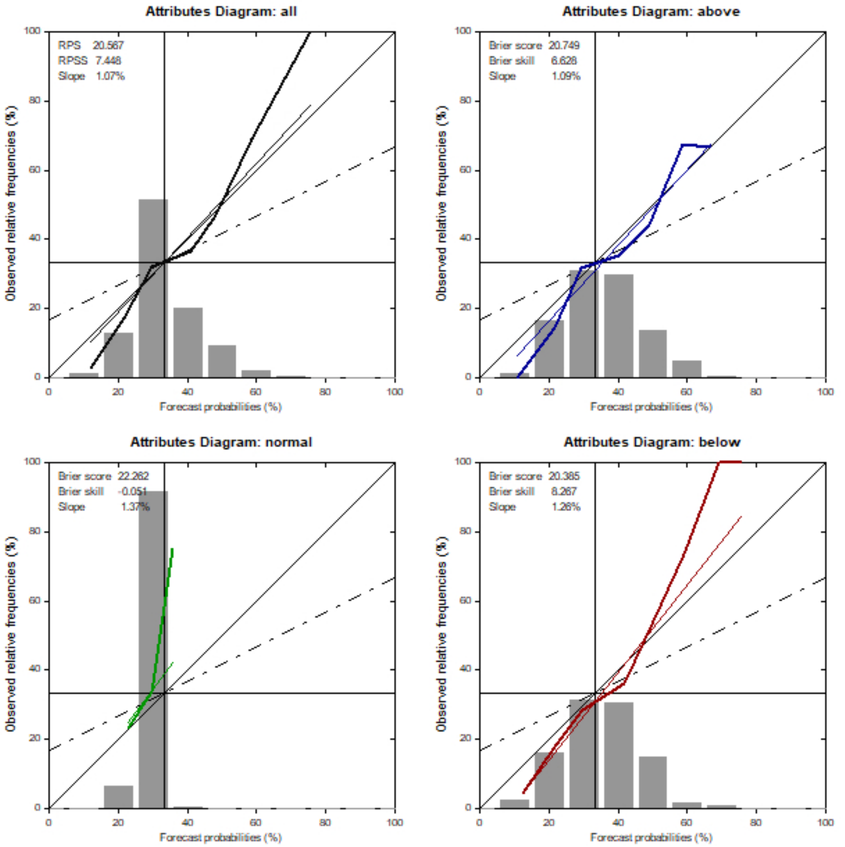
Source: WFP 2019

Predictors	Predictands
June-July-August precipitation anomaly	June-July-August VHI
June-July-August precipitation anomaly	June-July-August NDVI
June-July-August precipitation anomaly	June-July-August SMN
June-July-August precipitation anomaly	June-July-August VCI
June-July-August precipitation anomaly	August VHI
June-July-August precipitation anomaly	August NDVI
June-July-August precipitation anomaly	August SMN
June-July-August precipitation anomaly	August VCI

*VHI (Vegetation Health Index), VCI (Vegetation Condition Index) NDVI (Normalized Difference Vegetation Index), SMN (No noise NDVI)

Discrimination skill and reliability





*Discrimination skill: Is the forecast probability higher when an event occurs compared to when it doesn't occur? (Mason 2015)

**Reliability diagram : Observed relative frequency vs forecast probabilities (Mason 2015)

DID IT WORK?

Evidence suggests that the triggers worked, but assistance provided was not enough to overcome the crisis associated with famine-induced drought.

IMPACT EVALUATION

Temática	Variable(pregunta)	LB Control	PDM Control	LB Tratamiento	PDM Tratamiento
Acceso a información climática/meteorológica	Tiene acceso a información climática	30.9%	29.9%	**17.0%**	**100.0%**
	Usted o alguien del hogar recibe información climática en el momento adecuado para tomar decisiones adecuadas	51.3%	30.3%	**48.3%**	**68.5%**
	La información climática recibida es clara y permite comprender cómo afectará el clima a las personas o los medios de subsistencia/vida.	20.3%	14.2%	**12.8%**	**58.1%**

Source: WFP 2023

IMPACT EVALUATION

Temática	Variable(pregunta)	LB Control	PDM Control	LB Tratamiento	PDM Tratamiento
Disponibilidad y acceso a mecanismos de financiación de contingencia	¿Ha recibido su comunidad algún tipo de ayuda de instituciones gubernamentales, agencias de la ONU u ONGs en caso de crisis climáticas en los últimos tres años?	1.1%	5.1%	**7.7%**	**100.0%**
	¿Recibió la asistencia de manera oportuna para hacer frente a las consecuencias de la crisis?	0.0%	2.6%	**25.0%**	**94.2%**
	¿La asistencia prestada fue suficiente para recuperarse de las pérdidas sufridas?	0.0%	1.5%	30.0%	0.0%

Source: WFP 2023

THANK YOU

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