

Assessing the impacts of climate change on crop production in East Africa

An initial analysis



Overview

Objectives

Procedures

Initial results

What is next....



Objectives

Assess the impacts of climate change on crop production in East Africa using available data

Describe current variation in weather conditions

Describe productivity data for the major cropping activities

Derive relationship between production and weather

Describe expected change in climatic conditions

Assess the impact of climatic conditions on the systems



Changes

Microsoft Excel - CGM.xls

File Edit View Insert Format Tools Data Window Help


Type a question for help

100%

Arial 10

O11

Crop growth modeler



[Contents](#)
[Survey data](#)
[Calibration](#)
[Parameters](#)
[Settings](#)

Jetse Stoorvogel
Wageningen University
Land Dynamics Group
Wageningen
The Netherlands

Introduction / Survey data / Calibration / Parameters / Settings /

Draw AutoShapes

start

100%

D:\projects\GTZ\coun... Microsoft Excel - CGM... 11:18 AM



Changes

Survey data

<i>Id</i>	<i>Rainfall</i>	<i>Temperature</i>	<i>Soil depth</i>	<i>BD</i>	<i>SOM</i>	<i>Fertilizer</i>	<i>Yield</i>
1	661	19.2	30	1.2	2.8	10	379
2	680	21.2	30	1.2	2.8	2	0
3	640	19.5	30	1.2	3.0	8	428
4	472	18.8	30	1.2	3.2	19	836
5	462	18.8	30	1.2	3.2	4	637
6	730	20.9	30	1.2	3.8	6	946
7	891	21.7	30	1.2	2.1	10	583
8	641	19.5	30	1.2	2.9	18	671
9	892	21.1	30	1.2	2.4	0	886
10	703	20.5	30	1.2	3.3	0	455
11	848	22.9	30	1.2	2.9	3	661
12	794	20.8	30	1.2	3.6	19	828
13	529	17.9	30	1.2	3.6	14	493
14	526	18.7	30	1.2	3.1	19	672
15	737	22.3	30	1.2	2.2	8	746



Procedures

1. Crop growth simulation models
2. Spatial analogue approach (survey data)
3. Temporal analogue approach (general statistics)
4. Expert judgement



Ethiopia

	Sashemene	Holetta
Location	7.26°N; 38.56°W	9.05°N; 38.5°W
Altitude	1800 m.a.s.l.	2400 m.a.s.l.
Climate 1970 - 2000		
Rainfall	2380 mm/year	1391 mm/year
Tmin	20.9°C	10.8°C
Tmax	30.6°C	22.6°C
Climate 2040 - 2060		
Rainfall	2340 mm/year	1151 mm/year
Tmin	25.1°C	12.8°C
Tmax	27.9°C	25.7°C



Ethiopia

- Crop growth studies
- No calibrated models
- Thornton et al (2009)
- Spatial analogue method
- Survey is very small (21 observations)
- Survey by Gildemacher et al (2009) may be a solution
- Temporal analogue method
- No regional statistics
- National statistics from FAO

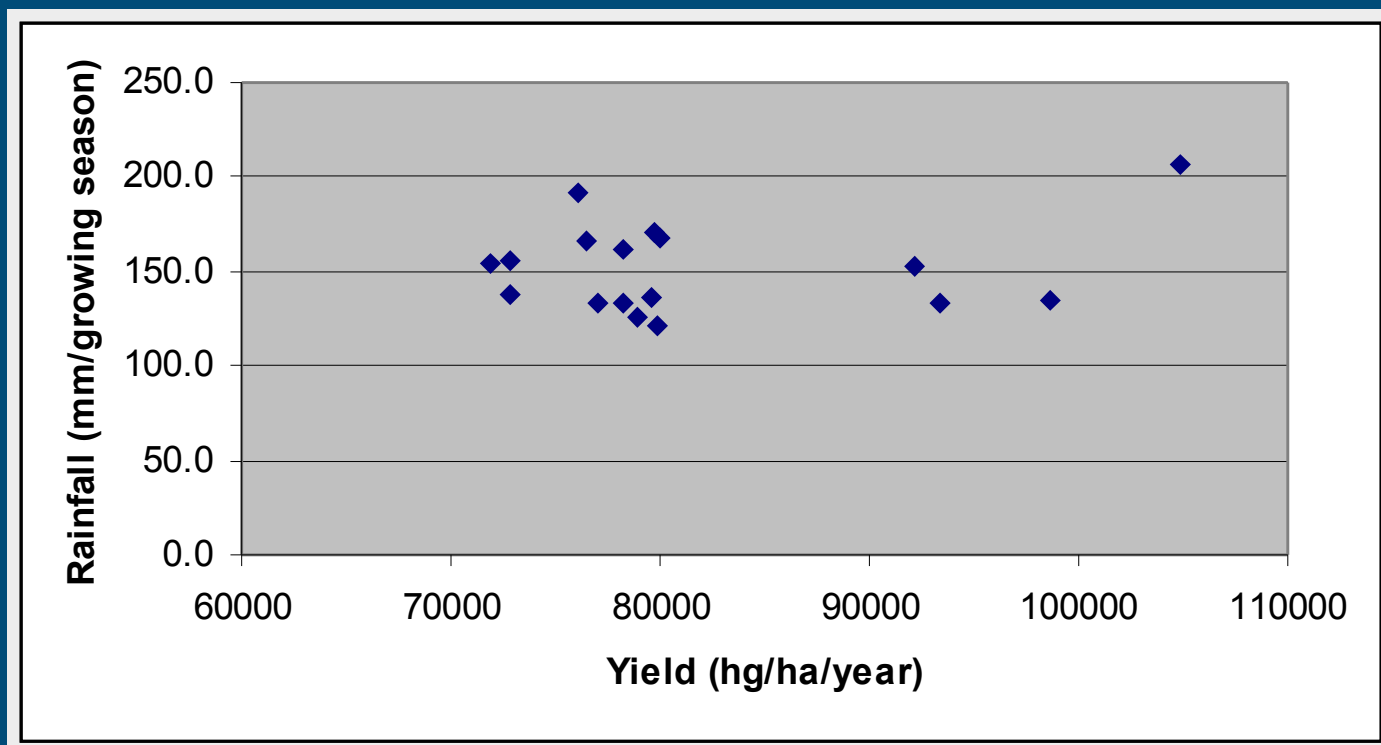


Ethiopia

Year	Yield	Tmin	Tmax	Tmean	Rainfall
1993	80045	7.9	20.3	14.1	167.9
1994	79545	7.2	20.5	13.9	136.5
1995	78888	6.8	21.2	14.0	125.4
1996	78260	7.1	20.5	13.8	161.0
1997	78260	7.7	21.7	14.7	133.4
1998	76041	8.8	22.2	15.5	191.4
1999	76545	7.1	20.5	13.8	166.7
2000	77000	6.6	20.4	13.5	133.5
2001	92222	6.4	20.8	13.6	153.3
2002	104872	7.3	21.7	14.5	206.1
2003	93349	7.6	20.0	13.8	133.1
2004	98594	7.5	20.1	13.8	135.1
2005	72800	7.4	20.3	13.9	137.1
2006	72800	8.2	20.0	14.1	156.3
2007	71914	8.1	20.0	14.0	153.9
2008	79723	15.2	21.4	18.3	170.2
2009	79821	9.0	22.5	15.7	121.6



Ethiopia



Kenya

Embu	
Location	0.52°S; 37.45°W
Altitude	1400 m.a.s.l.
Climate 1970 - 2000	
Rainfall	978 mm/year
Tmin	16.1°C
Tmax	26.9°C
Climate 2040 - 2060	
Rainfall	1018 mm/year
Tmin	17.7°C
Tmax	28.5°C



Kenya

Crop growth simulation

Location	Yield (kg / season)	
	2000	2050
Embu	1915	1546



Kenya

Crop growth simulation

Spatial analogue approach

Climate data from worldclim

(total rainfall and average temperature for short and long season)

Production data from survey

(127 farms with yield data for Potato, Beans (short and long season) and Maize.

Overlay of survey data and worldclim

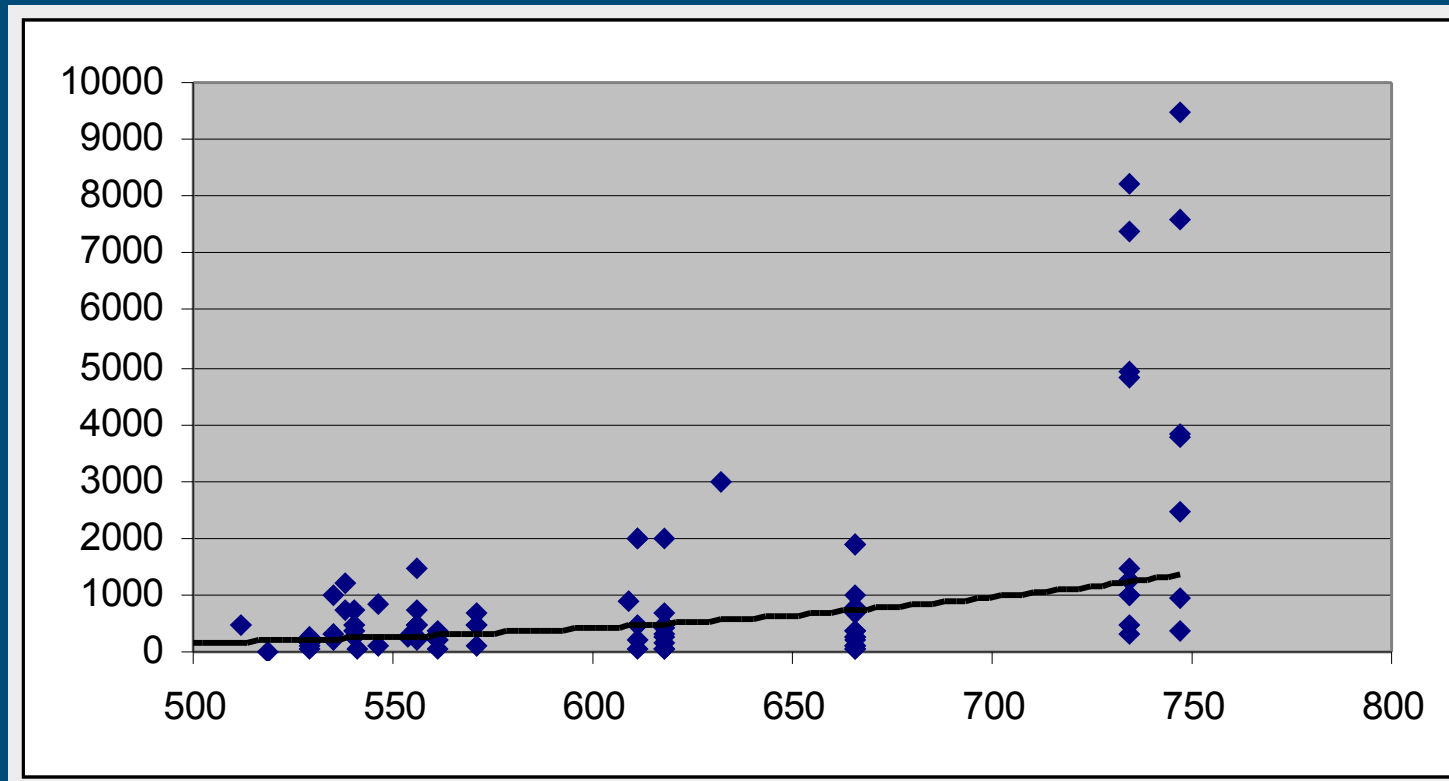


Kenya

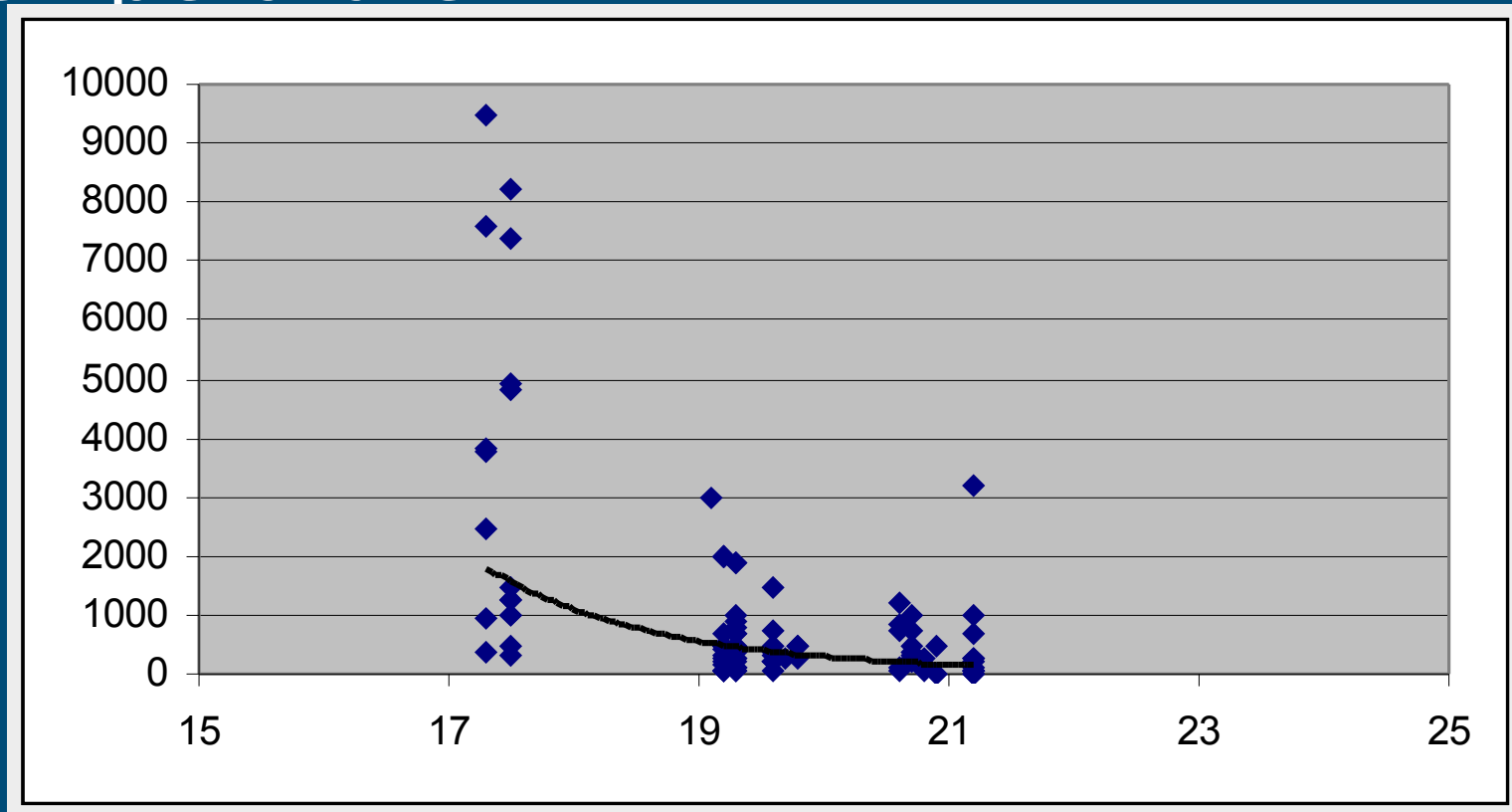
QNO	Tlong	Plong	Tshort	Pshort	Potlong	BeanLong	Beanshort	Maizeshort
5	20.20	589.00	20.60	538.00	5040	593	192	1184
6	20.30	567.00	20.80	529.00	288	247	137	137
12	20.30	578.00	20.70	535.00				
13	20.30	567.00	20.80	529.00	280	124	96	99
14	20.20	586.00	20.60	541.00	1440		96	49
15	20.30	567.00	20.80	529.00	720	1334	740	145
16	20.30	548.00	20.90	519.00	560		64	18
17	20.30	585.00	20.70	540.00	1080	534	211	370
20	20.30	578.00	20.70	535.00		62	493	987
21	20.40	537.00	20.90	512.00	720	309	274	493
23	20.30	578.00	20.70	535.00	530			291
24	20.30	567.00	20.80	529.00	424	247	55	274
25	20.30	585.00	20.70	540.00	352	1186	493	740
26	20.20	589.00	20.60	538.00	720	371	493	740
27	20.30	585.00	20.70	540.00	720	988		
29	18.90	847.00	19.30	666.00				987



Kenya - Maize short season



Kenya - Maize short season, temperature



Kenya

Embu	
Location	0.52°S; 37.45°W
Altitude	1400 m.a.s.l.
Climate 1970 - 2000	
Rainfall	978 mm/year
Tmin	16.1°C
Tmax	26.9°C
Climate 2040 - 2060	
Rainfall	1018 mm/year
Tmin	17.7°C
Tmax	28.5°C



Uganda

	Soroti	Kabale
Location	2.22°N; 33.73°W	1.19°N; 29.9°W
Altitude	1050 m.a.s.l.	2200 m.a.s.l.
Climate 1970 - 2000		
Rainfall	1131 mm/year	1033 mm/year
Tmin	20.9°C	12.1°C
Tmax	30.6°C	22.5°C
Climate 2040 - 2060		
Rainfall	1060 mm/year	911 mm/year
Tmin	22.8°C	14.3°C
Tmax	32.8°C	24.7°C



Uganda

Crop growth simulation

Location	Yield (kg / season)	
	2000	2050
Soroti	1652	1136
Kabale	1826	1811
Pallisa	1471	1118
Nakaseke	1030	695



Uganda

Crop growth simulation

Spatial analogue approach

Climate data from worldclim
(total rainfall and average temperature per growing season)

Production data from IFPRI survey
(284 farms with yield data for banana, beans, cassava, sweet potatoes, maize).

Overlay of survey data and worldclim

Uganda

Microsoft Excel - farmdata.xls

	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT
	HHID	Pgs_cas	Tgs_sp	Pgs_sp	Tgs_maiz	Pgs_maiz	Yban	Ybean	Ycas	Ysp	Ymaize									
1	1040401	1145.4457	21.0147	638.3915	21.18927	470.1359	WNA	WNA	WNA	WNA	WNA									
2	1040402	1226.8846	21.0731	666.6296	21.275298	514.8027	13526.18	WNA	WNA	WNA	WNA									
3	1040403	1037.6056	21.2187	612.7368	21.447968	438.6107	8974.331	WNA	WNA	WNA	WNA									
4	1040404	1222.2057	21.1844	680.7311	21.42	508.4552	WNA	WNA	8103.108	WNA	WNA									
5	1040405	1219.2094	20.8667	680.0991	21.102516	501.3077	9344.449	WNA	WNA	5333.333	723.6142	WNA								
6	1040406	1162.4697	21.1397	650.9315	21.372314	475.1544	6386.532	WNA	WNA	3118.672	363.6334	WNA								
7	1040407	1191.7311	21.2011	654.5360	21.401048	493.4391	2851.331	WNA	WNA	WNA	WNA									
8	1040408	1195.6381	20.9943	667.7683	21.213148	490.2176	21477.47	WNA	WNA	WNA	WNA									
9	1040409	1138.8580	21.0719	633.1273	21.257146	469.8702	24963.77	WNA	WNA	WNA	WNA									
10	1040410	1127.2618	21.1716	634.6623	21.393364	467.3016	3690.146	WNA	6656.667	WNA	WNA									
11	1040411	1141.2302	21.4213	639.7991	21.689872	473.4910	WNA	WNA	WNA	WNA	2327.955	WNA								
12	1040412	1167.0640	21.0061	653.3871	21.198776	476.0777	3636.363	WNA	WNA	WNA	WNA									
13	1040413	1168.8793	21.2696	652.7407	21.483448	482.9737	5381.814	WNA	WNA	WNA	WNA									
14	1040414	1138.8580	21.0719	633.1273	21.257146	469.8702	WNA	WNA	WNA	WNA	WNA									
15	1040415	1036.0112	21.2439	616.6666	21.456266	444.6691	2358.31	WNA	WNA	WNA	WNA									
16	1040416	1092.7934	21.0928	616.3962	21.260068	440.0221	5633.753	WNA	WNA	WNA	WNA									
17	1040417	1219.6311	20.9763	682.2146	21.187722	506.9633	9639.692	WNA	8163.979	WNA	WNA									
18	1040418	1215.3695	20.8859	678.3022	21.126394	500.0775	WNA	WNA	WNA	WNA	WNA									
19	1040419	1121.7668	21.2693	629.4224	21.503828	458.8307	WNA	WNA	WNA	WNA	WNA									
20	1040420	1220.1121	21.0026	682.1287	21.206964	507.2264	WNA	WNA	1520	1419.034	WNA									
21	1040601	964.6233	21.2616	698.3677	21.542066	390.8634	7513.669	WNA	1500.376	767.432	WNA									
22	1040602	914.1176	21.2392	660.1176	21.436704	367.6946	23336.46	WNA	WNA	WNA	WNA									
23	1040603	883.2146	20.9866	626.2146	21.28756	342.0000	36919	566.0893	WNA	WNA	3233.333	WNA								
24	1040604	948.3791	21.4184	673.4462	21.653218	377.0744	21626.68	1500	1742.666	WNA	WNA									
25	1040605	923.8632	20.9656	658.1500	21.221546	367.0000	24049.23	1800	868.7064	WNA	1087.639	WNA								
26	1040606	969.1924	21.0879	686.8922	21.326378	374.5233	24730.24	804.0637	170.1722	WNA	667.8684	WNA								
27	1040607	939.2684	21.3117	669.1216	21.663106	369.2636	29664.29	820	WNA	WNA	666.6667	WNA								
28	1040608	939.4348	21.3484	668.8217	21.600402	370.1836	28623.48	548.019	610.6497	WNA	WNA									
29	1040609	970.7467	21.4013	687.6426	21.64482	387.0336	23180	1263.166	1612.463	WNA	631.7646	WNA								
30	1040610	970.7608	21.2426	672.3761	21.52797	383.3818	12766.86	296.8731	448.4267	WNA	3384.616	WNA								

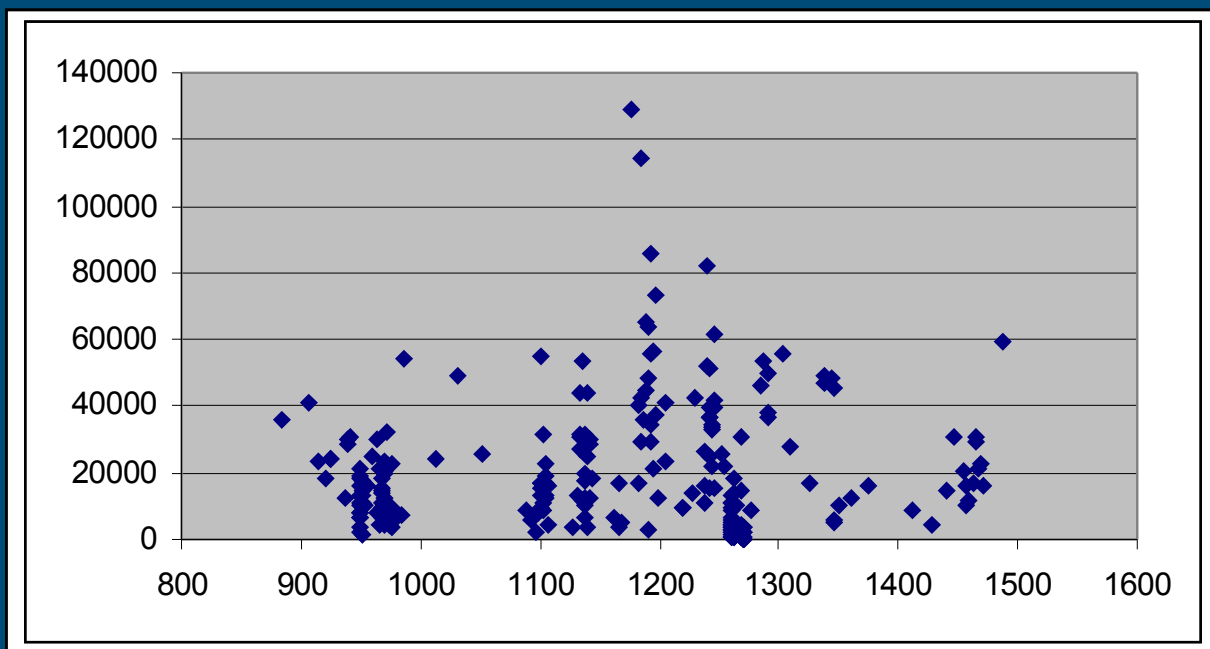
Draw | AutoShapes | Soil data | Banana | Beans | Cassava | Sweet potato | Maize | Headings

10:57 AM



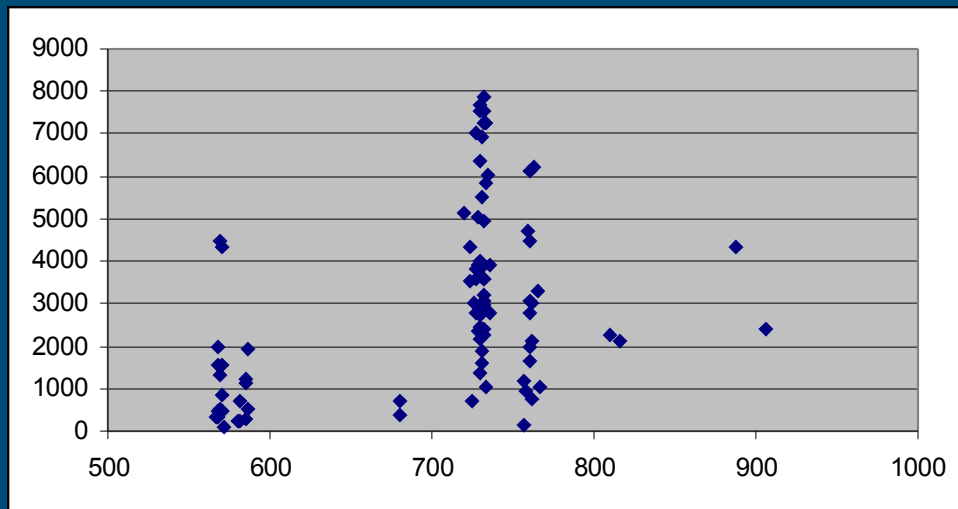
Uganda – bananas (n=246)

summary stat	Tgs_ban	Pgs_ban	Yban
minimum	19.0	883	224
maximum	23.4	1487	129190
average	21.8	1162	20207
standard deviation	0.9	148	19264



Uganda – Sweet potatoes (n=91)

summary stat	Tgs_ban	Pgs_ban	Ysp
minimum	18.7	567	92
maximum	22.8	906	7866
average	21.6	700	2943
standard deviation	0.6	80	2136



Uganda – district level data

District level data

Yield = production / area



What is next

Get high resolution climate data from Max Planck

Get production data for Ethiopia

Write up.

