
ANALYZING THE IMPACT OF UPOV MEMBERSHIP ON SPECIFIC CEREAL GRAINS AND CASSAVA IN EAST AFRICA

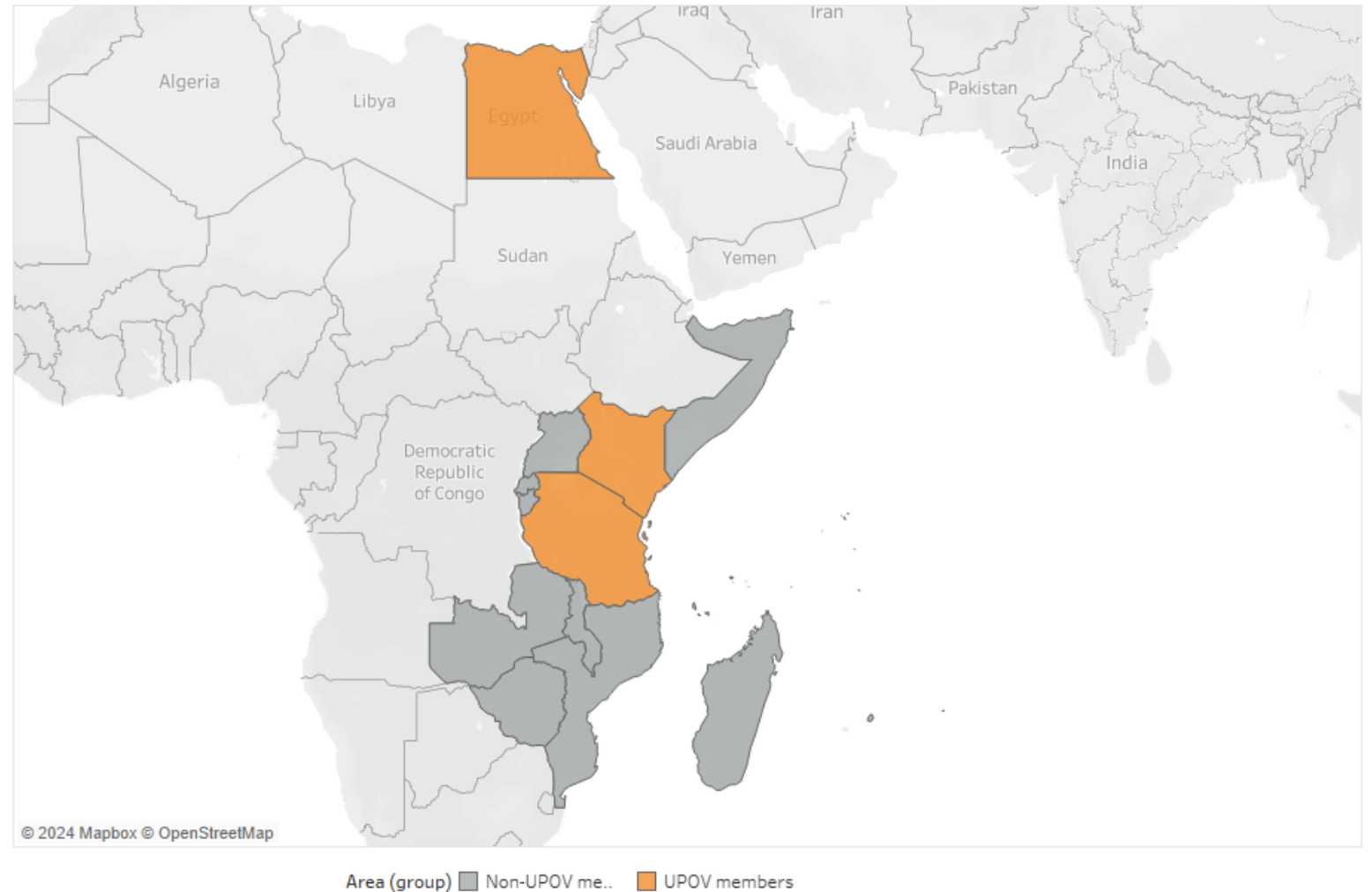
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PROJECT OVERVIEW:

- UPOV was established in 1961 to protect plant breeders' rights and encourage the development of new plant varieties.
- They are 78 member countries, shaping agricultural innovation and plant variety protection worldwide.
- Their objective is to protect the rights of plant breeders in their new varieties and to stimulate the development of new plant varieties
- They are facing criticism for favoring large agribusinesses over small-scale farmers.
- Research Question: How does UPOV membership affect area harvested and production change for Cereal Grains & Cassava in East Africa?
- Narrowed analysis to focus on crops: Cassava, Maize Corn, and Sorghum in Egypt, Kenya and Tanzania.

BY MAPPING UPOV
MEMBERSHIP IN EAST
AFRICA, WE GAIN
INSIGHTS INTO
REGIONAL DYNAMICS
SHAPING
AGRICULTURAL
POLICIES AND
INTERNATIONAL
COLLABORATIONS.

Mapping UPOV Membership: Egypt, Kenya, Tanzania, and Non-UPOV Countries.



PROJECT PLAN:

- Analyze the features of the data to get a deeper understanding.
- Prepare the data for an in-depth analysis on the distribution of flags, and the area harvested/production values of crops.
- Focus on East African countries in exploration relating information learned through the data and outside sources.
- Explore the most important/popular crops in countries to discover trends related to UPOV membership and compare with other countries.
- Analyze the data through a statistical lens.
- Discuss and put independent research and exploration together to answer original question.


WORK COMPLETED:

- Research on UPOV , further gaining domain knowledge and narrowed down our analysis
- Creation of a Pipeline for Data cleaning & transformation:
- Merging needed variables into one dataset
- Creation of crop type column
- Transformed data from wide to long
- Creating columns for change point focus.
- Selection of countries with Null values in mind.
- Conducted Statistical Analysis through change point focus

REFINED DATASET

4/23/2024

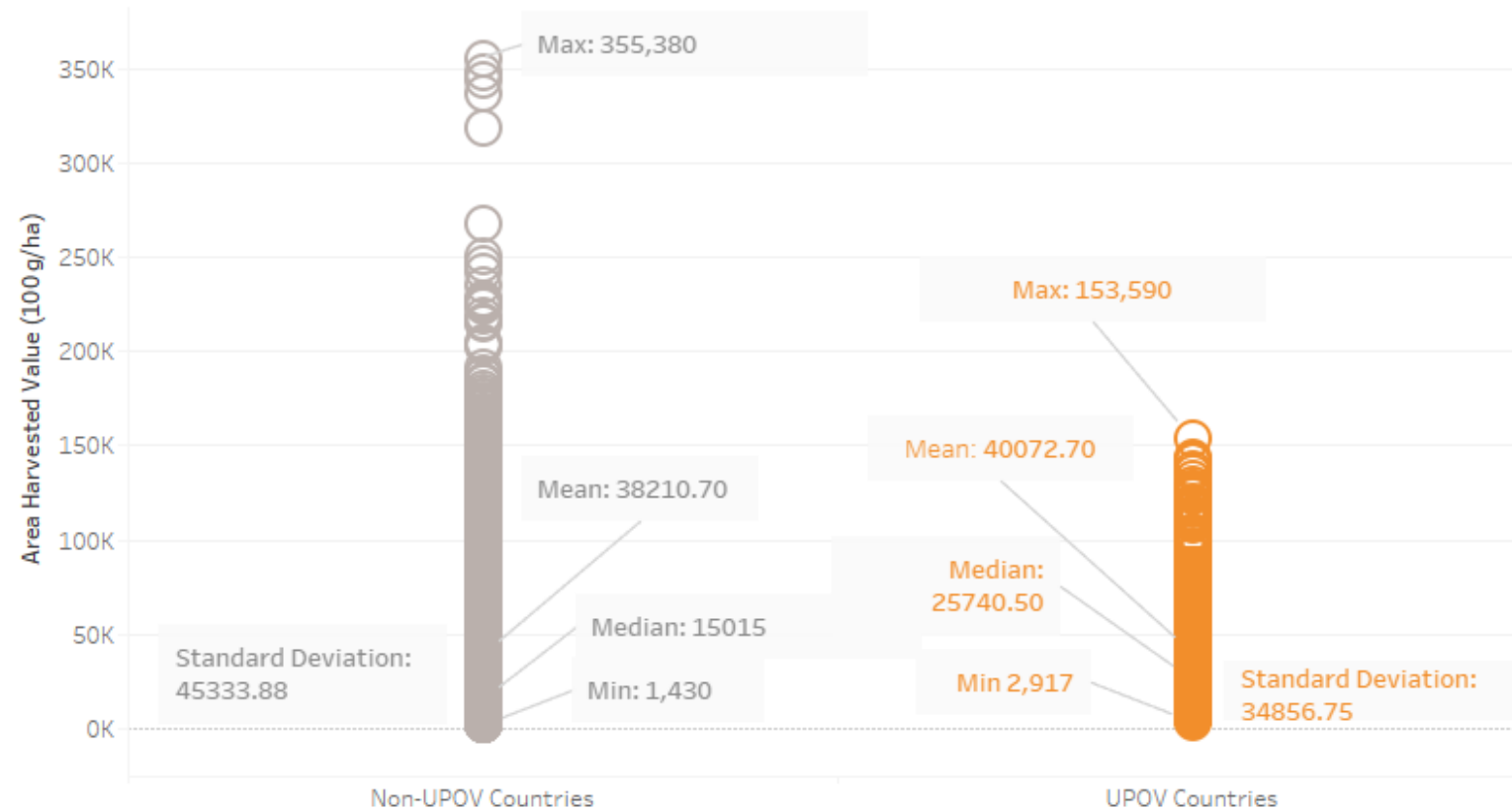
	Area Code	Area Code (M49)	Area	Item Code	Item Code (CPC)	Item	Entry Year	Crop Type	Year	Production Value (Tonnes)	Production Flag	Area Harvested (100 g/ha)	Area Harvested Flag	Annual Area Harvested Change	Annual Production Change
305	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1961	1617130.0	A	24014.0	E	0.0	0.0
306	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1962	2003690.0	A	26040.0	E	2026.0	386560.0
307	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1963	1867000.0	A	25824.0	E	-216.0	-136690.0
308	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1964	1934212.0	A	27716.0	E	1892.0	67212.0
309	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1965	2141000.0	A	40703.0	E	12987.0	206788.0
310	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1966	2376000.0	A	35891.0	E	-4812.0	235000.0
311	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1967	2167000.0	A	34506.0	E	-1385.0	-209000.0
312	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1968	2300000.0	A	35115.0	E	609.0	133000.0
313	59	'818	Egypt	56	'0112	Maize (corn)	2019	Cereal Grains	1969	2368000.0	A	37827.0	E	2712.0	68000.0



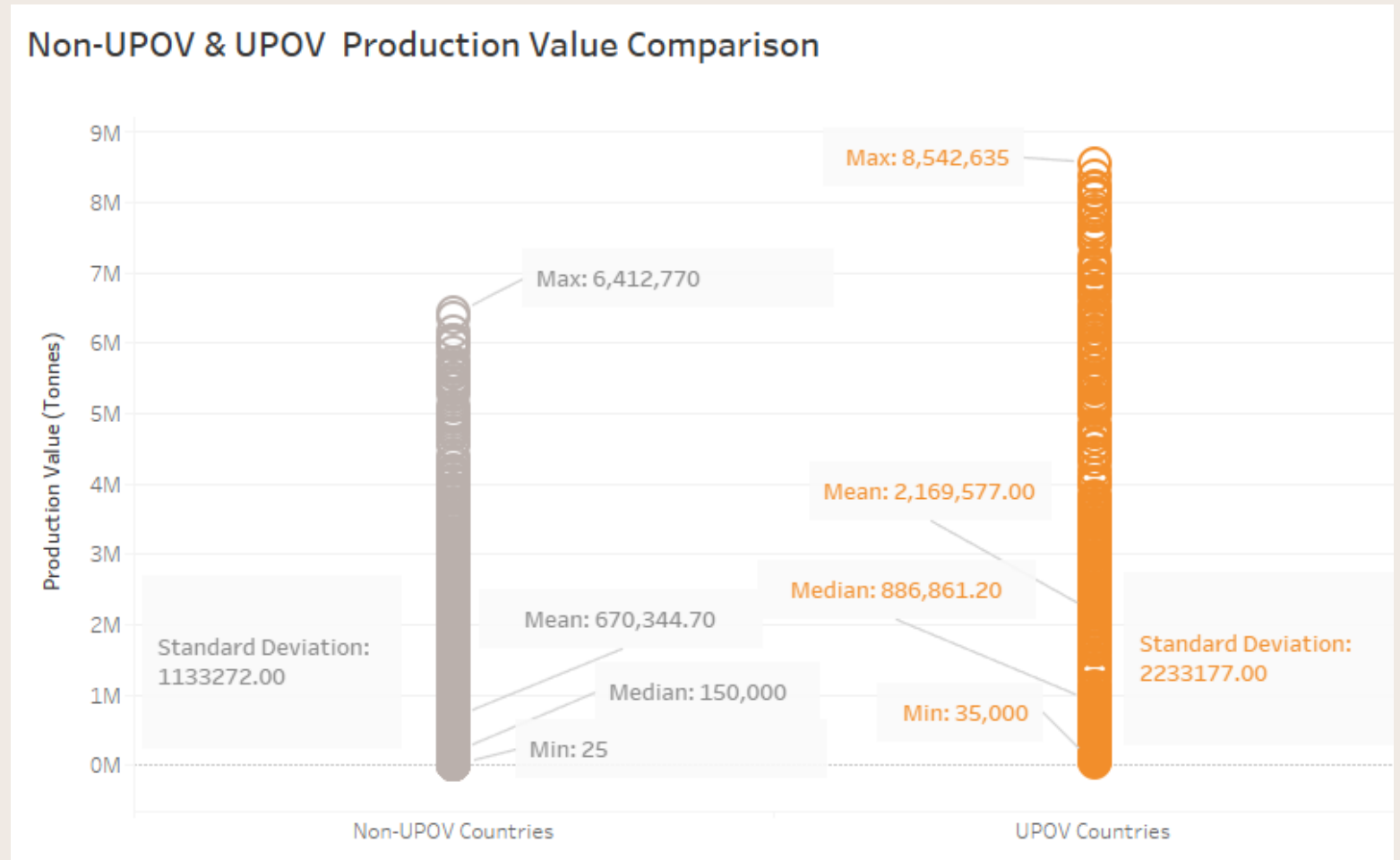
STATISTICAL INSIGHTS THROUGH CHANGE POINT RANKING

STATS ON UPOV & NON- UPOV AREA HARVESTED CASSAVA, MAIZE, & SORGHUM

Non-UPOV & UPOV Area Harvested Value Comparison

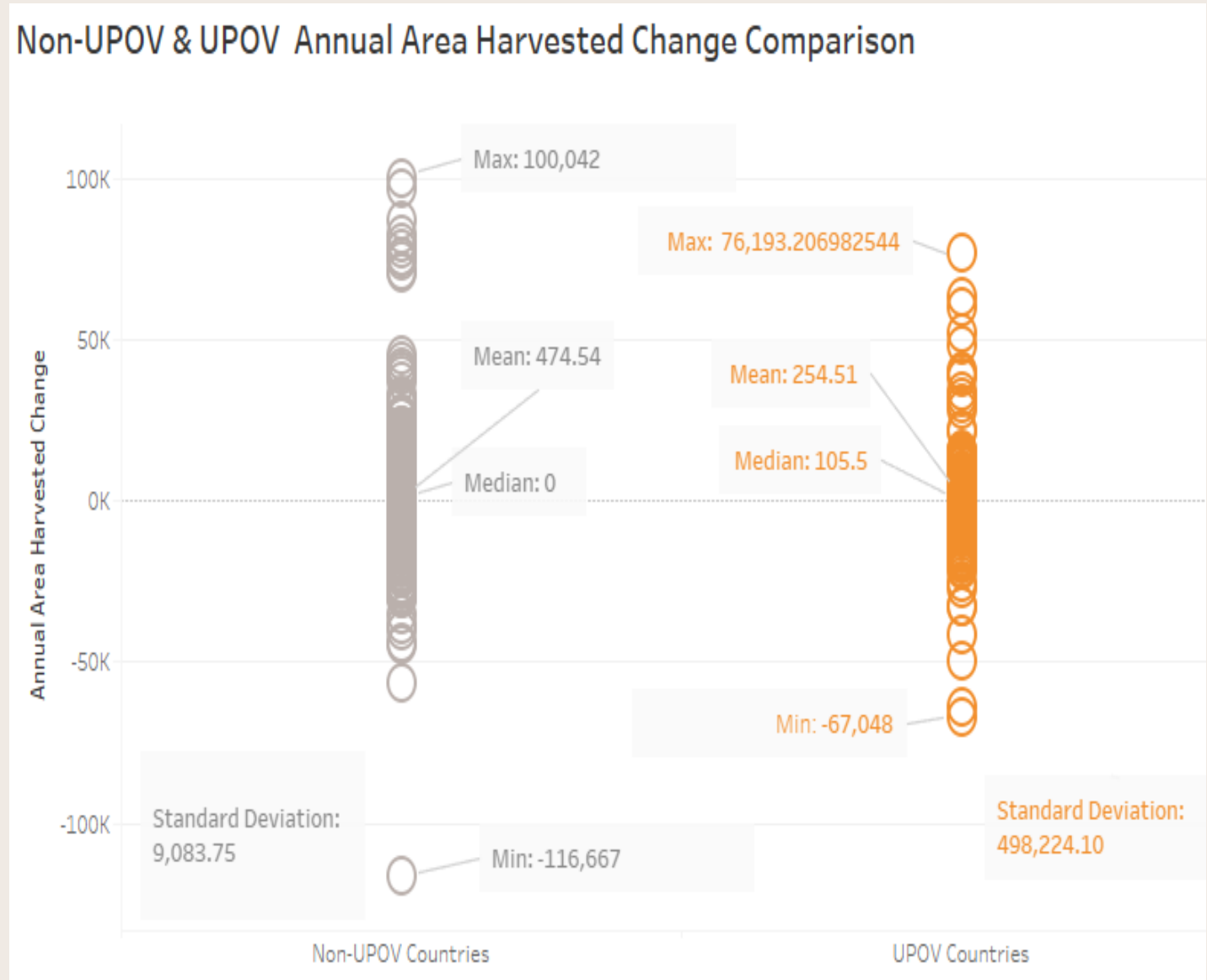


STATS ON UPOV & NON- UPOV PRODUCTION COMPARISON CASSAVA, MAIZE, & SORGHUM



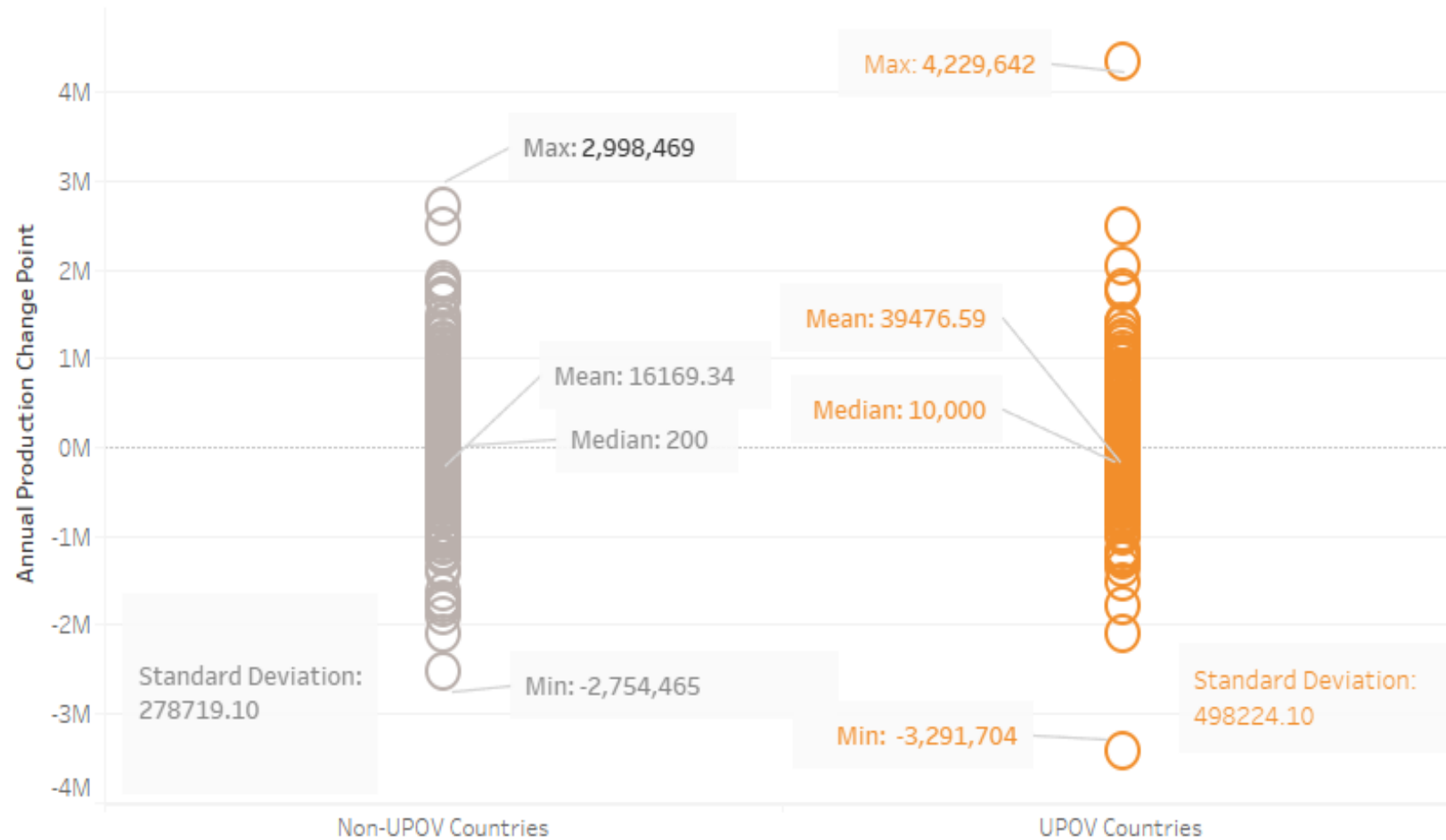
STATS ON UPOV & NON- UPOV ANNUAL AREA HARVESTED CHANGE COMPARISON

CASSAVA, MAIZE, & SORGHUM



STATS ON UPOV & NON- UPOV ANNUAL AREA HARVESTED CHANGE COMPARISON CASSAVA, MAIZE, & SORGHUM

Non-UPOV & UPOV Annual Production Change Comparison



Summary of Top Ten Annual Area Harvested Change

Non UPOV Members (100 g/ ha)

1. (1999-2000) Malawi, Cassava : 100,042
2. (2015-2016) Zambia, Cassava : 97,030
3. (1965-1966) Mauritius Cassava: 87,087
4. (1990-1991) Seychelles, Cassava: 82,151
5. (2020-2021) Rwanda, Cassava : 79,865
6. (1980-1981) Mauritius, Cassava : 78,000
7. (2016-2017) Zambia, Cassava : 75,522
8. (1963-1964) Rwanda, Cassava: 75,331
9. (2014-2015) Zambia, Cassava : 74,016
10. (2009-2010) Rwanda, Cassava : 71,292

Summary of Top Ten Annual Area Harvested Change

UPOV Members (100 g/ha)

1. (1984-1985) Kenya ,Cassava: 77,049
2. (2007-2008) Kenya, Cassava: 63,173
3. (2010-2011) Kenya, Cassava : 59,788
4. (2017-2018) Tanzania, Cassava: 51,644
5. (1982-1983) Kenya, Cassava: 48,000
6. (1980-1981) Kenya, Cassava: 40,166
7. (1989-1990) Tanzania ,Cassava: 39,693
8. (2017-2018) Kenya, Cassava: 38,177
9. (1976-1977) Tanzania, Cassava: 33,858
10. (2003-2004) Kenya, Cassava: 31,985

TOP TEN ANNUAL AREA HARVEST CHANGE

Summary of Top Ten Annual Production Change

Non Upov Members (Tonnes)

1. (2002-2003) Mozambique, Cassava: 2,703,857
2. (2017-2018) Mozambique, Cassava: 2,479,023
3. (1999-2000) Malawi, Cassava: 1,888,187
4. (2008-2009) Mozambique, Cassava: 1,831,331
5. (2019-2020) Uganda, Maize(Corn): 1,800,000
6. (1992-1993) Zimbabwe, Maize(Corn): 1,701,103
7. (1984-1985) Zimbabwe, Maize(Corn): 1,695,197
8. (1998-1999) Uganda, Cassava: 1,671,000
9. (2017-2018) Uganda, Cassava: 1,660,971
10. (2016-2017) Zambia, Cassava: 1,472,338.35

Summary of Top Ten Annual Production Change

Upov Members (Tonnes)

1. (2017-2018) Tanzania,Cassava: 4,346,952
2. (2018-2019) Egypt, Maize (corn): 2,481,904
3. (2003-2004) Tanzania,Maize (corn): 2,037,400
4. (2007-2008) Tanzania, Maize (corn): 1,781,710
5. (2003-2002) Tanzania, Maize (corn): 1,755,610
6. (2009-2010) Tanzania, Maize (corn): 1,406,870
7. (1994-1995) Tanzania, Maize (corn): 1,388,600
8. (2013-2014) Tanzania, Maize (corn): 1,380,847
9. (1974-1975) Tanzania,Cassava: 1,300,760
10. (1982-1983) Tanzania,Cassava: 1,236,000

TOP TEN ANNUAL PRODUCTION CHANGE

Summary of Bottom Ten Annual Area Harvested Change Non Upov Members (100 g/ha)	Summary of Bottom Ten Annual Area Harvested Change Upov Members (100 g/ha)
1. (1981-1982) Mauritius, Cassava: - 116,667	1. (1981-1982) Kenya, Cassava: - 67,048
2. (2007-2008) Uganda, Cassava: - 56,582	2. (2009-2010) Kenya, Cassava: - 63,910
3. (1979-1980) Rwanda, Cassava: - 44,857	3. (1983-1984) Kenya, Cassava: - 50,000
4. (1987-1988) Rwanda, Cassava: - 44,462	4. (1985-1986) Kenya, Cassava: - 41,784
5. (2004-2005) Mauritius, Cassava: - 40,357	5. (2002-2003) Tanzania, Cassava: - 32,658
6. (2016-2017) Burundi, Cassava: - 38,409	6. (1999-2000) Kenya, Cassava: - 32,652
7. (2001-2002) Mauritius, Cassava: - 35,385	7. (2020-2021) Kenya, Cassava: - 27,269
8. (2018-2019) Zambia, Cassava: - 30,322	8. (2018-2019) Egypt, Maize(corn): - 25,649
9. (1979-1980) Mauritius, Cassava: - 30,222	9. (2006-2007) Kenya, Cassava: - 21,671
10. (1982-1983) Malawi, Cassava: -29,608	10. (2008-2009) Kenya, Cassava: -20,927

Summary of Bottom Ten Annual Production Change Non Upov Members (Tonnes)	Summary of Bottom Ten Annual Production Change Upov Members (Tonnes)
1. (2001-2002) Mozambique, Cassava: - 2,528,547	1. (2017-2018) Egypt, Maize (corn): - 3,431,399
2. (2007-2008) Uganda, Cassava: - 2,097,381	2. (2008-2009) Tanzania, Maize (corn): - 2,114,510
3. (2011-2012) Mozambique, Cassava: -1,901,000	3. (2002-2003) Tanzania, Maize (corn): - 1,794,450
4. (2001-2002) Malawi, Cassava: -1,822,218	4. (2004-2005) Tanzania, Maize (corn): - 1,519,760
5. (2020-2021) Uganda, Maize (Corn): - 1,760,000	5. (2009-2010) Tanzania, Cassava: - 1,368,500
6. (2018-2019) Uganda, Cassava: - 1,730,231	6. (1986-1987) Tanzania, Cassava: - 1,286,400
7. (2004-2005) Mozambique, Cassava: - 1,630,339	7. (2019-2020) Tanzania, Cassava: - 1,264,608.54
8. (1986-1987) Zimbabwe, Maize(Corn): -1,414,760	8. (1994-1995) Tanzania, Cassava: - 1,240,400
9. (1972-1973) Zimbabwe, Maize(Corn): - 1,361,809	9. (2002-2003) Tanzania, Cassava: - 1,214,050
10. (1994-1995) Zimbabwe, Maize(Corn): -1,224,321	10. (20016-2017) Tanzania, Cassava: 1,176,186.35

BOTTOM TEN ANNUAL AREA HARVEST CHANGE

BOTTOM TEN ANNUAL PRODUCTION CHANGE

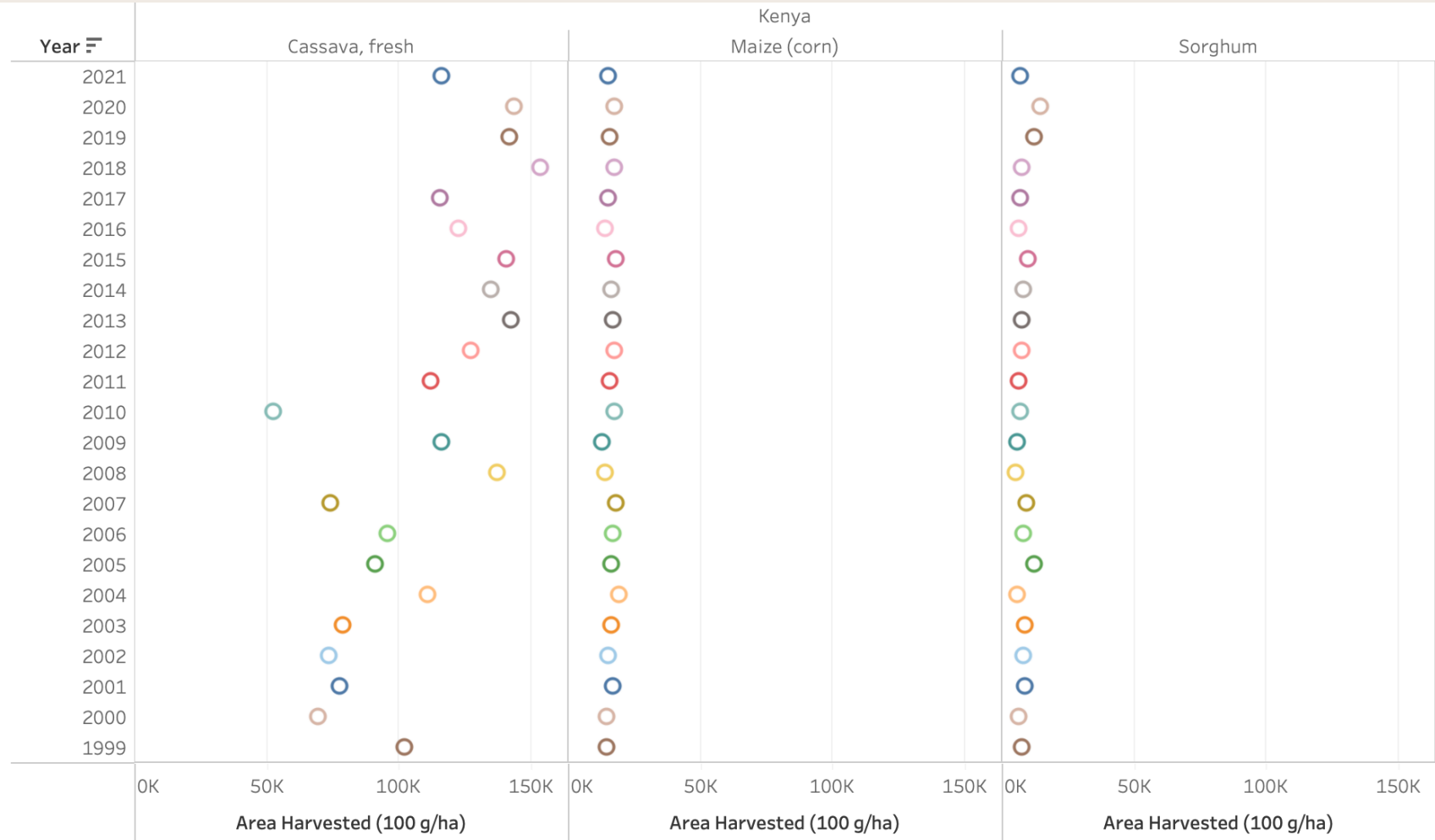
Kenya Cassava, Maize, and Sorghum Production 1999-2021

SINCE 1999, KENYA'S MAIZE AND SORGHUM HARVEST RATE HAS REMAINED STEADY.

CASSAVA AREA HARVESTED HAS FLUCTUATED ALTHOUGH YIELDS INCREASED OVER TIME

THE LOW HARVEST YIELD IN 2020 CAN BE ATTRIBUTED TO DISEASE AND DIMINISHING RESOURCES FOR PLANTING AND HARVESTING

USING A MIX OF SEEDS FROM KALPRO AND LEGACY PLANTING MATERIALS MAY ALSO CONTRIBUTE TO LOWER AND INCONSISTENT YIELDS

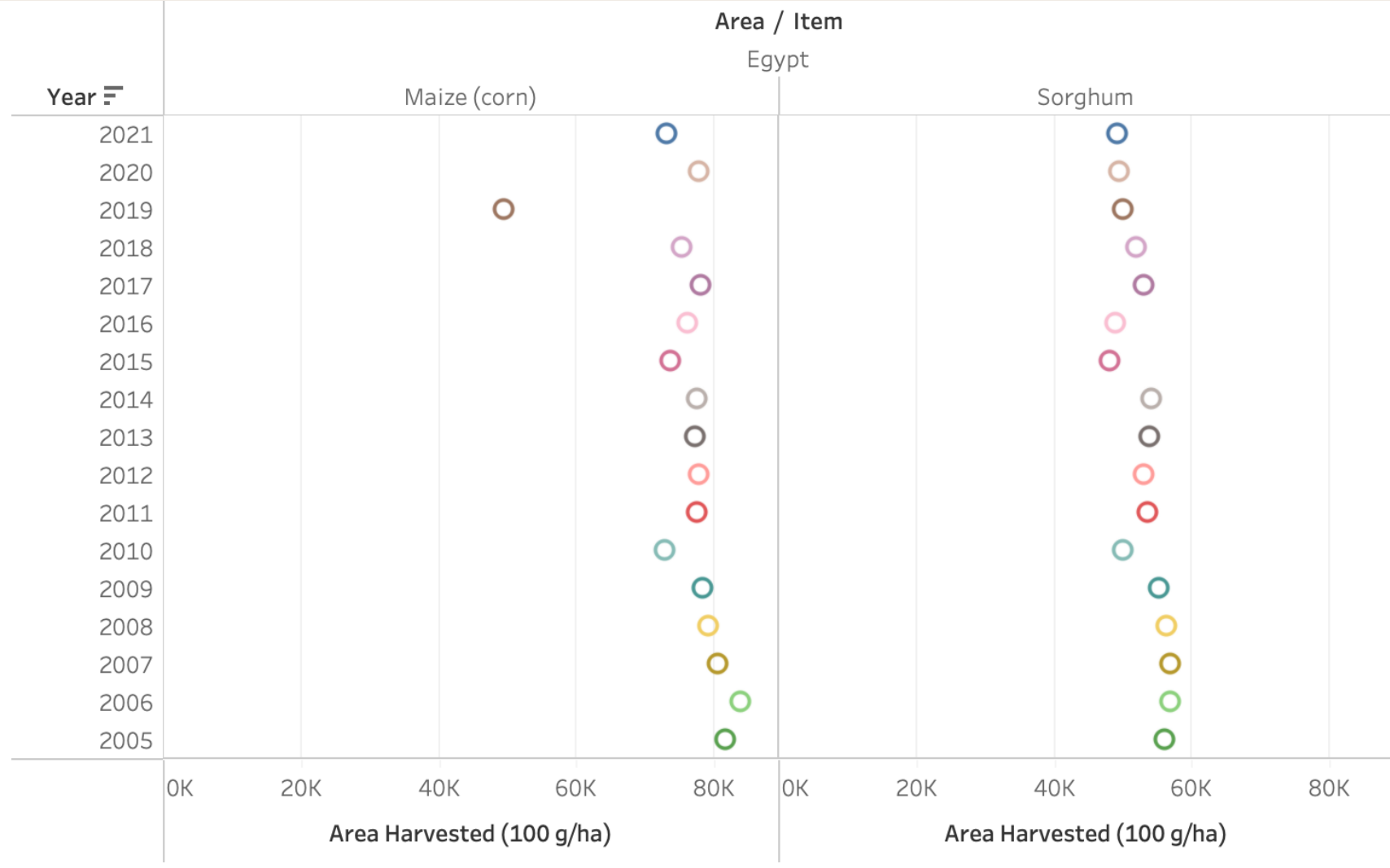


Egypt Maize, and Sorghum Production 2005-2021

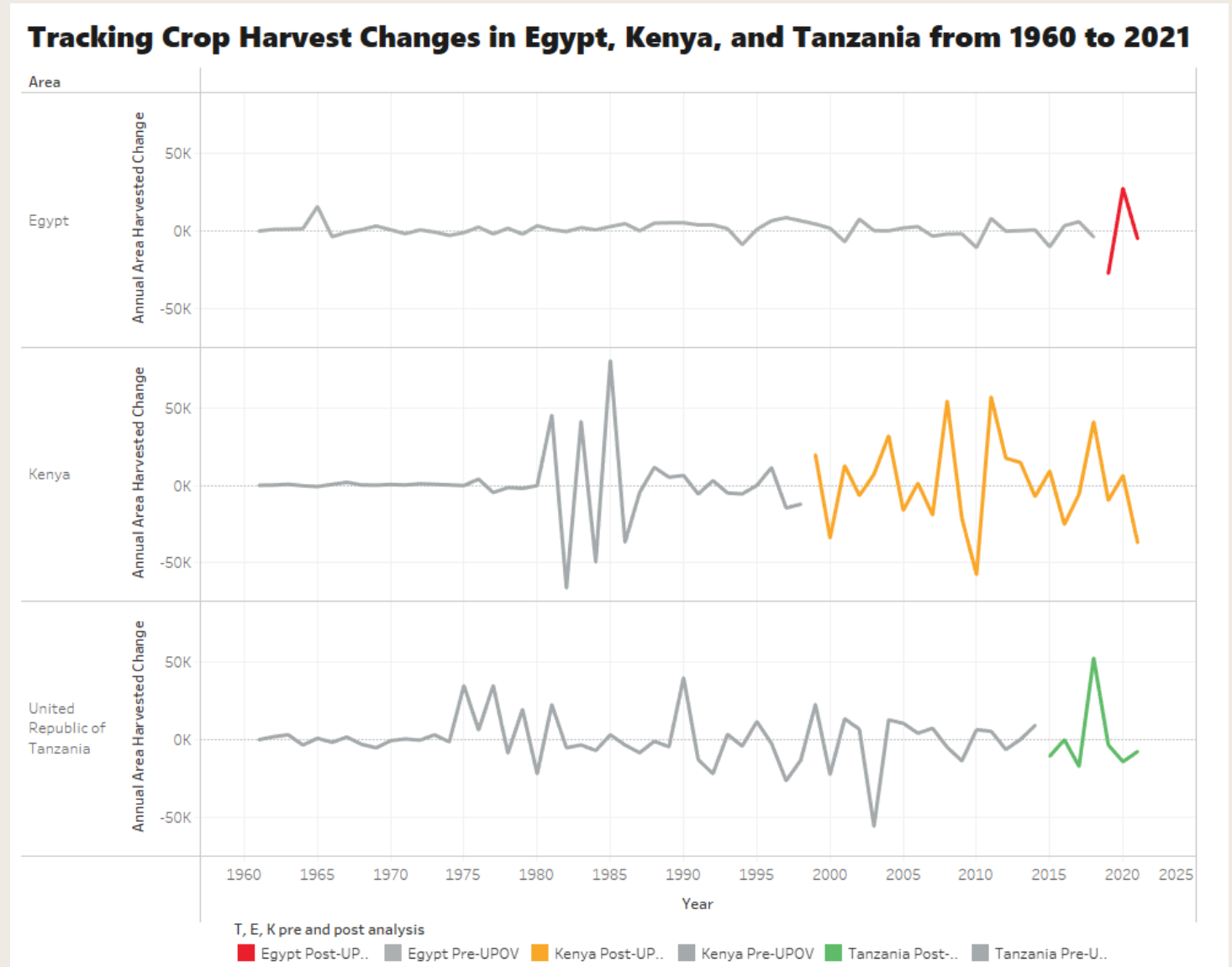
EGYPT'S MAIZE AND SORGHUM PRODUCTION HAS BEEN OVERALL STAGNANT IN THE LAST TWO DECADES DESPITE AN INCREASE IN THE POPULATION BY 30 MILLION.

WATER SCARCITY AND POLLUTION ISSUES OF GREAT IMPORTANCE AS 96% OF WATER IN EGYPT IS FROM THE NILE RIVER.

EGYPT HAS INCREASINGLY RELIED ON IMPORTS TO MEET DEMANDS IN GRAINS AS POPULATION GROWS.



- Since joining UPOV, Egypt's farmlands used for crops have grown. Kenya and Tanzania also saw bigger harvests, though with ups and downs.
- This hints that **UPOV might be helping farms expand, but the situation is unique for each country.**



VISUAL INSIGHT

The notable spikes and drops in yield for Cassava, maize, and sorghum across Egypt, Kenya, and Tanzania could be influenced by a combination of factors, including:

- The adoption of climate-smart agricultural practices like Tanzania's Matengo pits, which help conserve water (Malekela & Lusiru, 2022);
- The introduction of drought-tolerant and disease-resistant seed varieties, potentially through UPOV's plant variety protection;
- The direct impact of climate variability manifesting as changes in rainfall patterns and temperature.

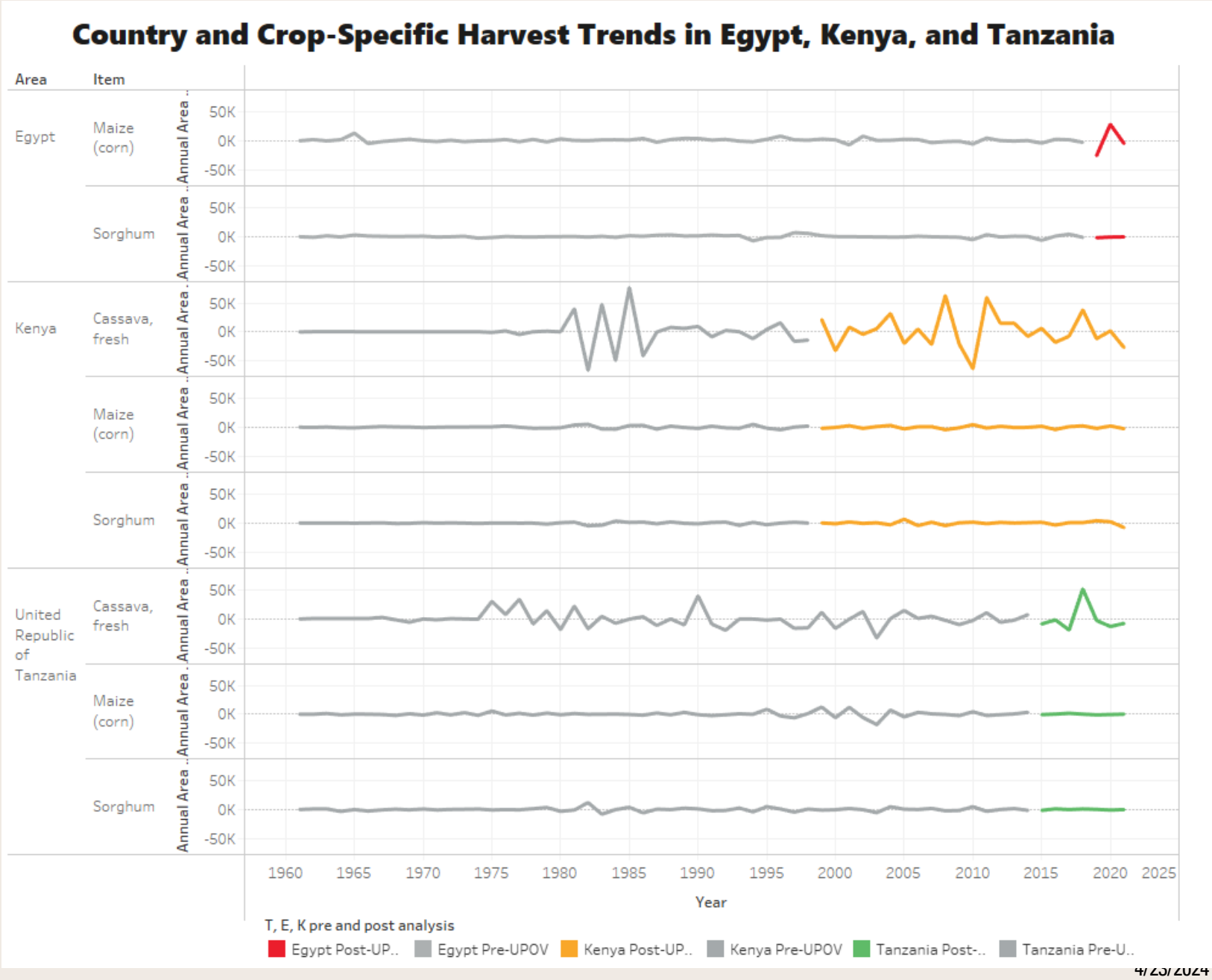
Additionally, socio-economic factors, such as the accessibility of improved seeds and technology to farmers of varying wealth, also play a crucial role. Also, note that Egypt does not produce Cassava.

Egypt's grain production has failed to keep pace with its expanding population, leading to increased reliance on food imports, particularly for Wheat and Maize.

The study notes a significant rise in maize imports from 43% to 53% between 2013 and 2017, highlighting growing concerns about water scarcity, pollution, and climate change impacting agricultural productivity.

The lack of investment in agricultural research further hampers growth, necessitating policy interventions to address these challenges.

Post-UPOV, Egypt's maize harvests expanded, indicating positive treaty effects. Meanwhile, **cassava's fluctuating yields in all countries** point to other influences like climate.



VISUAL INSIGHT

The harvested areas for Egypt, Kenya, and Tanzania change year over year, helping us identify trends such as growth or contraction in agricultural activities.

For instance, an increase of 3,189 hectares in one year suggests significant expansion in agricultural activities, possibly due to increased demand or greater cultivation capacity. Conversely, a decrease of 1,704 hectares might signal a need to investigate potential challenges farmers faced that year, such as economic hardships or unfavorable weather conditions.

STATISTICAL MODELING

- Focused on Analyzing the relationship
- Conducted mixed linear model regression
- Focused on dependent variable "Annual Area Harvest change"

Mixed Linear Model Regression Results						
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Model:	MixedLM Dependent Variable: Q('Annual Area Harvested Change')					
No. Observations:	2440	Method:	REML			
No. Groups:	15	Scale:	88613528.5736			
Min. group size:	61	Log-Likelihood:	-25781.3125			
Max. group size:	183	Converged:	Yes			
Mean group size:	162.7					

	Coef.	Std.Err.	z	P> z	[0.025	0.975]

Intercept	474.474	214.025	2.217	0.027	54.993	893.955
Q('Entry Year')	-0.109	0.237	-0.461	0.645	-0.574	0.355
Group Var	63.835	57.756				
=====						

CONCLUSION

Our visualizations not only reflect historical agricultural trends but also aid in forecasting future agricultural needs and adjustments. For instance, a steady increase in the annual area harvested change for maize might prompt further investment in maize processing facilities, or a decline in sorghum harvesting might trigger research into alternative crops more suited to current climatic conditions.

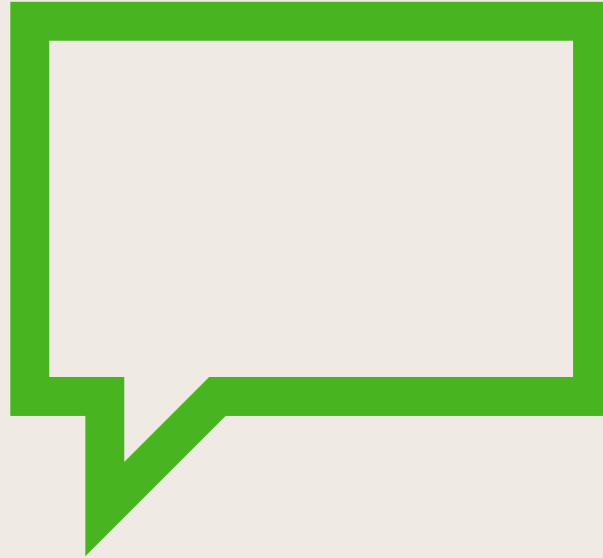
All three countries have a favorable response and participation in UPOV. However, small farmers do not reap the full benefits of obtaining the best plant material or the economic benefits of breeders. Small farmers do not have the resources to purchase plants or seeds or present new breeds due to government policies for applications.



RESOURCES

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THANK YOU FOR LISTENING!