Sawah Technology (1-1) Western, Eastern/Middle/ Southern, Sub Saharan Africa (SSA), Asia during 1961-2016 and Some world historical data during 600-2016

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1. Explosive increase of per capita rice consumption, paddy production and rice importation in Sub Saharan Africa (SSA), especially in West Africa. In some Asian countries the rice production has begun to decline due to industrial revolution.
2. Trends of areas of rice harvest and irrigated rice harvest, importation, self-sufficiency and per capita milled rice consumption in SSA, Nigeria, Western Africa, Madagascar, Eastern/Middle/Southern Africa and Asia during 1961-2016
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1. Explosive increase of per capita rice consumption, paddy production and rice importation in Sub Saharan Africa (SSA), especially in West Africa in comparison with Asia and other area of Africa

1-1. During1961-2016, Sub-Saharan Africa (SSA) increased

(1) per capita rice consumption, 2.5 times, from 11.3 kg to 27.7 kg/person/year
(2) their population 4.2 times, from 248 million to 1042 million,
(3) Annual paddy production increased 7.4 times, from 3.5 million to 26 million tons, of which 65% came from Western Africa in 2011-16. In 1961-65 it was 44%.
(4) paddy yield, 1.7 times, from 1.3t/ha to 2.2 t/ha. Yield increase has started since 2005-8.
(5) self-sufficient ratio dropped from 79% in 1961-65 to 54% in 2011-15,

1-2. Western Africa increased dramatically,

(1) per capita rice consumption, 3.4 times, from 14.5 kg to 49.6 kg/person/year
(2) their population 4.0 times, from 91million to 362million,
(3) paddy production increased 11 times, from 1.6 million to 17 million tons
(4) paddy yield, 2.0 times, from 1.0t/ha to 2.0 t/ha during 1961-65/2012-16, while
(5) self-sufficient ratio was 75% in 1961-65, 53% in 2011-14, but 61% in 2015-2016, while

1-3. Asian increase was not so dramatic but matured change, i.e.,

(1) per capita rice consumption, 1.2 times, from 79.4 kg to 97.1 kg/person/year
(2) their population 2.5 times, from 1.8 billion to 4.5 billion,
(3) paddy production increased 3.0 times, from 222 million to 668 million tons
(4) paddy yield, 2.4 times, from 2.0t/ha to 4.8 t/ha,

1-4. Comparison of Per Capita various foods' consumption trends in Western- and Eastern/Middle/Southern Africa and Asia during 1961-2016

(1) In Asia rice is No.1, then wheat, but now maize is mainly for animal feed.
(2) In Western Africa, general food supply is improving, including the highest rate of importation of rice/wheat. Rice is No.1 consumption now, then yam, maize and cassava. But sorghum/millet are decreasing, which were the highest consumption 50years ago.
(3) In Eastern/Middle/Southern Africa, maize is continuously No.1, then wheat, including the rapid increase of importation. General food supplies are stagnating last 50 years.

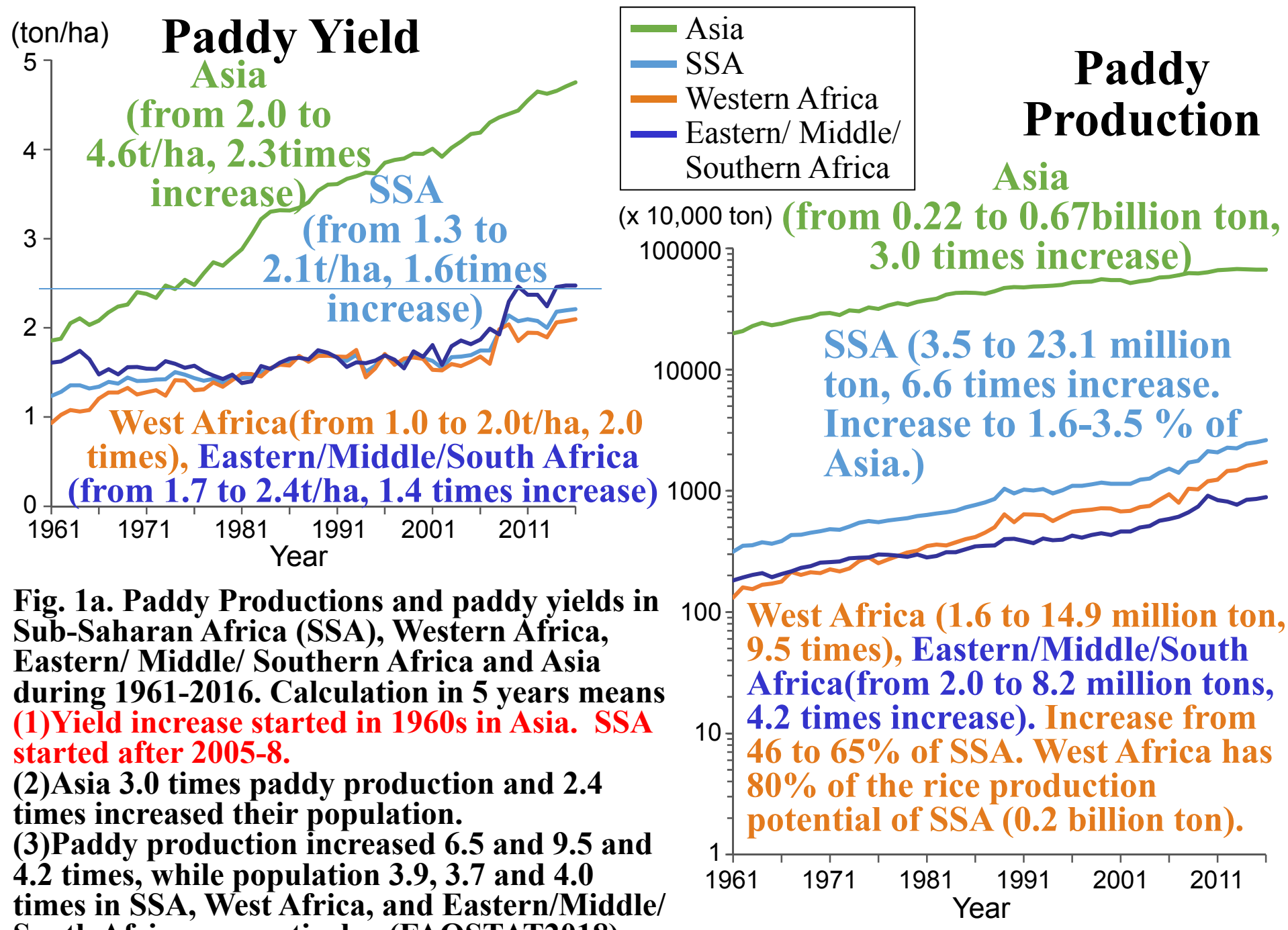


Fig. 1a. Paddy Productions and paddy yields in Sub-Saharan Africa (SSA), Western Africa, Eastern/ Middle/ Southern Africa and Asia during 1961-2016. Calculation in 5 years means
(1)Yield increase started in 1960s in Asia. SSA started after 2005-8.
(2)Asia 3.0 times paddy production and 2.4 times increased their population.
(3)Paddy production increased 6.5 and 9.5 and 4.2 times, while population 3.9, 3.7 and 4.0 times in SSA, West Africa, and Eastern/Middle/ South Africa, respectively. (FAOSTAT2018)

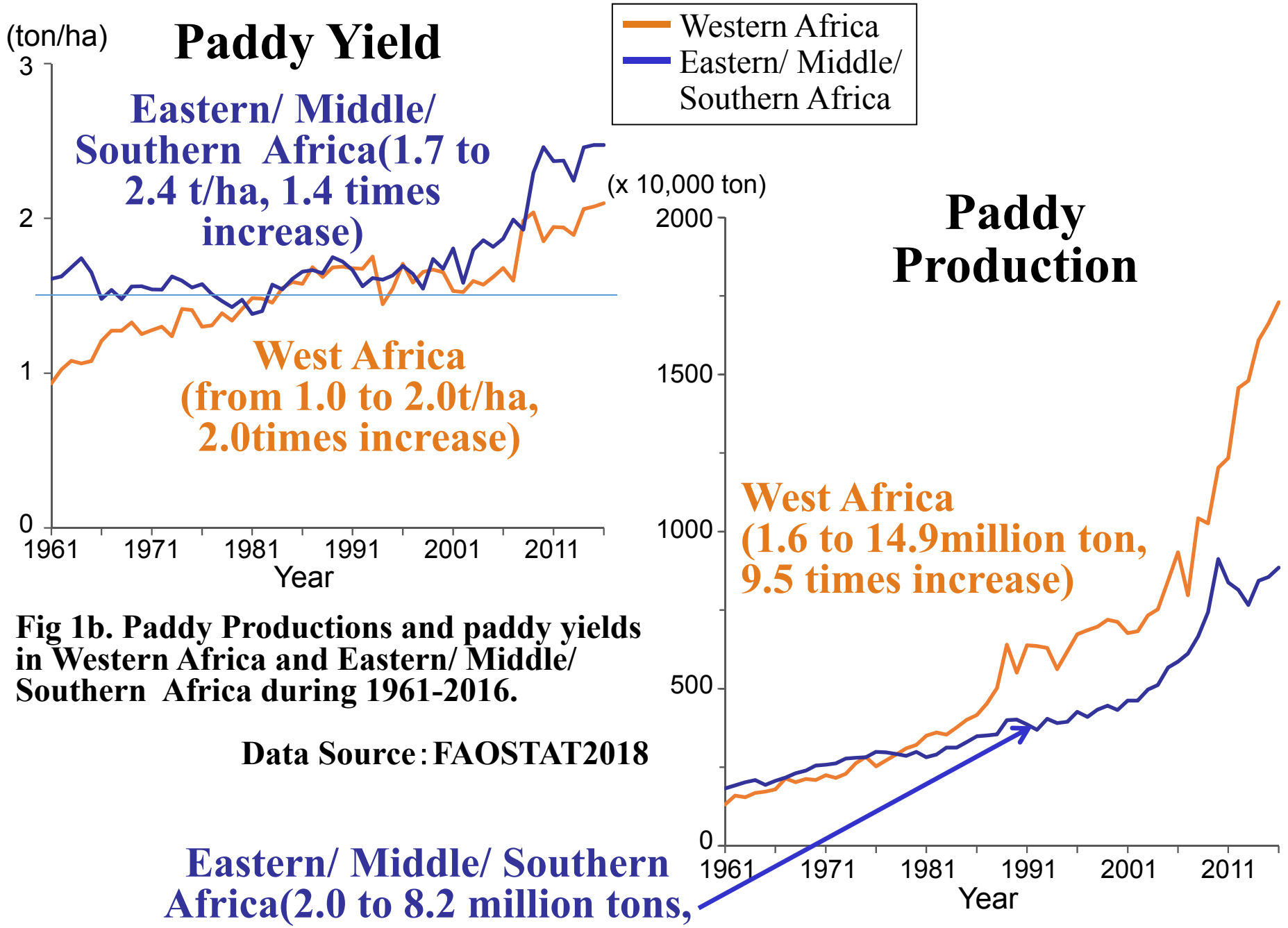


Fig 1b. Paddy Productions and paddy yields in Western Africa and Eastern/ Middle/ Southern Africa during 1961-2016.

Data Source：FAOSTAT2018

Table1a. Rice Value Trends in Sub Saharan Africa during 1961-2016. Data source: FAOSTAT 2018; Conversion ratio: Paddy x 0.625 = Milled rice amount; All data are mean of five years except for 2008 and 2016 as well as missing annual data.

	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2008	2006 -2010	2011 -2015	2016
Population (million)	248	281	321	369	426	490	563	644	734	839	840	962	1042
Area harvested (1,000 ha)	2694	3110	3556	4114	4469	5292	6223	6814	7521	8705	8788	10952	11823
Index (%) of area harvested (100 for mean of 1971-1980)	70.2	81.1	92.7	107	117	138	162	178	196	227	229	286	308
Irrigated rice area harvested (1,000 ha)	947	1034	1128	1255	1381	1559	1715	1862	1919	1980	1982	2094	
Index (%) of irrigated area (100 for mean of 1971-1980)	79.5	86.8	94.7	105	116	131	144	156	161	166	166	176	
Percent of Irrigated rice area harvested (%)	35.2	33.2	31.7	30.5	30.9	29.5	27.6	27.3	25.5	22.8	22.6	19.1	
Paddy production (1,000 ton)	3531	4330	5149	5835	6735	8830	10058	11272	12379	17085	17046	23122	26144
Index (%) of paddy production (100 for mean of 1971-1980)	64	79	94	106	123	161	183	205	225	311	310	421	476
Production (1,000 ton, milled rice)	2207	2706	3218	3647	4210	5519	6286	7045	7737	10678	10654	14451	16340
Paddy yield (ton/ha)	1.31	1.39	1.45	1.42	1.51	1.67	1.62	1.65	1.64	1.96	1.93	2.11	2.21
Index (%) of paddy yield (100 for mean of 1971-1980)	91.4	97.1	101	99	105	116	113	115	115	137	135	147	154
Yield (ton/ha, milled rice)	0.82	0.87	0.90	0.89	0.94	1.04	1.01	1.03	1.03	1.23	1.21	1.32	1.38
Imported quantity (1,000 ton, milled rice)	600	696	904	1866	2847	3057	3838	4470	7707	8654	8954	12528	12487
Self-Sufficiency ratio (%)	78.8	79.5	78.1	66.9	59.6	64.2	62.1	61.3	50.1	55.2	54.1	53.6	56.7
Imported rice price ($/ton, milled rice)	135	156	267	356	343	276	294	303	242	556	428	507	419
Consumption per capita (kg/person, milled rice)	11.3	12.1	12.8	14.9	16.6	17.5	18.0	17.9	21.0	23.0	23.3	28.0	27.7

Table1b. Rice Value Trends in Asia during 1961-2016. Data source: FAOSTAT 2018; Conversion ratio: Paddy x 0.625 = Milled rice amount; All data are mean of five years except for 2008, and 2016 as well as missing annual data.

	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2008	2006 -2010	2011 -2015	2016
Population (million)	1811	2036	2292	2543	2804	3099	3385	3635	3871	4103	4103	4331	4463
Area harvested (million ha)	111	118	124	128	129	130	132	137	135	143	141	144	140
Index (%) of area harvested (100 for mean of 1971-1980)	88.4	93.7	98.3	102	102	103	105	109	107	113	112	114	111
Irrigated rice area harvested (million ha)	70.2	75.0	80.7	86.6	84.4	85.2	94.3	89.2	87.4	91.6	91.9	95.5	
Index (%) of irrigated area (100 for mean of 1971-1980)	84.0	89.7	96.5	104	101	102	113	107	105	110	110	114	
Percent of Irrigated rice area harvested (%)	63.0	63.5	65.0	67.5	65.6	65.5	71.5	65.0	65.0	64.0	65.2	66.4	
Paddy production (million ton)	222	264	302	342	406	448	487	536	544	624	612	667	668
Index (%) of paddy production (100 for mean of 1971-1980)	68.9	82.0	93.8	106	126	139	151	167	169	194	190	207	208
Production (million ton, milled rice)	139	165	189	213	254	280	304	335	340	390	382	417	417
Paddy yield (ton/ha)	1.99	2.23	2.43	2.66	3.15	3.44	3.69	3.91	4.04	4.36	4.34	4.64	4.75
Index (%) of paddy yield (100 for mean of 1971-1980)	77.9	87.5	95.5	105	124	135	145	153	159	171	170	182	187
Yield (ton/ha, milled rice)	1.24	1.39	1.52	1.66	1.97	2.15	2.31	2.44	2.53	2.72	2.71	2.90	2.97
Imported quantity (1,000 ton, milled rice)	5343	5527	5445	5675	5546	5208	6783	11719	11578	14006	13410	16241	15681
Self-Sufficiency ratio (%)	96.3	96.7	97.2	97.4	97.8	98.2	97.8	96.6	96.7	96.5	96.6	96.3	96.4
Imported rice price ($/ton, milled rice)	125	162	270	366	379	324	372	365	312	770	623	712	615
Consumption per capita (kg/person, milled rice)	79.4	83.6	84.7	86.2	92.4	92.0	91.9	95.4	90.8	98.4	96.4	100	97.1

Table2a. Rice Value Trends in Western Africa during 1961-2016. Data source: FAOSTAT 2018; Conversion ratio: Paddy x 0.625 = Milled rice amount; All data are mean of five years except for 2008 and 2016 as well as missing annual data.

	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2008	2006 -2010	2011 -2015	2016
Population (million)	90.7	101	114	130	149	171	196	224	255	291	292	334	362
Area harvested (1,000 ha)	1515	1603	1826	2137	2434	3095	3814	4221	4697	5249	5465	7496	8244
Index (%) of area harvested (100 for mean of 1971-1980)	76.4	80.9	92.1	108	123	156	192	213	237	265	276	378	416
Irrigated rice area harvested (1,000 ha)	55.2	58.2	65.3	143	221	309	483	623	563	616	617	654	
Index (%) of irrigated area (100 for mean of 1971-1980)	53.1	55.9	62.8	137	213	297	465	599	541	592	593	628	
Percent of Irrigated rice area harvested (%)	3.64	3.63	3.58	6.68	9.09	10.0	12.7	14.8	12.0	11.7	11.3	8.72	
Paddy production (1,000 ton)	1571	2035	2430	2890	3683	5119	6167	6977	7377	10423	10004	14885	17293
Index (%) of paddy production (100 for mean of 1971-1980)	59.1	76.5	91.4	109	138	192	232	262	277	392	376	559	650
Production (1,000 ton, milled rice)	982	1272	1519	1807	2302	3199	3854	4360	4611	6514	6253	9303	10808
Paddy yield (ton/ha)	1.04	1.27	1.33	1.35	1.51	1.65	1.62	1.65	1.57	1.99	1.83	1.98	2.10
Index (%) of paddy yield (100 for mean of 1971-1980)	77.3	94.7	99.2	101	113	123	121	123	117	148	137	148	157
Yield (ton/ha, milled rice)	0.65	0.79	0.83	0.84	0.95	1.03	1.01	1.03	0.98	1.24	1.14	1.24	1.31
Imported quantity (1,000 ton, milled rice)	333	403	477	1188	1809	1852	2401	2801	4996	5496	5574	7666	7164
Self-Sufficiency ratio (%)	74.9	75.9	76.1	61.9	56.0	63.0	61.6	60.9	48.0	54.2	52.7	54.8	60.1
Imported rice price ($/ton, milled rice)	133	148	253	362	342	261	274	291	234	545	413	495	394
Consumption per capita (kg/person, milled rice)	14.5	16.5	17.5	22.9	27.5	29.4	32.0	32.0	37.7	41.2	40.5	50.8	49.6

Table2b. Rice Value Trends in Eastern, Middle and Southern Africa during 1961-2016. Data source: FAOSTAT 2018; Conversion ratio: Paddy x 0.625 = Milled rice amount; All data are mean of five years except for 2008 and 2016 as well as missing annual data.

	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2008	2006 -2010	2011 -2015	2016
Population (million)	157	180	207	239	276	319	367	420	480	548	548	628	680
Area harvested (1,000 ha)	1179	1506	1730	1976	2035	2197	2409	2593	2825	3456	3323	3456	3579
Index (%) of area harvested (100 for mean of 1971-1980)	63.6	81.3	93.4	107	110	119	130	140	152	187	179	186	193
Irrigated rice area harvested (1,000 ha)	892	976	1063	1112	1160	1251	1231	1238	1356	1364	1365	1441	
Index (%) of irrigated area (100 for mean of 1971-1980)	82.0	89.7	97.7	102	107	115	113	114	125	125	126	132	
Percent of Irrigated rice area harvested (%)	75.7	64.8	61.4	56.3	57.0	56.9	51.1	47.8	48.0	39.5	41.1	41.7	
Paddy production (1,000 ton)	1960	2296	2719	2944	3053	3711	3891	4295	5001	6662	7042	8237	8851
Index (%) of paddy production (100 for mean of 1971-1980)	69.2	81.1	96.0	104	108	131	137	152	177	235	249	291	313
Production (1,000 ton, milled rice)	1225	1435	1699	1840	1908	2319	2432	2684	3126	4163	4401	5148	5532
Paddy yield (ton/ha)	1.66	1.52	1.57	1.49	1.50	1.69	1.62	1.66	1.77	1.93	2.11	2.38	2.47
Index (%) of paddy yield (100 for mean of 1971-1980)	109	99.5	103	97.4	98.0	110	106	108	116	126	138	156	162
Yield (ton/ha, milled rice)	1.04	0.95	0.98	0.93	0.94	1.05	1.01	1.04	1.11	1.20	1.32	1.49	1.55
Imported quantity (1,000 ton, milled rice)	267	292	426	678	1037	1205	1437	1669	2711	3158	3379	4862	5323
Self-Sufficiency ratio (%)	82.2	83.0	80.0	73.2	64.9	65.9	62.9	61.8	53.9	56.9	56.2	51.6	51.0
Imported rice price ($/ton, milled rice)	138	167	280	342	344	298	328	324	258	576	456	524	453
Consumption per capita (kg/person, milled rice)	9.49	9.60	10.3	10.6	10.7	11.0	10.5	10.4	12.1	13.4	14.2	15.9	16.0

2. Trends of areas of rice harvest and irrigated rice harvest, importation, self-sufficiency and per capita milled rice consumption in SSA, Nigeria, Western Africa, Madagascar, Eastern/Middle/Southern Africa and Asia during 1961-2016

Table 3. Rice Value Trends in Nigeria (No.1 rice producing country in SSA during 2011-2015) during 1961-2016. Data source: FAOSTAT 2018; Conversion ratio: Paddy x 0.625 = Milled rice amount; All data are mean of five years except for 2008 and 2016 as well as missing annual data.

	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2008	2006 -2010	2011 -2015	2016
Population (million)	48.1	53.6	60.2	69.3	79.5	90.5	103	116	132	150	150	172	186
Area harvested (1,000 ha)	179	234	289	332	630	1069	1678	2053	2271	2382	2366	2854	2996
Index (%) of area harvested (100 for mean of 1971-1980)	57.7	75.4	93.0	107	203	344	541	661	732	767	762	919	965
Irrigated rice area harvested (1,000 ha)	98.0	98.0	98.0	98.0	98.0	171	261	315	313	266	266	219	
Index (%) of irrigated area (100 for mean of 1971-1980)	100	100	100	100	100	175	266	322	319	272	272	223	
Percent of Irrigated rice area harvested (%)	54.7	41.9	33.9	29.5	15.6	16.0	15.5	15.4	13.8	11.2	11.3	7.67	
Paddy production (1,000 ton)	207	321	470	596	1300	2216	2980	3248	3139	4179	3885	5426	6071
Index (%) of paddy production (100 for mean of 1971-1980)	39	60	88	112	244	416	559	609	589	784	729	1018	1139
Production (1,000 ton, milled rice)	130	201	294	373	813	1385	1862	2030	1962	2612	2428	3391	3794
Paddy yield (ton/ha)	1.15	1.36	1.67	1.71	2.06	2.10	1.78	1.59	1.38	1.75	1.66	1.91	2.03
Index (%) of paddy yield (100 for mean of 1971-1980)	67.9	80.7	98.8	101	122	124	106	94.0	81.7	104	98.3	113	120
Yield (ton/ha, milled rice)	0.72	0.85	1.04	1.07	1.29	1.31	1.11	0.99	0.86	1.10	1.04	1.19	1.27
Imported quantity (1,000 ton, milled rice)	1.28	1.09	3.73	408	492	289	329	647	1436	971	1241	1851	90.5
Self-Sufficiency ratio (%)	99.0	99.4	98.8	51.0	62.7	81.7	84.8	76.2	57.8	72.9	66.5	65.1	97.7
Imported rice price ($/ton, milled rice)	220	197	404	565	463	258	275	337	222	795	512	550	439
Consumption per capita (kg/person, milled rice)	2.71	3.76	4.93	11.1	16.5	18.4	21.4	23.0	25.7	23.8	24.3	30.6	20.9

Table 4. Rice Value Trends in Madagascar (No.2 rice producing country in SSA during 2011-2015) during 1961-2016. Data source: FAOSTAT 2018; Conversion ratio: Paddy x 0.625 = Milled rice amount; All data are mean of five years except for 2008 and 2016 as well as missing annual data.

	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2008	2006 -2010	2011 -2015	2016
Population (million)	5.49	6.24	7.15	8.24	9.5	11.0	12.7	14.8	17.3	20.0	20.0	23.0	24.9
Area harvested (1,000 ha)	843	986	1042	1147	1183	1142	1166	1187	1227	1284	1284	1020	862
Index (%) of area harvested (100 for mean of 1971-1980)	77.0	90.1	95.2	105	108	104	107	108	112	117	117	93.2	78.7
Irrigated rice area harvested (1,000 ha)	375	438	463	510	526	507	675	793	909	1044	1044	793	
Index (%) of irrigated area (100 for mean of 1971-1980)	77.0	90.1	95.2	105	108	104	139	163	187	215	215	163	
Percent of Irrigated rice area harvested (%)	44.4	44.4	44.4	44.4	44.4	44.4	57.9	66.8	74.1	81.3	81.3	77.70	
Paddy production (1,000 ton)	1563	1779	1943	2037	2087	2271	2430	2511	2898	3914	4055	4032	3816
Index (%) of paddy production (100 for mean of 1971-1980)	78.5	89.4	97.6	102	105	114	122	126	146	197	204	203	192
Production (1,000 ton, milled rice)	977	1112	1214	1273	1305	1420	1519	1569	1811	2446	2535	2520	2385
Paddy yield (ton/ha)	1.85	1.80	1.87	1.78	1.76	1.99	2.08	2.12	2.36	3.05	3.15	3.97	4.43
Index (%) of paddy yield (100 for mean of 1971-1980)	102	99.0	102	97.6	96.8	109	114	116	129	167	173	218	243
Yield (ton/ha, milled rice)	1.16	1.13	1.17	1.11	1.10	1.24	1.30	1.32	1.47	1.91	1.97	2.48	2.77
Imported quantity (1,000 ton, milled rice)	17.0	15.1	67.1	104	214	94.8	46.2	87.5	190	169	151	282	233
Self-Sufficiency ratio (%)	98.4	98.7	94.8	92.5	86.1	93.8	97.1	94.9	90.8	93.6	94.2	89.8	91.1
Imported rice price ($/ton, milled rice)	127	129	236	293	263	302	315	288	198	473	387	438	385
Consumption per capita (kg/person, milled rice)	181	180	179	167	160	138	123	112	115	131	134	122	105

Table 5. Ranking Trend of Paddy Production (x1,000 ton) of Major Sub Saharan African Countries + Egypt During 1961-2016. (The rank is based on mean annual paddy production during 2011-15; Data source: FAOSTAT 2018; Blue >10 times increase, Green >5 times increase, Red decrease.)

Country	Rank (2011-15)	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2006 -2010	2011 -2015	2016
Egypt		1845	2342	2396	2363	2333	2566	4178	5333	5997	6147	5519	6300
Nigeria	1	207	321	470	596	1300	2216	2980	3248	3139	3885	5426	6071
Madagascar	2	1563	1779	1943	2037	2087	2271	2430	2511	2898	4055	4032	3816
UR Tanzania	3	120	121	229	320	330	653	579	743	1035	1591	2369	2986
Mali	4	172	158	174	191	165	274	447	678	847	1334	2059	2781
Guinea	5	230	286	355	441	548	680	844	1048	1150	1469	1941	1983
Cote d'Ivoire	6	220	321	388	479	451	621	673	624	665	779	1693	1768
Sierra Leone	7	336	457	502	563	484	501	446	316	490	849	1120	1560
Senegal	8	100	114	88	97	127	155	172	202	218	380	555	885
Ghana	9	34	53	66	92	64	80	161	213	264	324	552	688
DR Congo	10	62	146	198	220	273	351	404	344	317	317	311	306
Burkina Faso	11	32	38	35	42	44	38	57	98	92	172	308	340
Liberia	12	125	158	222	247	286	271	76	170	124	256	275	309
Chad	13	29	36	42	33	21	56	84	112	122	142	258	258
Benin	14	1	2	9	13	7	9	12	34	63	104	247	281
Mauritania	15	0.6	0.7	3	6	20	49	51	82	75	85	233	213
Uganda	16	3	7	15	22	19	33	71	91	128	184	227	247
Cameroon	17	10	16	18	52	77	65	38	51	52	99	196	359
Guinea-Bissau	18	48	40	38	52	96	109	127	99	90	155	177	186
Mozambique	19	94	86	110	62	82	93	74	175	107	145	174	115
Togo	20	21	19	16	15	15	25	40	79	67	94	164	137
Kenya	21	14	20	33	40	42	48	47	48	48	52	121	118
Malawi	22	6	14	56	70	34	37	49	74	73	113	119	84
Ethiopia	23							10	13	13	57	115	136
Rwanda	24	0.0	0.7	2	3	6	8	11	9	35	71	86	111
Niger	25	11	33	33	28	46	68	63	63	68	67	79	30
Burundi	26	3	3	5	8	13	33	37	52	63	74	61	147
Gambia	27	33	34	30	27	30	23	18	23	25	52	54	60
Zambia	28		0.4	0.8	2	8	10	11	12	14	30	43	27
Sudan (former)	32	1	2	6	10	4	1	1	5	18	25	25	28

Table 6. Ranking Trend of Paddy Production of African (x10,000 tons) and Asian(x Million tons) Countries During 1961-2016. (This rank is based on the mean annual paddy production during 2011-15; Data source: FAOSTAT 2018; Blue >10 times and Green >5 times increase of paddy production in 50years, Red decrease.)

Rank	Asian Countries	Mean paddy production [million ton] (**Paddy yield [t/ha]**, Milled rice consumption per capita [kg/person])			SSA Countries	Mean paddy production [10,000 ton] (**Paddy yield [t/ha]**, Milled rice consumption per capita [kg/person])		
		1961-1970	1981-1990	2007-2016		1961-1970	1981-1990	2007-2016
1	**China**	85 (**2.9**, 71)	171 (**5.2**, 99)	200 (**6.7**, 92)	**Egypt**	209 (**5.2**, 41)	245 (**6.0**, 30)	579 (**9.6**, 43)
2	India	55 (**1.5**, 70)	93 (**2.3**, 73)	152 (**3.5**, 76)	**Nigeria**	26 (**1.3**, 3)	176 (**2.1**, 17)	486 (**1.8**, 27)
3	Indonesia	14 (**1.9**, 94)	39 (**4.0**, 148)	68 (**5.1**, 175)	Madagascar	167 (**1.8**, 181)	218 (**1.9**, 149)	408 (**3.7**, 126)
4	Bangladesh	16 (**1.7**, 179)	23 (**2.2**, 156)	50 (**4.4**, 204)	**UR Tanzania**	12 (**1.1**, 8)	49 (**1.6**, 17)	216 (**2.2**, 29)
5	Viet Nam	9.2 (**1.9**, 169)	16 (**2.8**, 164)	42 (**5.5**, 289)	**Mali**	16 (**1.0**, 19)	22 (**1.2**, 26)	187 (**3.0**, 83)
6	Thailand	12 (**1.8**, 233)	19 (**2.0**, 227)	33 (**3.0**, 306)	**Guinea**	26 (**1.7**, 48)	61 (**1.7**, 94)	177 (**1.4**, 127)
7	Myanmar	7.7 (**1.6**, 204)	14 (**3.0**, 234)	29 (**3.9**, 353)	Cote d'Ivoire	27 (**1.0**, 50)	54 (**1.2**, 66)	134 (**2.3**, 89)
8	Philippines	4.4 (**1.4**, 93)	8.6 (**2.6**, 101)	17 (**3.8**, 126)	Sierra Leone	40 (**1.3**, 107)	49 (**1.3**, 100)	103 (**1.8**, 125)
9	Japan	17 (**5.3**, 112)	13 (**6.1**, 69)	10 (**6.5**, 56)	Senegal	11 (**1.3**, 56)	14 (**2.0**, 67)	54 (**3.7**, 97)
10	Pakistan	2.3 (**1.6**, 28)	4.9 (**2.5**, 33)	10 (**3.6**, 34)	**Ghana**	4.3 (**1.1**, 8)	7.2 (**1.1**, 8)	48 (**2.5**, 28)
11	**Cambodia**	2.7 (**1.2**, 257)	2.0 (**1.3**, 171)	8.6 (**3.0**, 367)	DR Congo	10 (**0.8**, 5)	31 (**0.8**, 8)	31 (**0.8**, 4)
12	South Korea	5.0 (**4.2**, 113)	7.7 (**6.3**, 126)	5.8 (**6.8**, 80)	**Burkina Faso**	3.5 (**0.9**, 5)	4.1 (**1.7**, 11)	26 (**2.2**, 29)
13	Nepal	2.2 (**1.9**, 122)	2.8 (**2.0**, 105)	4.5 (**3.0**, 112)	**Liberia**	14 (**0.8**, 98)	28 (**1.2**, 125)	28 (**1.3**, 99)
14	Sri Lanka	1.1 (**2.1**, 104)	2.4 (**3.0**, 100)	3.9 (**3.8**, 126)	**Chad**	3.2 (**1.1**, 6)	3.9 (**1.2**, 7)	21 (**1.4**, 11)
15	Lao PDR	0.7 (**1.0**, 221)	1.3 (**2.0**, 215)	3.4 (**3.9**, 344)	**Benin**	0.2 (**0.7**, 2)	0.8 (**1.2**, 12)	20 (**3.3**, 108)
16	**DPR Korea**	2.1 (**4.3**, 100)	2.2 (**3.4**, 74)	2.6 (**4.8**, 71)	**Mauritania**	0.1 (**1.5**, 12)	3.5 (**4.5**, 48)	17 (**4.9**, 60)
17	Iran	0.9 (**2.7**, 24)	1.7 (**3.4**, 32)	2.3 (**4.2**, 35)	**Uganda**	0.5 (**1.1**, 1)	2.6 (**1.3**, 1)	21 (**2.2**, 7)
18	Malaysia	1.3 (**2.2**, 124)	1.8 (**2.6**, 91)	2.3 (**3.5**, 84)	**Cameroon**	1.3 (**1.0**, 3)	7.1 (**4.2**, 9)	18 (**1.4**, 31)
19	Taiwan	2.9 (**3.7**, 142)	2.7 (**4.8**, 88)	1.6 (**6.1**, 47)	Guinea-Bissau	4.4 (**1.0**, 55)	10 (**1.5**, 103)	17 (**1.8**, 105)
20	Turkey	0.2 (**4.0**, 5)	0.3 (**4.8**, 6)	0.8 (**7.9**, 10)	Mozambique	9.0 (**1.3**, 7)	8.8 (**0.9**, 10)	16 (**0.6**, 22)

Paddy production (**Yield**, Consumption)

Paddy production (**Yield**, Consumption)

Table 7. Ranking Trend of Paddy Production (x1,000 ton) of Asian Countries During 1961-2016. (This rank is based on the mean annual paddy production during 2011-15; Data source: FAOSTAT 2018)

Country	Rank (2011-15)	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2006 -2010	2011 -2015	2016
China, mainland	1	72222	97732	119952	134992	164249	177011	181742	196188	174491	190102	204717	209503
India	2	52733	57140	64510	73291	84815	100863	115905	127443	128561	142276	157728	158757
Indonesia	3	12393	16277	21177	25671	35766	42277	47499	50496	52466	60546	70467	77298
Bangladesh	4	15034	16572	16793	19318	21604	24622	26613	31620	37651	45780	51252	52590
Viet Nam	5	9487	9001	10727	11045	14586	17265	22508	29450	34621	37896	44051	43437
Thailand	6	11267	12874	13948	15917	18874	19271	20378	23785	29353	32518	34658	25268
Myanmar	7	7769	7715	8385	10615	14276	13742	15934	18342	23481	31536	26755	25673
Philippines	8	3957	4828	5364	7268	8075	9220	9863	11057	13765	16084	18055	17627
Japan	9	16444	17764	15688	15021	13609	13264	12685	11999	10885	10763	10489	8044
Pakistan	10	1824	2848	3593	4589	4934	4923	5330	6981	7134	8898	9744	10412
Cambodia	11	2461	2880	1485	1071	1710	2316	2535	3679	4558	7200	9224	9827
South Korea	12	4809	5212	5912	7464	7578	7910	6834	7098	6683	6210	5612	5625
Nepal	13	2147	2170	2365	2306	2533	3106	3158	3820	4235	4147	4775	4299
Sri Lanka	14	967	1298	1355	1774	2390	2359	2558	2542	2900	3660	3932	4117
Lao PDR	15	609	827	865	799	1213	1311	1394	1811	2445	2912	3615	4149
DPR Korea (North Korea)	16	1972	2138	2568	2916	2285	2135	3720	1859	2289	2394	2763	2536
Iran (Islamic Republic of)	17	851	1023	1265	1410	1541	1768	2311	2425	2618	2395	2280	2386
Malaysia	18	1154	1428	1945	1906	1791	1734	2062	2094	2225	2378	2274	2252
Taiwan	19	2737	3043	3017	3186	2976	2374	2150	1931	1615	1482	1654	1588
Turkey	20	222	233	252	294	309	275	218	312	436	741	886	920
Afghanistan	21	343	382	405	426	351	331	333	346	402	604	526	357
Kazakhstan	22							334	226	246	304	368	448
Uzbekistan	23							505	353	197	196	314	212
Iraq	24	138	270	172	172	139	188	255	211	205	267	312	181
Turkmenistan	25							81	28	92	51	109	130
Timor-Leste	26	14	15	19	27	37	41	52	42	53	86	93	82
Tajikistan	27							21	47	53	59	81	96
Bhutan	28	39	44	49	54	61	54	44	48	49	72	78	76
Kyrgyzstan	29							4.0	13	18	19	26	35
Azerbaijan	30							1.6	14	14	4.1	3.6	5.4

Table 7. Ranking Trend of Paddy Production (x1,000 ton) of Asian Countries During 1961-2016. (This rank is based on the mean annual paddy production during 2011-15; Data source: FAOSTAT 2018 ; Green >5 times increase of paddy production in 50years, Red decrease.)

Country	Rank (2011-15)	1961 -1965	1966 -1970	1971 -1975	1976 -1980	1981 -1985	1986 -1990	1991 -1995	1996 -2000	2001 -2005	2006 -2010	2011 -2015	2016
China, mainland	1	72222	97732	119952	134992	164249	177011	181742	196188	174491	190102	204717	209503
India	2	52733	57140	64510	73291	84815	100863	115905	127443	128561	142276	157728	158757
Indonesia	3	12393	16277	21177	25671	35766	42277	47499	50496	52466	60546	70467	77298
Bangladesh	4	15034	16572	16793	19318	21604	24622	26613	31620	37651	45780	51252	52590
Viet Nam	5	9487	9001	10727	11045	14586	17265	22508	29450	34621	37896	44051	43437
Thailand	6	11267	12874	13948	15917	18874	19271	20378	23785	29353	32518	34658	25268
Myanmar	7	7769	7715	8385	10615	14276	13742	15934	18342	23481	31536	26755	25673
Philippines	8	3957	4828	5364	7268	8075	9220	9863	11057	13765	16084	18055	17627
Japan	9	16444	17764	15688	15021	13609	13264	12685	11999	10885	10763	10489	8044
Pakistan	10	1824	2848	3593	4589	4934	4923	5330	6981	7134	8898	9744	10412
Cambodia	11	2461	2880	1485	1071	1710	2316	2535	3679	4558	7200	9224	9827
South Korea	12	4809	5212	5912	7464	7578	7910	6834	7098	6683	6210	5612	5625
Nepal	13	2147	2170	2365	2306	2533	3106	3158	3820	4235	4147	4775	4299
Sri Lanka	14	967	1298	1355	1774	2390	2359	2558	2542	2900	3660	3932	4117
Lao PDR	15	609	827	865	799	1213	1311	1394	1811	2445	2912	3615	4149
DPR Korea (North Korea)	16	1972	2138	2568	2916	2285	2135	3720	1859	2289	2394	2763	2536
Iran (Islamic Republic of)	17	851	1023	1265	1410	1541	1768	2311	2425	2618	2395	2280	2386
Malaysia	18	1154	1428	1945	1906	1791	1734	2062	2094	2225	2378	2274	2252
Taiwan	19	2737	3043	3017	3186	2976	2374	2150	1931	1615	1482	1654	1588
Turkey	20	222	233	252	294	309	275	218	312	436	741	886	920
Afghanistan	21	343	382	405	426	351	331	333	346	402	604	526	357
Kazakhstan	22							334	226	246	304	368	448
Uzbekistan	23							505	353	197	196	314	212
Iraq	24	138	270	172	172	139	188	255	211	205	267	312	181
Turkmenistan	25							81	28	92	51	109	130
Timor-Leste	26	14	15	19	27	37	41	52	42	53	86	93	82
Tajikistan	27							21	47	53	59	81	96
Bhutan	28	39	44	49	54	61	54	44	48	49	72	78	76
Kyrgyzstan	29							4.0	13	18	19	26	35
Azerbaijan	30							1.6	14	14	4.1	3.6	5.4

3. Trends of world market prices of rice, soybean, wheat and maize during 1970-2018 (MAFF, Japan)

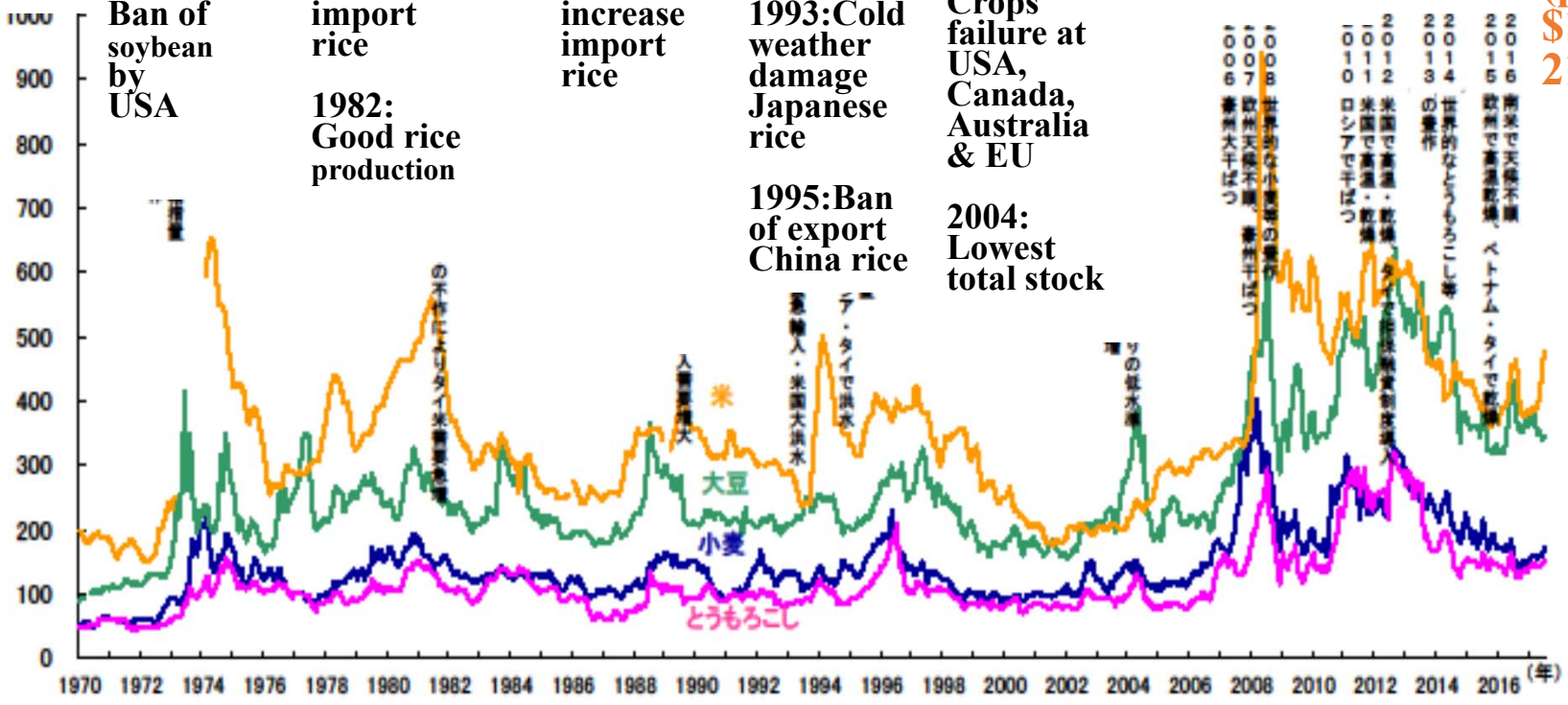
3-1. General price fluctuation trends of the four crops are very volatile and somewhat similar. This may be affected by climate fluctuation and cycling.

3-2. Last 50 years, Rice price has been about three times expensive than Maize and Wheat. Even 50% more expensive than Beans. Since necessary resources to produce per ton are similar, rice production has the highest benefit for African farmers.

3-3. Reasons: (1)Rice is Money, Rice can be easily converted into cash, High Re-deemability, (2) Easy Distribution, Preservation, Cooking and Post Harvest, (3) Good Taste and Quality Food, and (4) Others,

3-4. No devaluation compare to national currency like Naira in Nigeria. 1$=0.66Naira in 1970, =0.55N in 1980, =7.4N in 1990, =86 in 2000, =160N in 2010, =160N in 2015, =320N in 2016, =370Naira in August 2017

Trends of world price in $ per ton



Prices at 4th of June 2018

Rice:$475 (past record $1038 on 21 May 2008)

Soybean: $375 (past record $651 on 3 Jul 2008)

Wheat: $192 (past record $470 on 27 Feb 2008)

Maize: $154 (past record $327 on 21 Aug 2012)

Fig. 2. Trends of world trading prices of Rice at Thai (milled 2nd class FOB) , Soybean, Wheat and Maize at Chicago commodity exchange during 1971-2018 (Ministry of Agriculture, Forestry and Fishery, MAFF, Japan, 2018).

Note : Prices of wheat, Maize, and Soybean are prices at both the first and the last Friday of each month. Rice price is at both the first and the last Wednesday of each month. Note FOB, Free On Board at Bangkok port.

4. The past 50 years comparative trends of SSA and Asia for the population, the annual per capita production and import amount (Kg), the daily average intake of kcal, and the yields of major staple food crops.

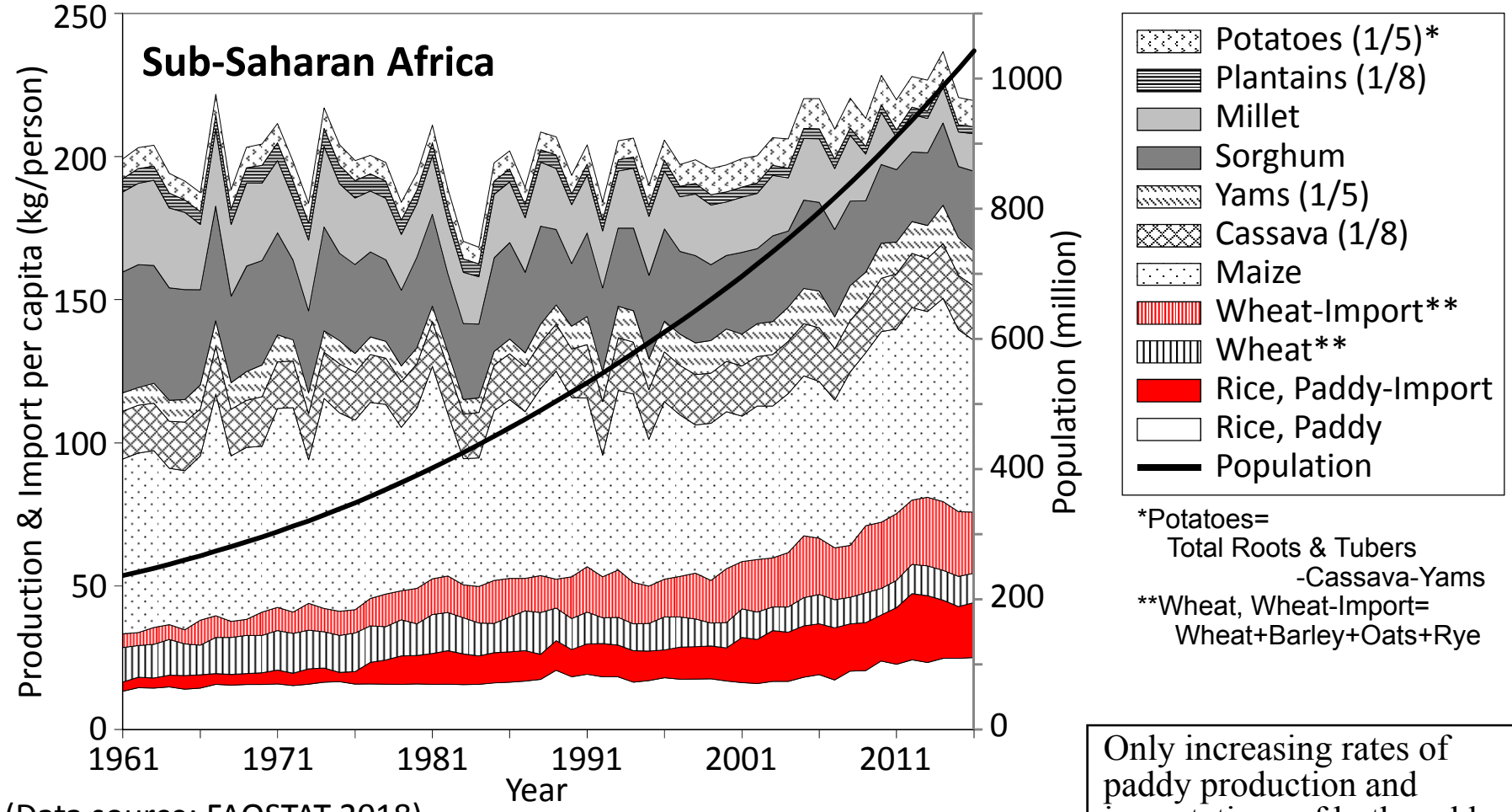
Tentative verification of cereals' equivalent coefficients of 1/8 for Cassava and Plantains, and 1/5 for Yam and Potatoes

1. The original Kg weight data of FAOSTA were divided 5 for yam and potatoes, while cassava and plantains were divided by 8 to estimate their cereals' equivalent amount for comparison.
2. Tentative reasons are as follows.

(1) Cassava and yam Food energy supply, kcal per g of potatoes and plantain are one fifth, a quarter for Yama and cassava, i.e., cassava 132kcal/100g, potatoes 82kcal/100g, yam 100kcal/100g, plantain 122kcal/100g, while milled rice 368kcal/100g, maize 365kca/100g, wheat 327kcal/100g.

(2) The post harvest loss of cassava and Yam are estimated 2 times, plantain for 1.6 times, and potatoes for 1.0 of cereals.

3.These conversion factors, 1/8 and 1/5 respectively, can be supported through the comparison between many figures on food supply (kcal/capita/day) and those of kg per person.

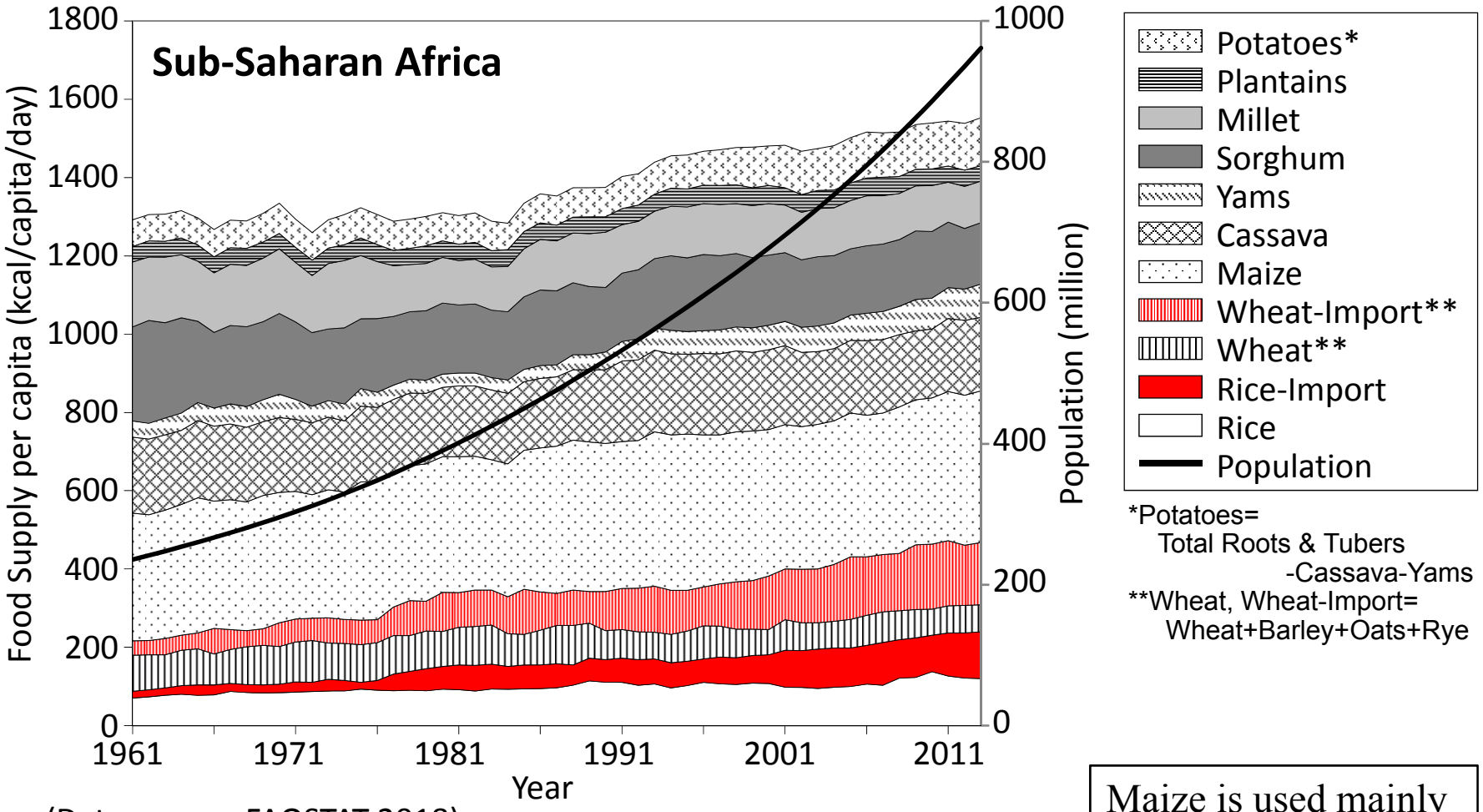


(Data source: FAOSTAT 2018)

Fig. 3a. Per Capita various Food Production & Import (kg/person) in Sub-Saharan Africa during 1961-2016.

Cereal equivalent amounts of calories per kg are one fifth for Potato & plantain, one fourth for Yam and cassava (FAO Food composition data). In addition to these, postharvest and storage losses are estimated 2 times bigger than cereals for Cassava, 1.6 times for plantain, 1.3 times for Yam, and 1.0 for potatoes. Thus the cereals conversion ratios of potatoes and Yams are 1/5 and 1/8 for Plantains and Cassava.

Only increasing rates of paddy production and importations of both paddy and wheat exceeded to population growth. Per capita productions of both potatoes and Yam increased slightly. Per Capita rice consumption became No.2 in 2000s. Per capita food productions, however, have been stagnated last 50 years.

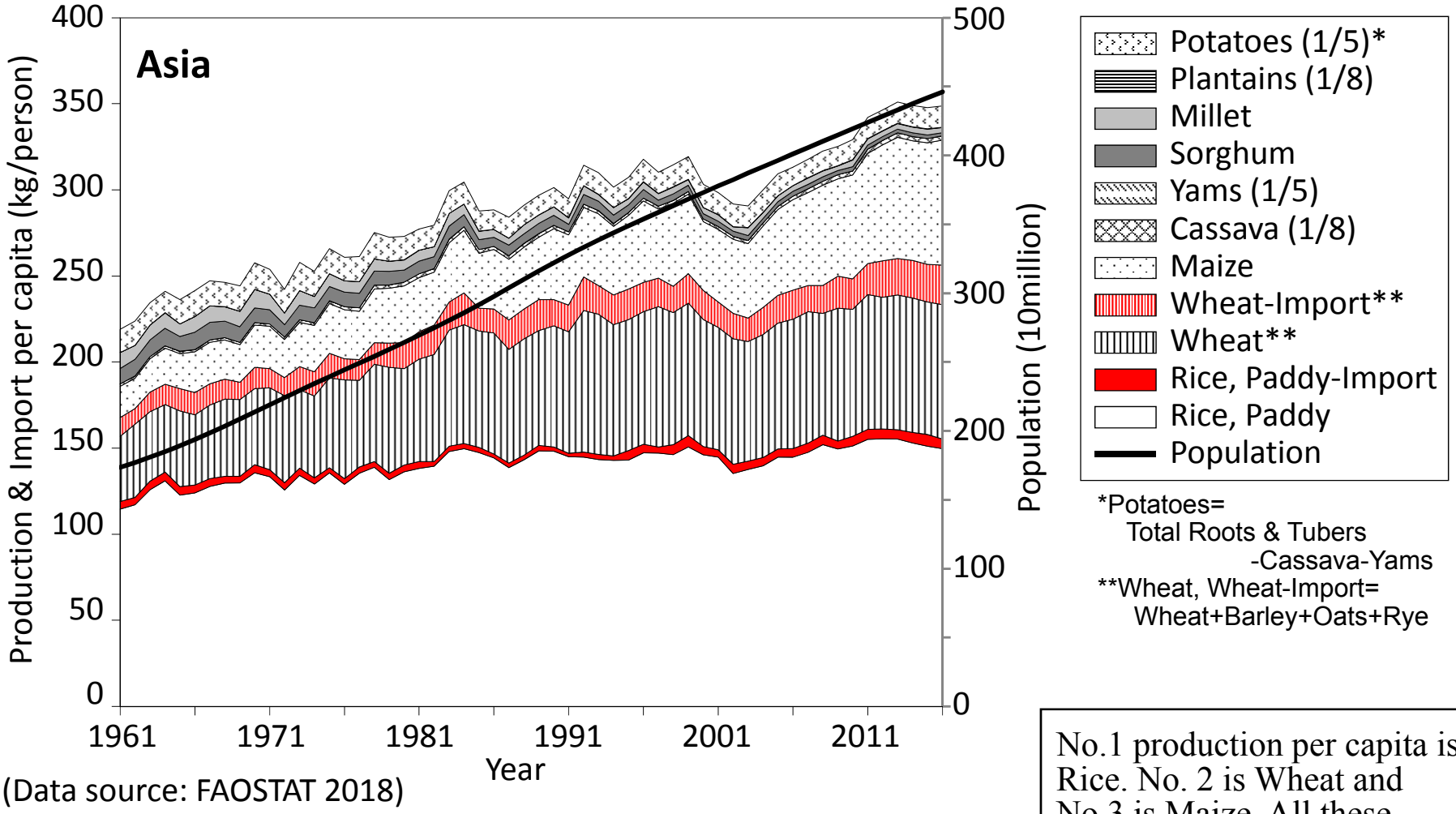


(Data source: FAOSTAT 2018)

Maize is used mainly for food in SSA

Fig. 3b. Per Capita Various Food Supply (kcal/capita/day) in Sub-Saharan Africa during 1961-2013.

We used that the cereals' equivalent coefficients of 1/8 for Cassava and Plantains as well as 1/5 for Yam and Potatoes. These conversion factors can be tentatively verified if we compare figure on per capita production and importation amounts in kg and per capita consumption in kcal.



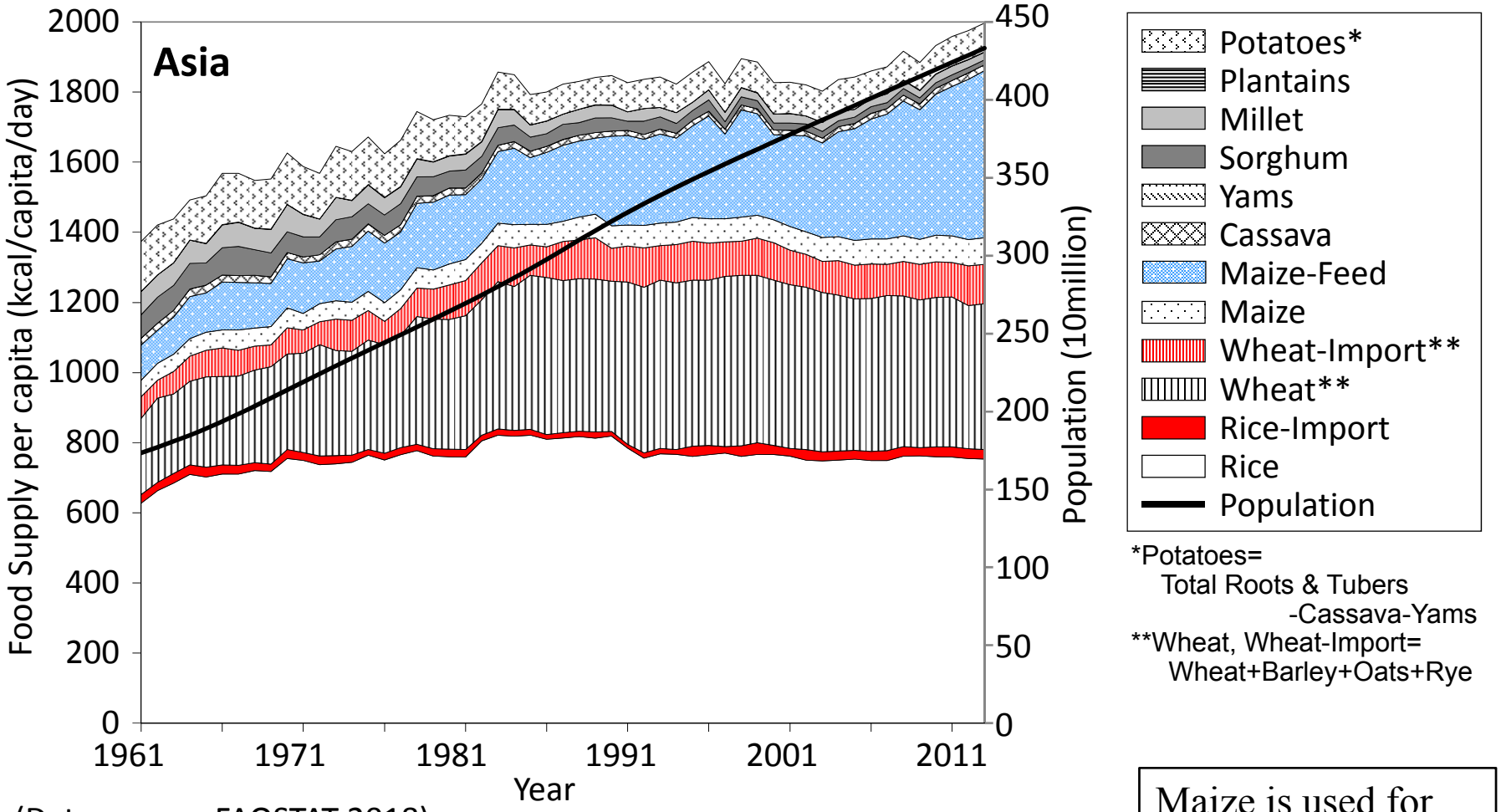
(Data source: FAOSTAT 2018)

Fig.4a. Per Capita various Food Production & Import (kg/person) in Asia during 1961-2016.

Cereal equivalent amounts of calories per kg are one fifth for Potato & plantain, one fourth for Yam and cassava (FAO Food composition data). In addition to these, postharvest and storage losses are estimated 2 times bigger than cereals for Cassava, 1.6 times for plantain, 1.3 times for Yam, and 1.0 for potatoes. Thus the cereals conversion ratios of potatoes and Yams are 1/5 and 1/8 for Plantains and Cassava.

No.1 production per capita is Rice. No. 2 is Wheat and No.3 is Maize. All these three grains increased significantly per Capita production thanks to the Green Revolution during last 50 years. This is the basic foundation of sustainable and rapid economic growth of Asian counties.

Feed（FAOSTAT, Production-Food Supply Quantity）追加



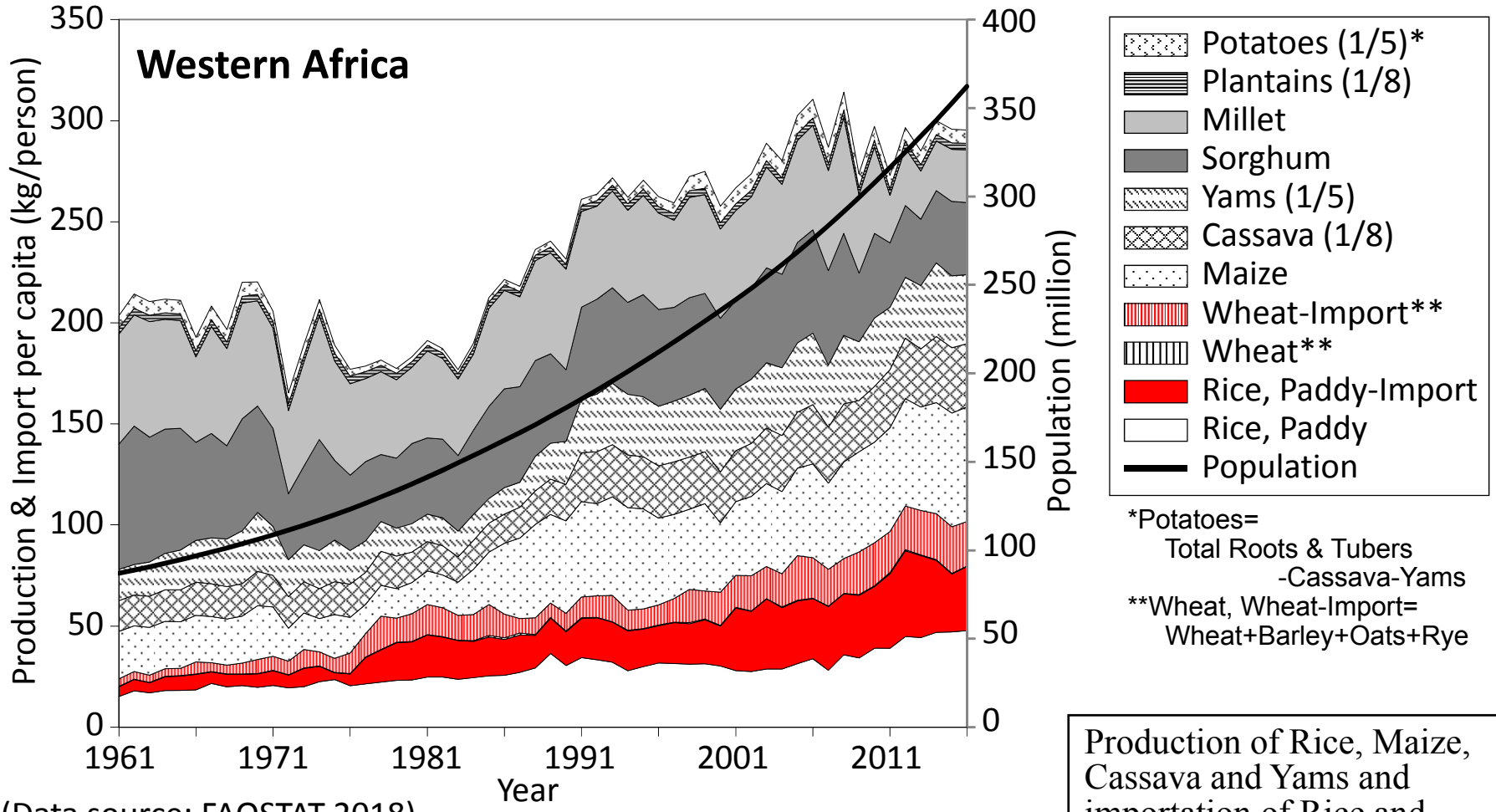
*Potatoes=
Total Roots & Tubers
-Cassava-Yams
**Wheat, Wheat-Import=
Wheat+Barley+Oats+Rye

(Data source: FAOSTAT 2018)

Fig. 4b. Per capita various Food Supply (kcal/capita/day) in Asia during 1961-2013.

Maize is used for animal feed in Asia

We used that the cereals' equivalent coefficients of 1/8 for Cassava and Plantains as well as 1/5 for Yam and Potatoes. These conversion factors can be tentatively verified if we compare figure on per capita production and importation amounts in kg and per capita consumption in kcal.

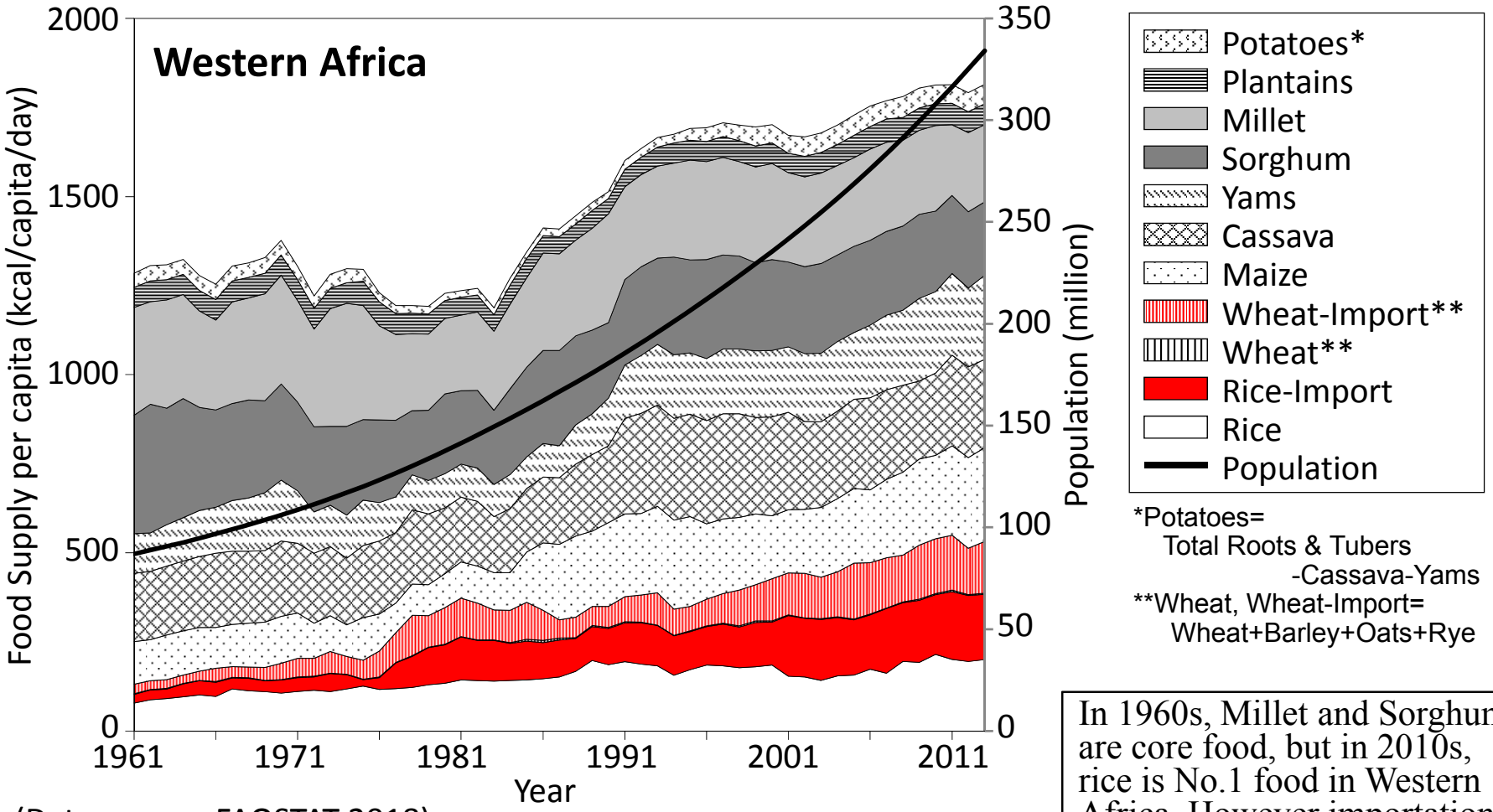


(Data source: FAOSTAT 2018)

Fig. 5a. Per Capita Various Food Production & Import (kg/person) in Western Africa during 1961-2016.

Cereal equivalent amounts of calories per kg are one fifth for Potato & plantain, one fourth for Yam and cassava (FAO Food composition data). In addition to these, postharvest and storage losses are estimated 2 times bigger than cereals for Cassava, 1.6 times for plantain, 1.3 times for Yam, and 1.0 for potatoes. Thus the cereals conversion ratios of potatoes and Yams are 1/5 and 1/8 for Plantains and Cassava.

Production of Rice, Maize, Cassava and Yams and importation of Rice and Wheat increased than Population growth. Rice production increased to the level to compete Maize production. Rice consumption ranked No.1 including importation. Overall food Production per capita slightly increased during last 50 years.



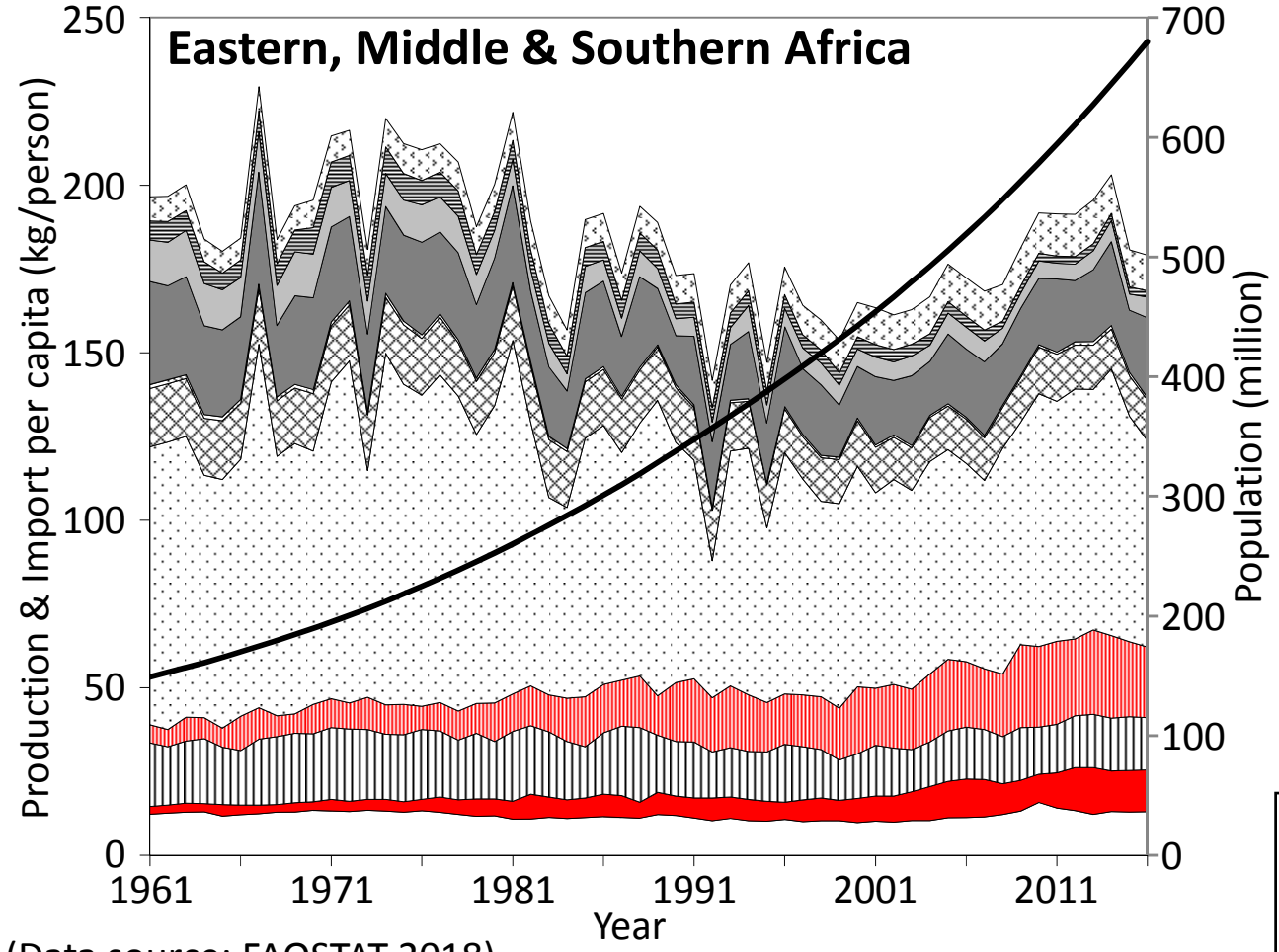
*Potatoes=
Total Roots & Tubers
-Cassava-Yams
**Wheat, Wheat-Import=
Wheat+Barley+Oats+Rye

(Data source: FAOSTAT 2018)

Fig.5b. Per Capita Various Food Supply (kcal/capita/day) in Western Africa during 1961-2013.

In 1960s, Millet and Sorghum are core food, but in 2010s, rice is No.1 food in Western Africa. However importation has been expanding rapidly even though under good Rice production ecology.

We used that the cereals' equivalent coefficients of 1/8 for Cassava and Plantains as well as 1/5 for Yam and Potatoes. These conversion factors can be tentatively verified if we compare figure on per capita production and importation amounts in kg and per capita consumption in kcal.



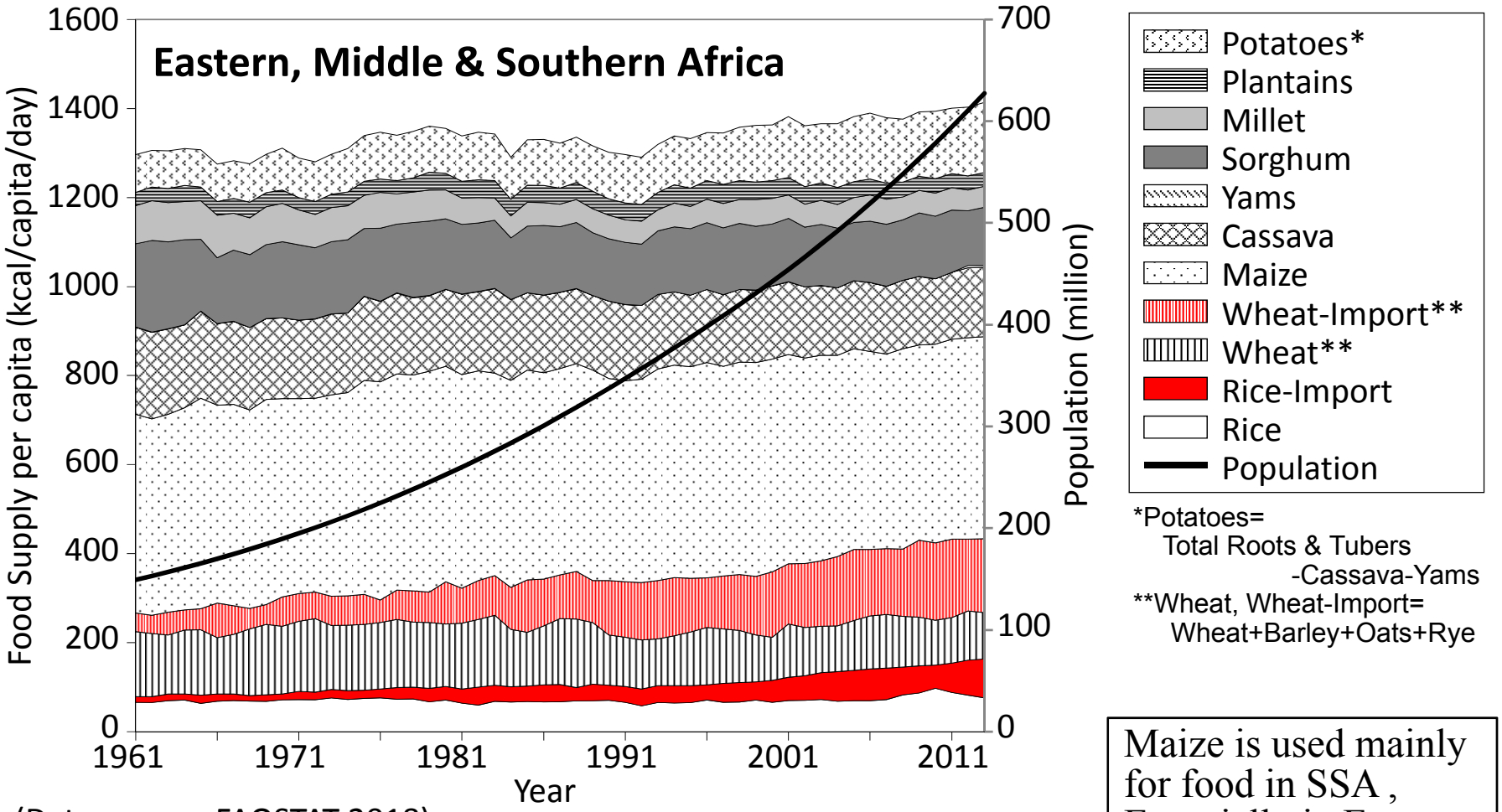
*Potatoes=
Total Roots & Tubers
-Cassava-Yams
**Wheat, Wheat-Import=
Wheat+Barley+Oats+Rye

(Data source: FAOSTAT 2018)

Fig.6a. Per Capita Food Production & Import (kg/person) in Eastern, Middle & Southern Africa during 1961-2016.

Cereal equivalent amounts of calories per kg are one fifth for Potato & plantain, one fourth for Yam and cassava (FAO Food composition data). In addition to these, postharvest and storage losses are estimated 2 times bigger than cereals for Cassava, 1.6 times for plantain, 1.3 times for Yam, and 1.0 for potatoes. Thus the cereals conversion ratios of potatoes and Yams are 1/5 and 1/8 for Plantains and Cassava.

Maize has been No.1 staple food. Only increasing rates of importations of both paddy and wheat exceeded to population growth. Per capita productions of both potatoes and Yam increased slightly. Per Capita rice consumption became No.3 in 2000s. No.2 is Wheat. Per capita food productions, however, have been stagnated last 50 years.



*Potatoes=
Total Roots & Tubers
-Cassava-Yams
**Wheat, Wheat-Import=
Wheat+Barley+Oats+Rye

(Data source: FAOSTAT 2018)

Fig.6b. Per Capita Various Food Supply (kcal/capita/day) in Eastern, Middle & Southern Africa during 1961-2013.

Maize is used mainly for food in SSA , Especially in Eastern, Middle & Southern Africa.

We used that the cereals' equivalent coefficients of 1/8 for Cassava and Plantains as well as 1/5 for Yam and Potatoes. These conversion factors can be tentatively verified if we compare figure on per capita production and importation amounts in kg and per capita consumption in kcal.

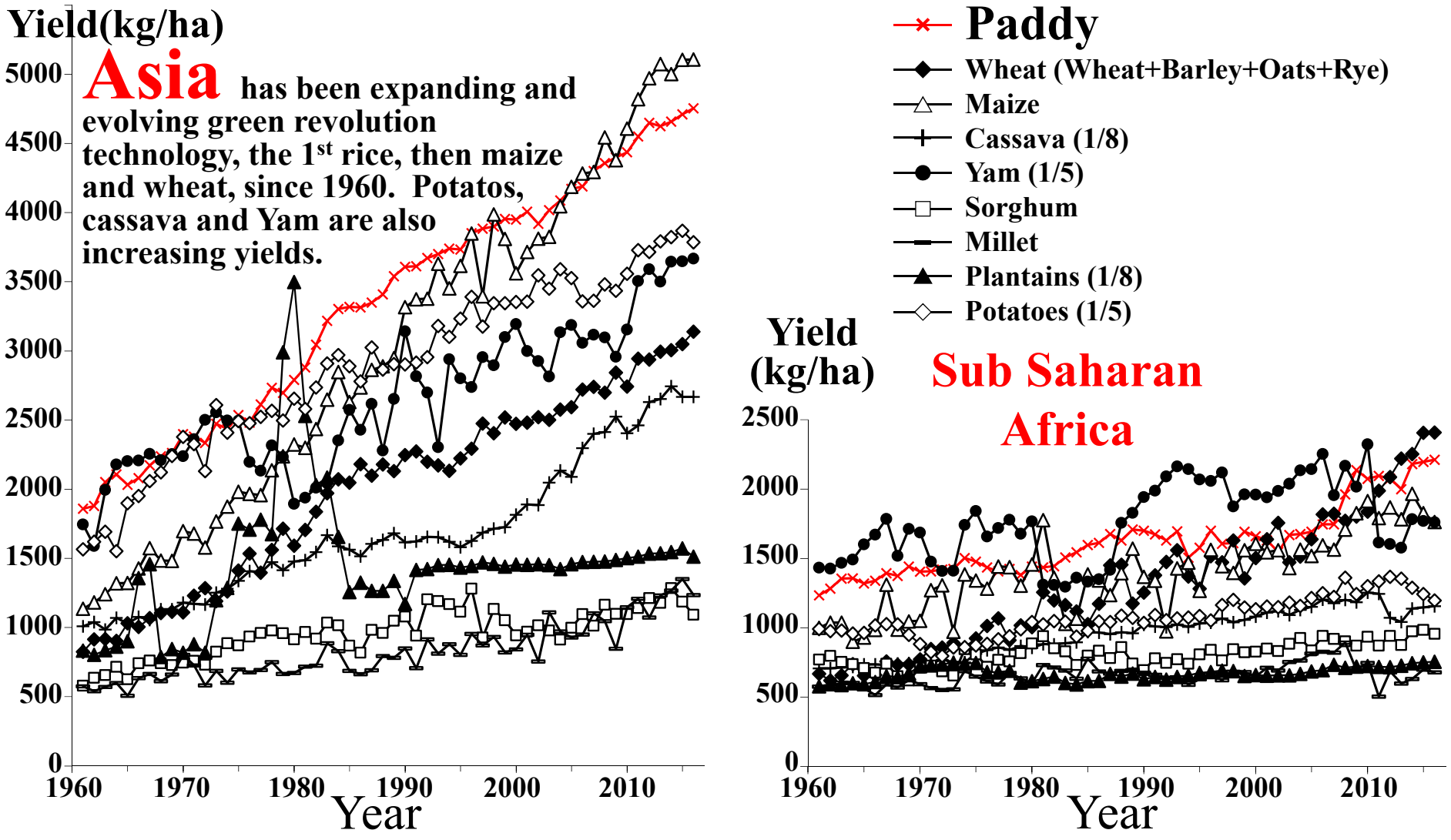


Fig.7. Yield trends of five major cereals as well as yam and cassava between Asia and Sub Saharan Africa (SSA) during 1961-2016 show that SSA has no clear indication of green revolution except for paddy (FAOSTA 2018). Kg weight data of yam and cassava were divided by 5 and 8 respectively to calculate cereals equivalent. Cassava and yam Food energy supply, kcal per g of potatoes and plantain are one fifth, a quarter for Yama and cassava. The post harvest loss of cassava and Yam are estimated 2 times, plantain for 1.6 times, and potatoes for 1.0 of cereals. This can be supported through the comparison between many figures on food supply (kcal/capita/day) and those of kg per person.

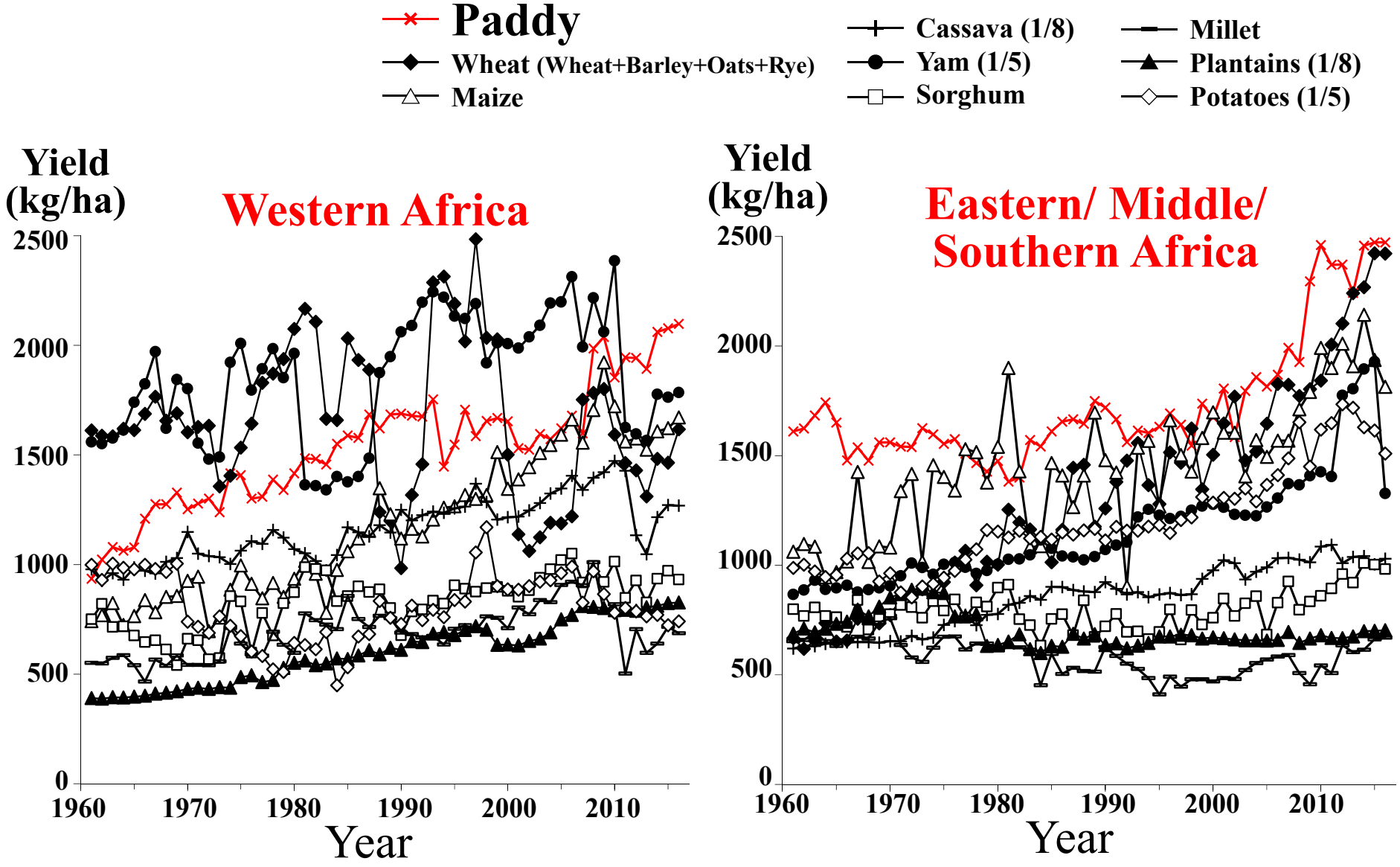


Fig. 8. Yield trends of five major cereals as well as yam and cassava between Western Africa and Eastern/ Middle/ Southern Africa during 1961-2016 (FAOSTA 2018). Kg weight data of yam and cassava were divided by 5 and 8 respectively to calculate cereals equivalent because of high water contents, high postharvest losses and low protein as well as nutrient minerals.

Table 8. Yield(kg/ha) trends of five major cereals as well as yam and cassava between Asia and Sub Saharan Africa (SSA) during 1961-2016. All data are mean of five years except for 2016. Data source: FAOSTAT, 2018.

		1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
Asia	Rice, Paddy	1986	2231	2433	2664	3153	3444	3691	3907	4041	4337	4639	4754
	Wheat	918	1081	1277	1560	1927	2168	2201	2433	2535	2749	2986	3139
	Maize	1241	1533	1777	2125	2572	2951	3489	3721	3917	4422	4995	5108
	Cassava (1/8)	1027	1115	1242	1434	1570	1610	1627	1714	2010	2409	2632	2668
	Yams (1/5)	1943	2233	2483	2155	2184	2624	2713	2977	3012	3077	3578	3668
	Sorghum	643	744	815	950	962	978	1125	1068	975	1094	1201	1092
	Millet	559	675	660	691	769	756	823	885	943	1019	1227	1234
	Plantains (1/8)	848	1054	1187	2331	1911	1273	1436	1454	1449	1484	1541	1514
	Potatoes (1/5)	1666	2151	2394	2544	2817	2896	3077	3323	3494	3439	3785	3786
SSA	Rice, Paddy	1310	1392	1447	1419	1507	1666	1617	1655	1644	1934	2110	2211
	Wheat	668	733	877	1003	1153	1303	1414	1496	1605	1811	2191	2409
	Maize	982	1077	1256	1385	1324	1382	1297	1514	1524	1722	1848	1764
	Cassava (1/8)	717	746	768	853	904	975	1016	1058	1122	1205	1129	1156
	Yams (1/5)	1485	1676	1577	1722	1323	1661	2092	1996	2049	2145	1670	1762
	Sorghum	755	681	745	790	831	783	770	821	866	915	931	958
	Millet	585	579	603	624	711	685	633	661	748	798	624	681
	Plantains (1/8)	592	661	741	655	618	647	650	675	665	717	732	756
	Potatoes (1/5)	975	981	844	956	1007	1058	1076	1141	1172	1276	1318	1197

Table 9. Yield(kg/ha) trends of five major cereals as well as yam and cassava between Western Africa and Eastern/ Middle/ Southern Africa during 1961-2016. All data are mean of five years except for 2016. Data source: FAOSTAT, 2018.

		1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
Western Africa	Rice, Paddy	1036	1268	1328	1351	1512	1651	1620	1654	1569	1831	1983	2098
	Wheat	1603	1680	1511	1871	1925	1448	1913	2013	1140	1630	1430	1616
	Maize	764	851	856	892	958	1194	1204	1358	1496	1714	1578	1671
	Cassava (1/8)	956	1024	1038	1110	1050	1170	1232	1268	1283	1407	1219	1269
	Yams (1/5)	1607	1812	1691	1897	1368	1754	2176	2050	2101	2194	1665	1784
	Sorghum	736	623	696	749	925	828	828	886	934	979	902	931
	Millet	560	539	598	620	762	736	673	730	830	888	632	686
	Plantains (1/8)	393	416	447	502	559	603	670	679	677	796	805	826
	Potatoes (1/5)	979	937	712	572	583	735	789	969	919	886	769	740
Eastern/ Middle/ Southern Africa	Rice, Paddy	1662	1523	1571	1491	1501	1687	1616	1658	1772	2109	2383	2473
	Wheat	665	730	875	1001	1148	1300	1412	1491	1612	1814	2208	2422
	Maize	1031	1125	1326	1461	1393	1452	1340	1574	1536	1726	1980	1814
	Cassava (1/8)	635	649	678	759	850	894	871	904	986	1038	1037	1030
	Yams (1/5)	894	896	982	989	1058	1043	1180	1246	1243	1376	1761	1328
	Sorghum	781	759	803	829	756	738	706	749	797	849	957	982
	Millet	659	698	615	638	583	539	512	473	522	536	604	669
	Plantains (1/8)	707	794	880	716	637	661	644	675	660	669	682	703
	Potatoes (1/5)	973	1005	898	1077	1130	1145	1170	1233	1324	1524	1669	1509

5. Data Cross check of FAOSTAT and USDA including Maize production data

Table 10a. Paddy Production (x 1,000 ton) during 1961-2016 (Egypt and Sub Saharan Africa Rank 1-8 rice production countries). All data are mean of five years except for 2016 as well as missing annual data. Data source: USDA, PS&D Online, 2018.

	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
Egypt	1845	2341	2426	2363	2351	2498	4103	5285	5983	6274	6436	6957
Nigeria	356	397	510	634	930	2122	2971	3248	3139	3885	5425	6000
Madagascar	1544	1826	1842	2053	2114	2258	2408	2540	2896	4055	4033	3816
Tanzania	117	143	214	288	358	641	580	746	994	1467	2370	2800
Mali	170	131	141	200	155	264	440	674	854	1225	2074	2782
Guinea	278	344	347	374	393	495	541	753	921	1446	1932	2174
Cote d'Ivoire	218	321	384	472	451	659	718	839	735	793	1715	2054
Sierra Leone	336	459	489	531	495	529	411	317	491	849	1025	1160
Senegal	103	112	93	104	123	153	176	178	234	361	555	900

Table 10b. Paddy Yield (t/ha) during 1961-2016 (Egypt and Sub Saharan Africa Rank 1-8 rice production countries). All data are mean of five years except for 2016 as well as missing annual data. Data source: USDA, PS&D Online, 2018.

	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
Egypt	5.29	5.08	5.27	5.46	5.73	6.17	7.74	8.68	9.72	10.02	9.11	8.18
Nigeria	1.84	1.75	1.82	1.63	1.45	1.98	1.78	1.59	1.38	1.66	1.91	2.00
Madagascar	1.85	2.01	1.76	1.80	1.78	1.87	2.04	2.10	2.36	2.90	2.77	2.59
Tanzania	1.41	1.11	1.54	1.28	1.96	1.77	1.51	1.57	1.70	1.87	2.39	2.55
Mali	0.98	0.75	0.96	1.25	0.97	1.13	1.66	2.03	2.24	2.61	3.02	3.33
Guinea	1.00	0.95	0.80	0.91	0.87	0.90	1.33	1.50	1.49	1.85	1.94	2.00
Cote d'Ivoire	0.87	1.11	1.18	1.17	1.18	1.14	1.14	1.39	1.77	1.94	2.38	2.28
Sierra Leone	1.23	1.40	1.36	1.32	1.22	1.40	1.33	1.23	1.07	1.57	1.70	1.54
Senegal	1.31	1.19	1.19	1.37	1.90	2.06	2.37	2.39	2.69	3.05	3.93	4.00

Table 11a. Paddy Production (x 1,000 ton) during 1961-2016 (Egypt and Sub Saharan Africa Rank 1-8 rice production countries). All data are mean of five years except for 2016 as well as missing annual data. Data source: FAOSTAT, 2018.

	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
Egypt	1845	2342	2396	2363	2333	2566	4178	5333	5997	6147	5519	6300
Nigeria	207	321	470	596	1300	2216	2980	3248	3139	3885	5426	6071
Madagascar	1563	1779	1943	2037	2087	2271	2430	2511	2898	4055	4032	3816
Tanzania	120	121	229	320	330	653	579	743	1035	1591	2369	2986
Mali	172	158	174	191	165	274	447	678	847	1334	2059	2781
Guinea	230	286	355	441	548	680	844	1048	1150	1469	1941	1983
Cote d'Ivoire	220	321	388	479	451	621	673	624	665	779	1693	1768
Sierra Leone	336	457	502	563	484	501	446	316	490	849	1120	1560
Senegal	100	114	88	97	127	155	172	202	218	380	555	885

Table 11b. Paddy Yield (t/ha) during 1961-2016 (Egypt and Sub Saharan Africa Rank 1-8 rice production countries). All data are mean of five years except for 2016 as well as missing annual data. Data source: FAOSTAT, 2018.

	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
Egypt	5.29	5.08	5.30	5.45	5.67	6.28	7.77	8.67	9.65	9.72	9.53	9.37
Nigeria	1.15	1.36	1.67	1.71	2.06	2.10	1.78	1.59	1.38	1.66	1.91	2.03
Madagascar	1.85	1.80	1.87	1.78	1.76	1.99	2.08	2.12	2.36	3.15	3.97	4.43
Tanzania	1.33	0.94	1.46	1.26	1.29	1.88	1.62	1.58	1.81	1.98	2.39	2.43
Mali	1.05	0.95	0.91	1.15	0.99	1.35	1.68	2.04	2.17	2.78	3.14	3.33
Guinea	1.70	1.70	1.71	1.71	1.71	1.71	1.71	1.71	1.74	1.65	1.23	1.18
Cote d'Ivoire	0.88	1.11	1.24	1.17	1.17	1.17	1.11	1.57	1.94	2.07	2.41	2.51
Sierra Leone	1.23	1.40	1.39	1.37	1.33	1.34	1.30	1.21	1.03	1.57	1.85	2.07
Senegal	1.30	1.25	1.14	1.25	1.89	2.06	2.31	2.44	2.52	3.12	3.94	3.93

Table 12a. Maize Production (x 1,000 ton) during 1961-2016 (Egypt and Sub Saharan Africa Rank 1-8 maize production countries). All data are mean of five years except for 2016 as well as missing annual data. Data source: FAOSTAT, 2018.

	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
South Africa	5272	6376	8519	9406	8259	9164	8006	9475	9796	10325	11699	7779
Nigeria	1109	1150	916	695	1107	4841	6355	5126	5243	7277	9323	10414
Egypt	1913	2322	2539	3012	3510	4129	4975	5985	6475	6949	7758	8001
Ethiopia	743	856	904	1229	1274	1701	1556	2802	3137	4005	6767	7847
Tanzania	702	661	871	1605	1835	2496	2240	2345	3492	4116	5488	5876
Kenya	1164	1490	1780	2139	2084	2599	2536	2264	2684	2889	3612	3339
Malawi	838	1053	1222	1284	1357	1354	1396	1980	1617	3095	3542	2369
Zambia	646	702	1115	1289	937	1435	987	974	929	1737	2875	2873
Uganda	215	336	468	515	368	469	758	914	1202	1913	2689	2663

Table 12b. Maize Yield (t/ha) during 1961-2016 (Egypt and Sub Saharan Africa Rank 1-8 maize production countries). All data are mean of five years except for 2016 as well as missing annual data. Data source: FAOSTAT, 2018.

	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	2016
South Africa	1.23	1.42	1.80	2.04	1.80	2.00	1.91	2.49	2.92	4.08	4.43	4.00
Nigeria	0.86	0.92	0.91	1.20	1.26	1.36	1.19	1.36	1.53	1.91	1.55	1.59
Egypt	2.89	3.62	3.64	3.83	4.31	5.17	6.04	7.30	7.73	7.88	7.67	7.39
Ethiopia	0.96	1.03	1.07	1.53	1.62	1.59	1.39	1.67	1.75	2.30	3.28	3.67
Tanzania	0.79	0.64	0.83	1.22	1.35	1.37	1.40	1.74	1.79	1.36	1.41	1.46
Kenya	1.19	1.21	1.30	1.44	1.72	1.83	1.81	1.50	1.68	1.59	1.70	1.43
Malawi	0.99	1.06	1.13	1.22	1.17	1.09	1.09	1.49	1.06	2.01	2.11	1.42
Zambia	0.84	0.83	1.09	1.65	1.81	1.95	1.58	1.59	1.66	2.23	2.75	2.48
Uganda	1.11	1.11	1.27	1.34	1.26	1.28	1.51	1.50	1.69	2.01	2.45	2.32

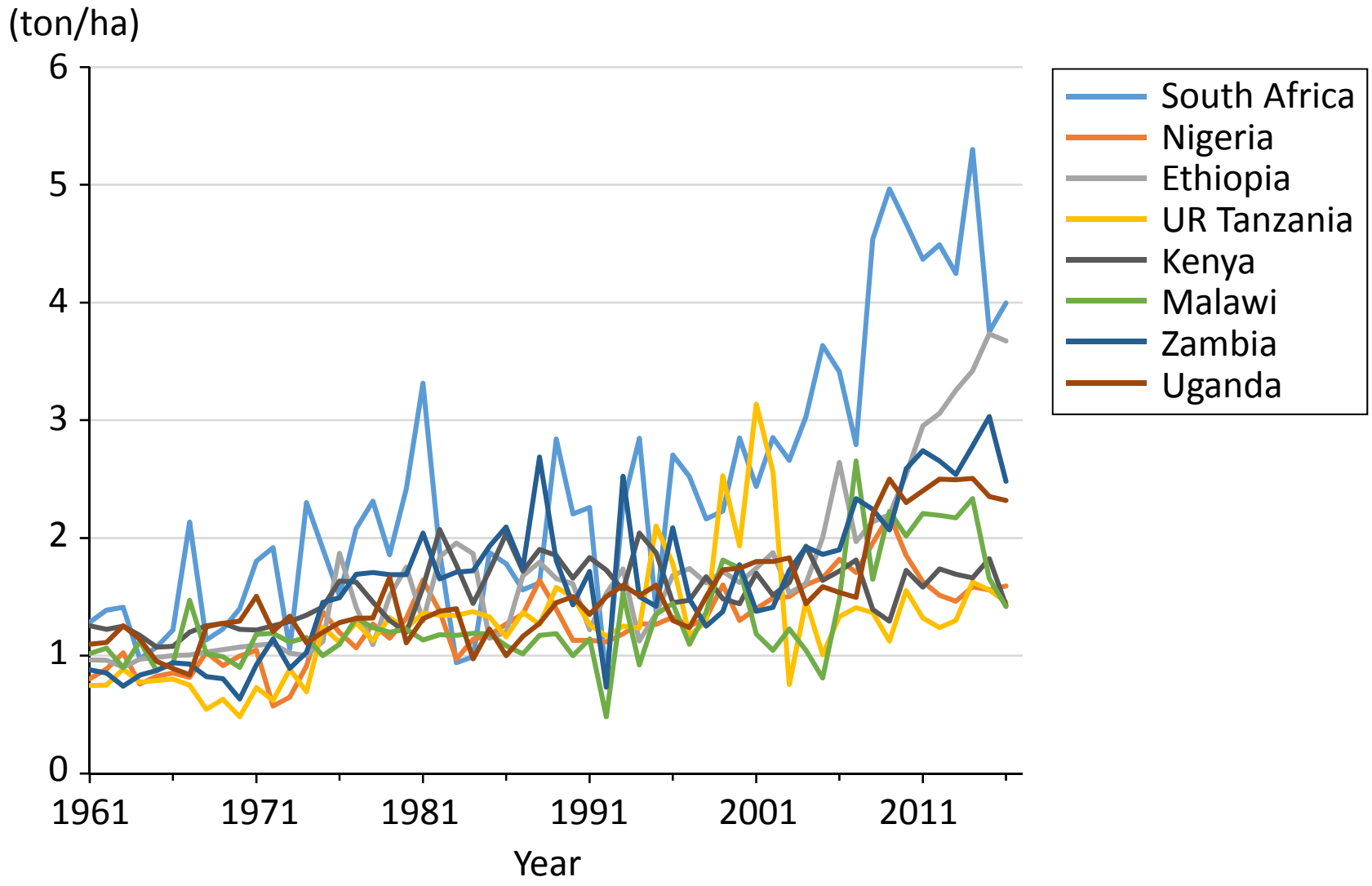


Fig. 9. Maize Yield during 1961-2016
（Sub Saharan Africa Rank 1-8 rice production countries)

Data source: FAOSTAT 2018

6. General Ranking Trend of Paddy Production and Yields of SSA's rank 1st-8th, 9th-16th, 17th-24th and below 25th countries during 1961-2016

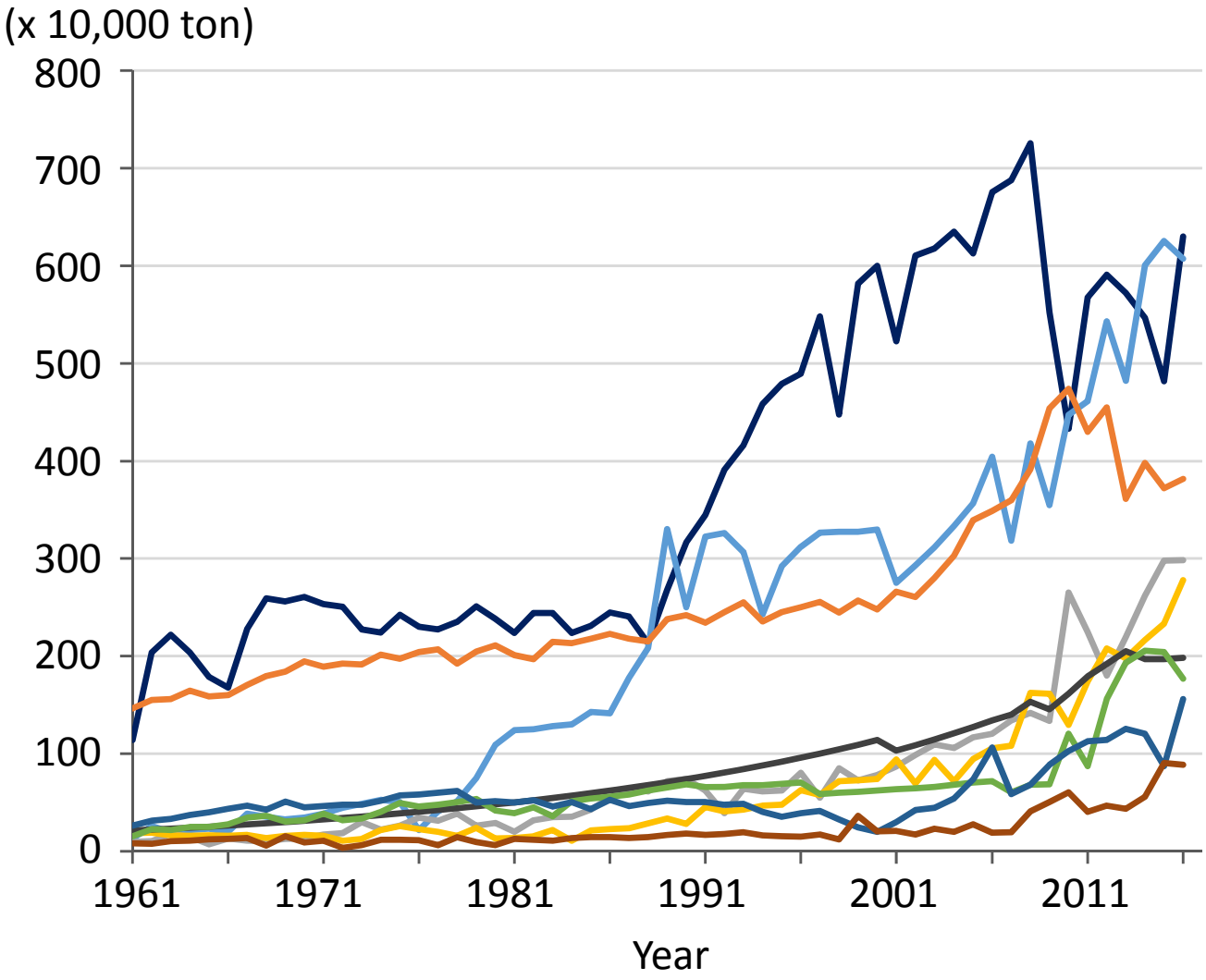


Fig. 10. Paddy Production during 1961-2016（Egypt and Sub Saharan Africa Rank 1-8 countries of paddy production)

Data source: FAOSTAT 2018

Paddy productions have been increased explosively in Nigeria. The average paddy production index for 2011 - 2015 is 26 times when that of 1961 - 1965 is 1. These indices are 3.0 for Egypt, 2.6 for Madagascar, 20 for Tanzania, 12 for Mali, 8.4 for Guinea, 7.7 for Cote d'Ivoire, 3.3 for Sierra Leone, and 5.6 for Senegal.

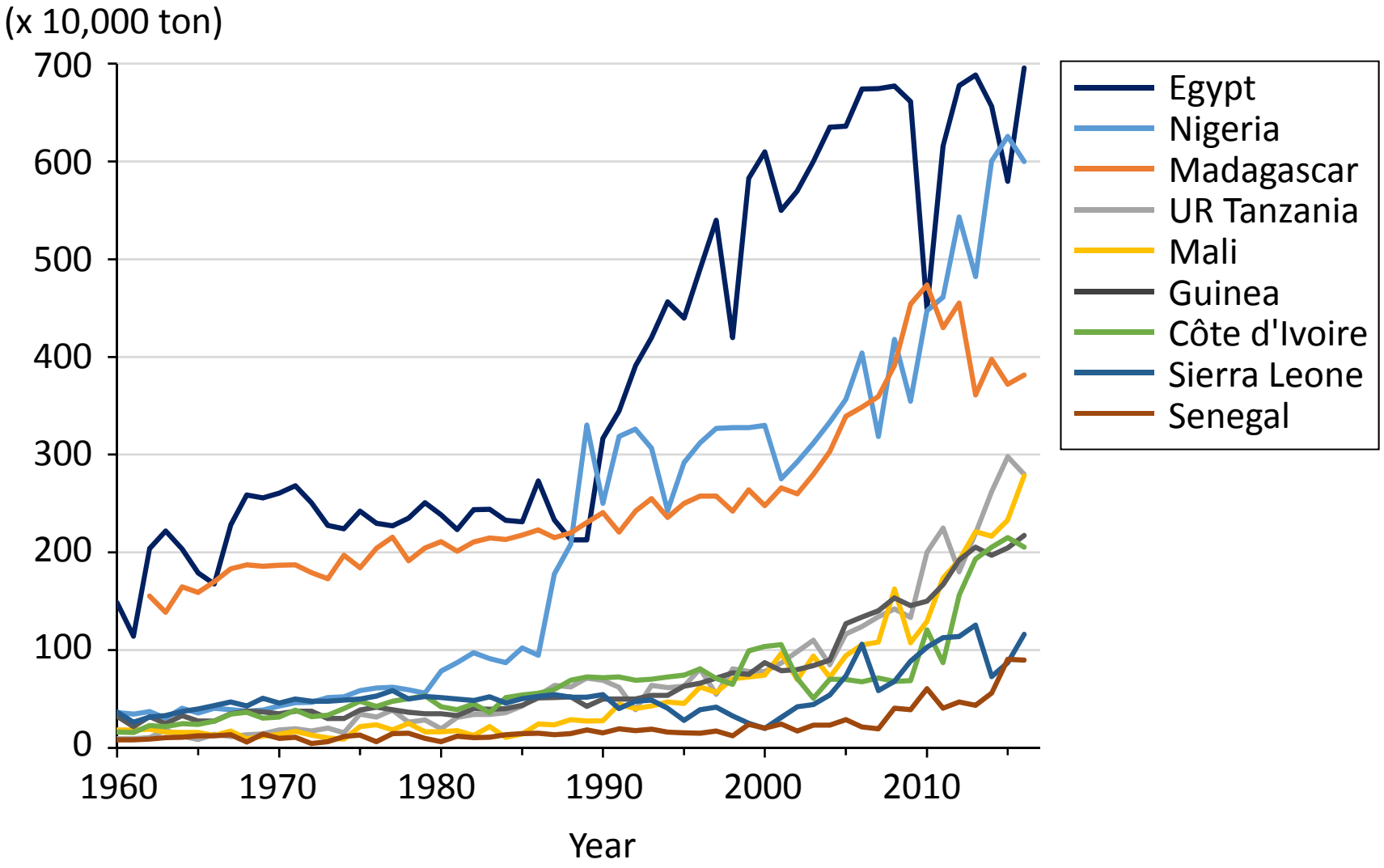


Fig.11. Paddy Production during 1960-2016
（Egypt and Sub Saharan Africa Rank 1-8 rice production countries)

Data source: USDA, PS&D Online, 2018

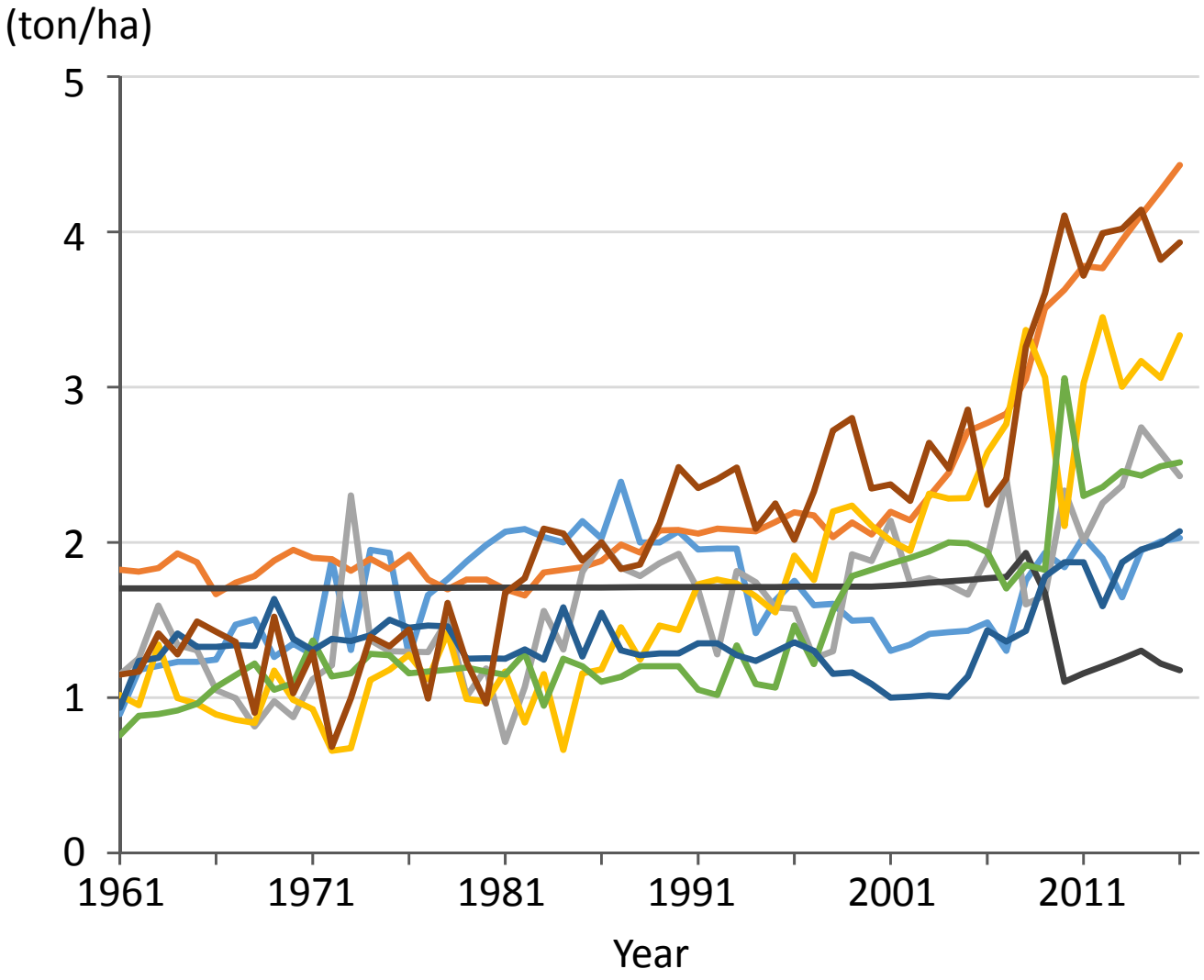


Fig. 12. Paddy Yield during 1961-2016
（Sub Saharan Africa Rank 1-8 rice production countries）

Data source: FAOSTAT 2018

Recent (2011-2016) National Paddy yield No.1 was Madagascar (4t/ha, 3.8 million ton), No.2, Senegal (3.9t/ha, 0.6million ton) , No.3, Mali (3.2t/ha, 2.2 million ton), No. 4, Cote d'Ivoire (2.4t/ha, 1.7million ton), No.5, Tanzania (2.4t/ha, 2.5million ton), No.6, Nigeria (1.9t/ha, 5.5million ton), No. 7, Sierra Leone (1.9t/ha, 1.2million ton), and Guinea (1.2t/ha, 1.9million ton). Major determining factors of the paddy yield are quality and quantity of irrigated rice fields and their management.

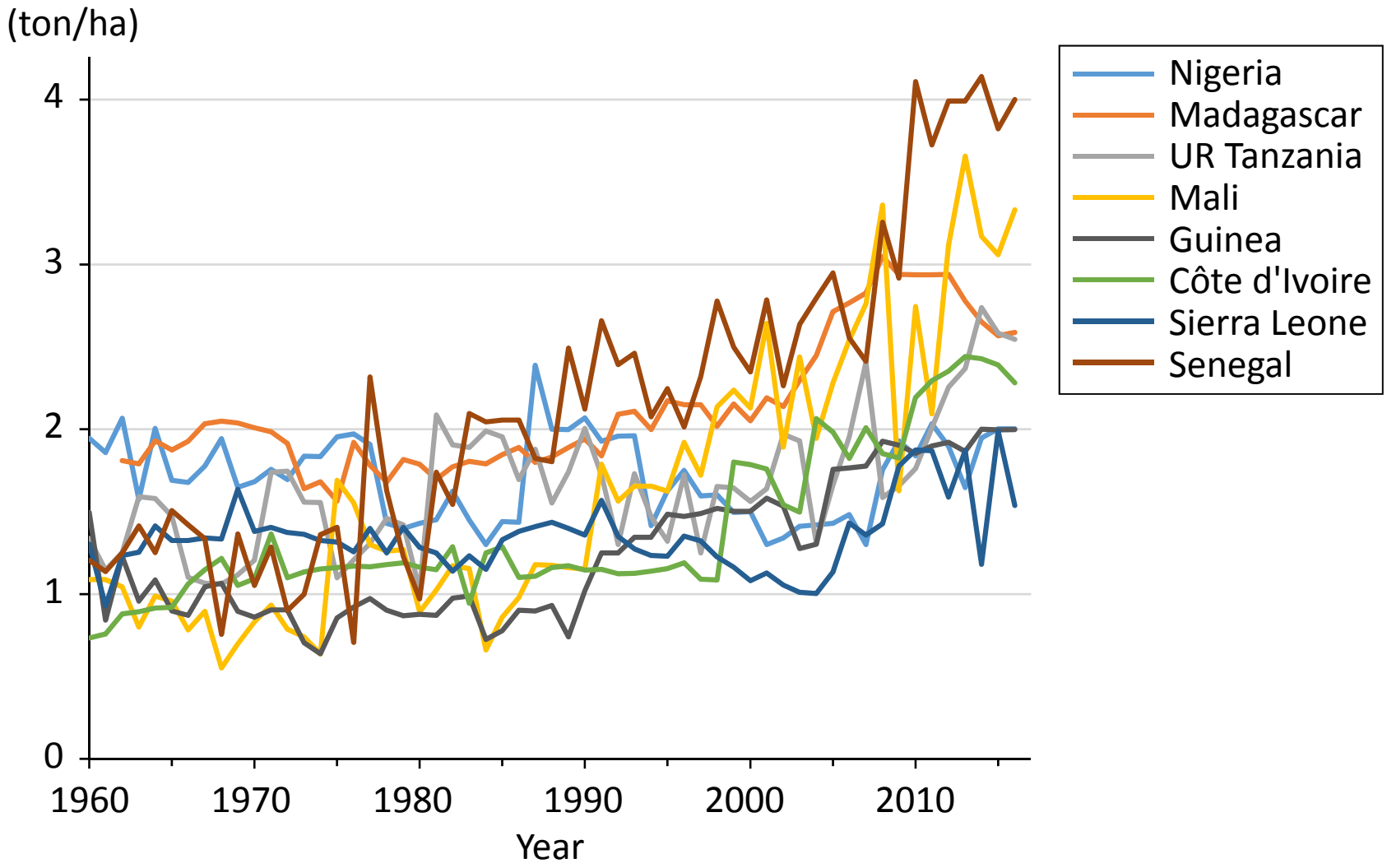


Fig. 13. Paddy Yield during 1960-2016
（Sub Saharan Africa Rank 1-8 rice production countries)

Data source: USDA, PS&D Online, 2018

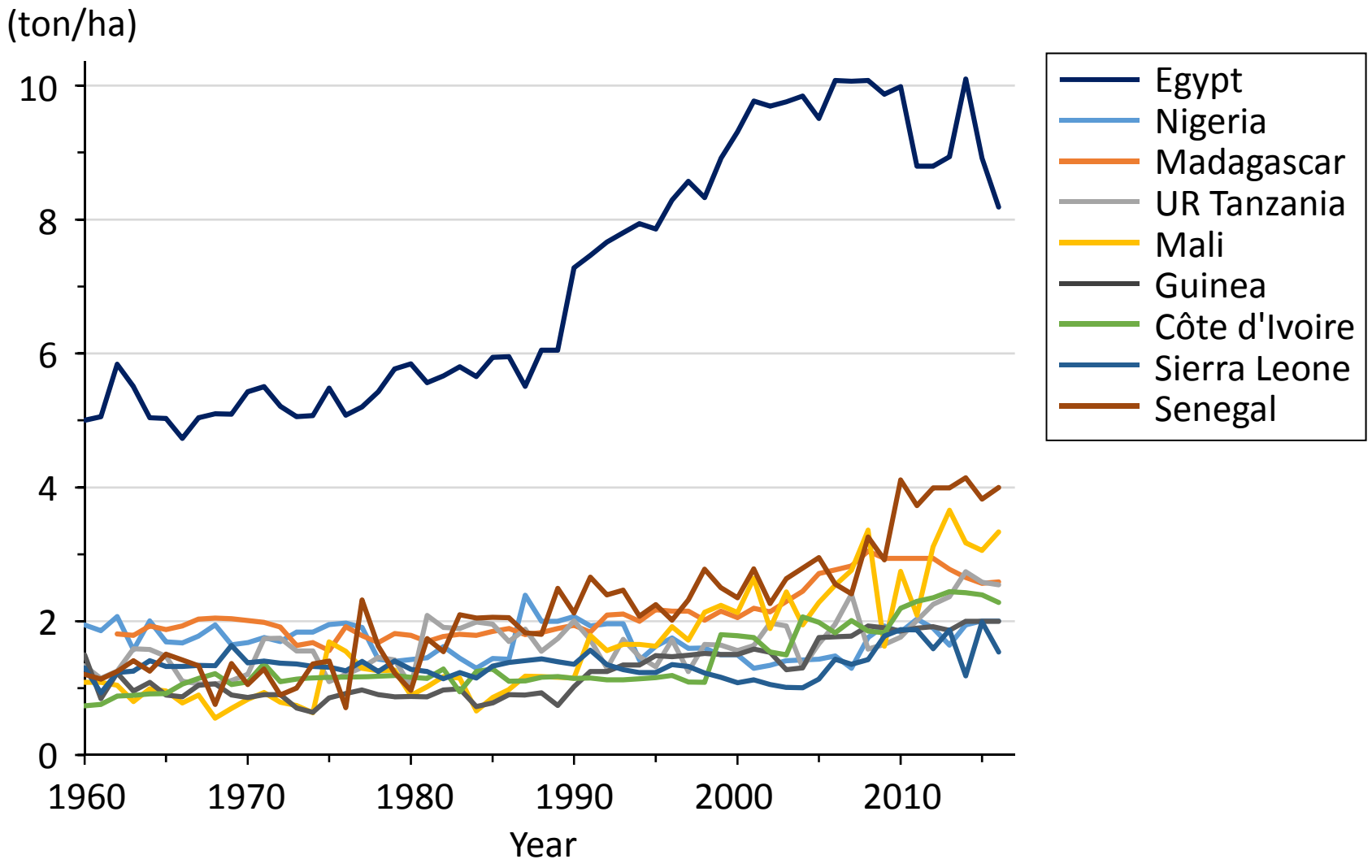


Fig. 14. Paddy Yield during 1960-2016
（Egypt and Sub Saharan Africa Rank 1-8 rice production countries)

Data source: USDA, PS&D Online, 2018

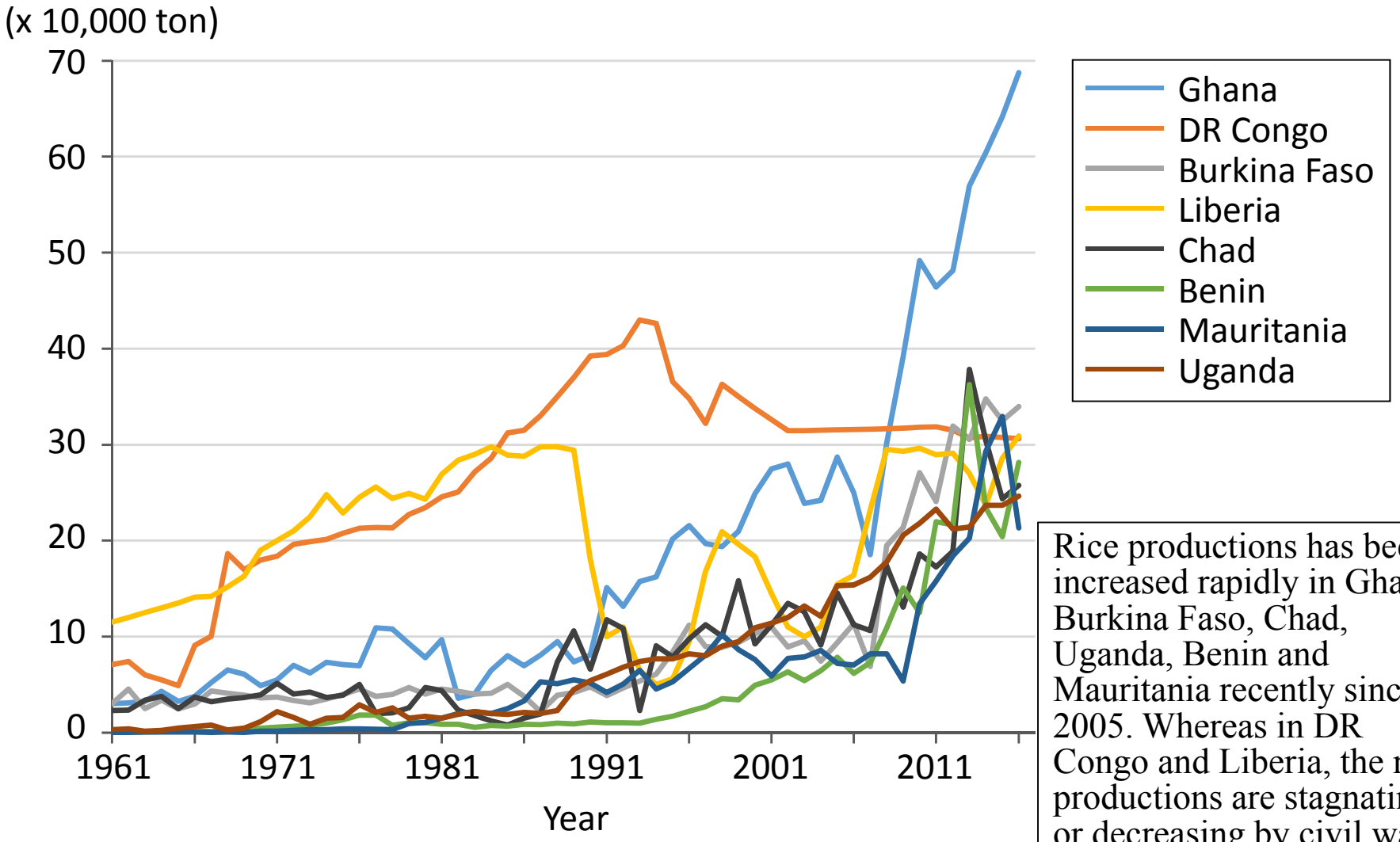
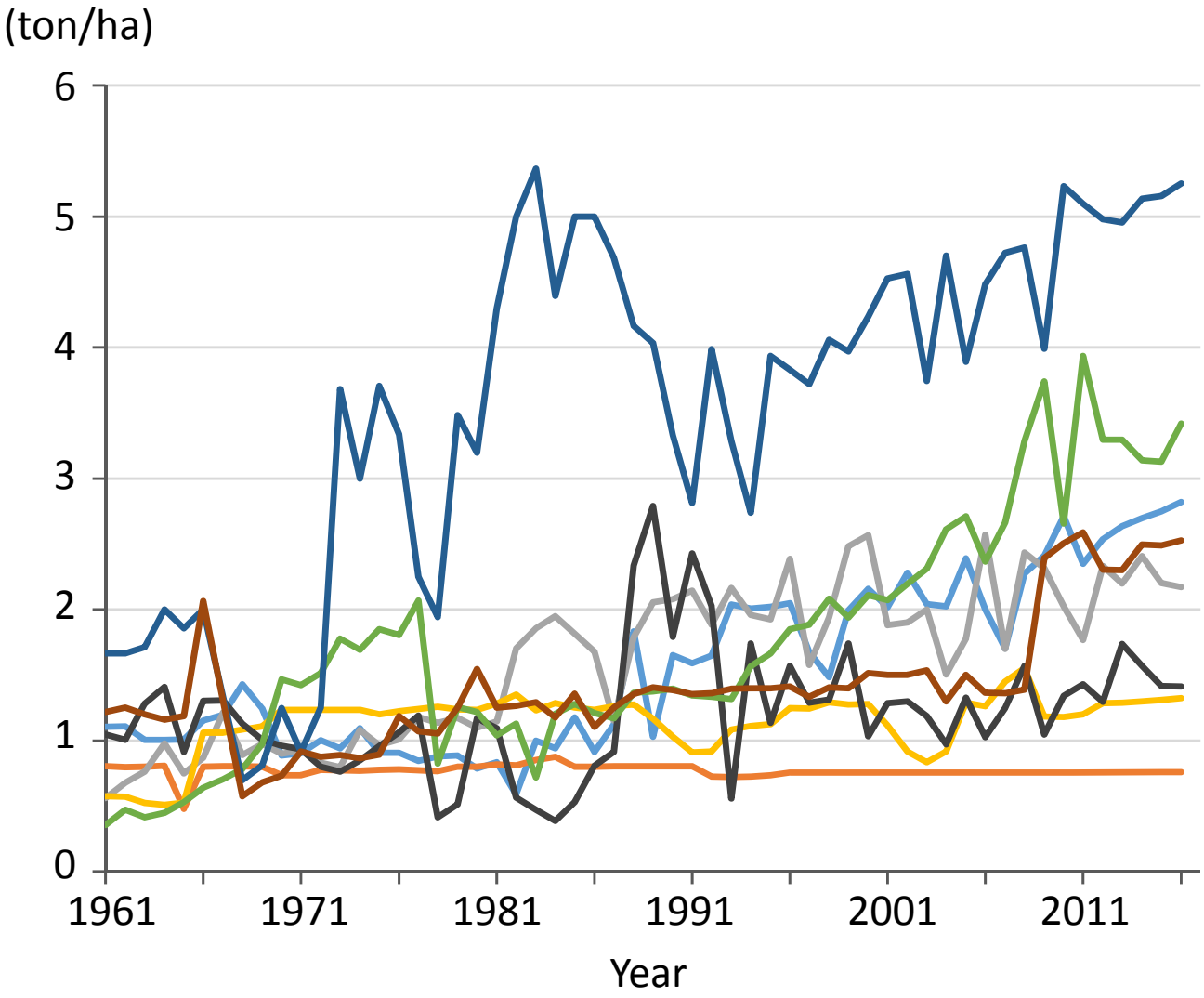


Fig. 15. Paddy Production during 1961-2016 (Sub Saharan Africa Rank 9-16 rice production countries).

Data source: FAOSTAT 2018

Rice productions has been increased rapidly in Ghana, Burkina Faso, Chad, Uganda, Benin and Mauritania recently since 2005. Whereas in DR Congo and Liberia, the rice productions are stagnating or decreasing by civil war and other reasons.
Chad has huge potential for developing irrigated Sawah systems, equal to or higher than Nigeria.



The ratio of irrigated rice fields is 100% along the Senegal river flood plain in Mauritania. Irrigated Sawah fields are developing and improving in Benin, Burkina Faso and Uganda. In these countries, paddy yield are increasing recently since 2005.

Fig. 16. Paddy Yield during 1961-2016 (Sub Saharan Africa Rank 9-16 rice production countries).

Data source: FAOSTAT 2018

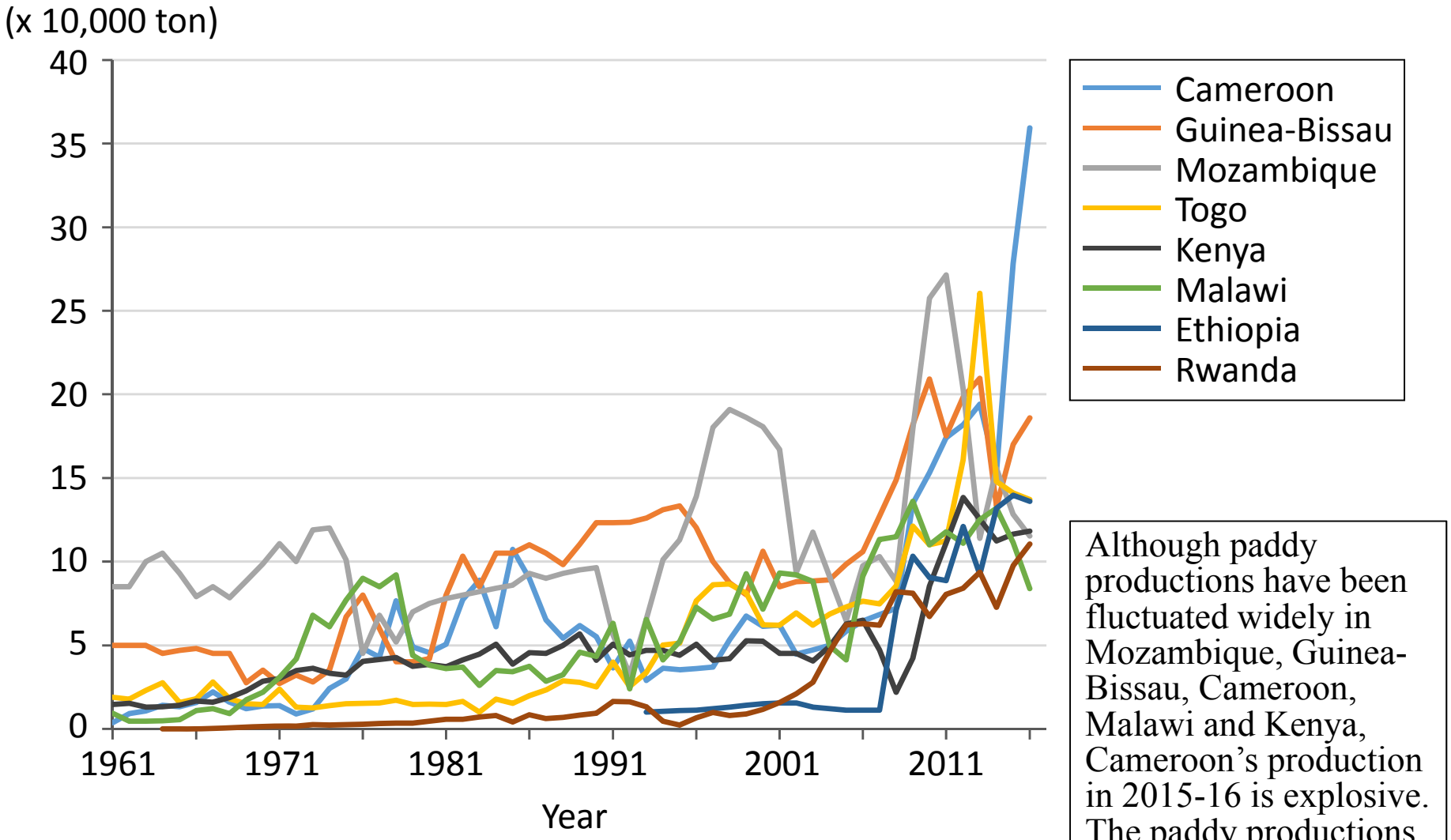


Fig. 17. Paddy Production during 1961-2016 (Sub Saharan Africa Rank 17-24 rice production countries).

Data source: FAOSTAT 2018

Although paddy productions have been fluctuated widely in Mozambique, Guinea-Bissau, Cameroon, Malawi and Kenya, Cameroon's production in 2015-16 is explosive. The paddy productions are increasing rapidly in Togo, Rwanda and Ethiopia in addition to the above countries recently since 2011.

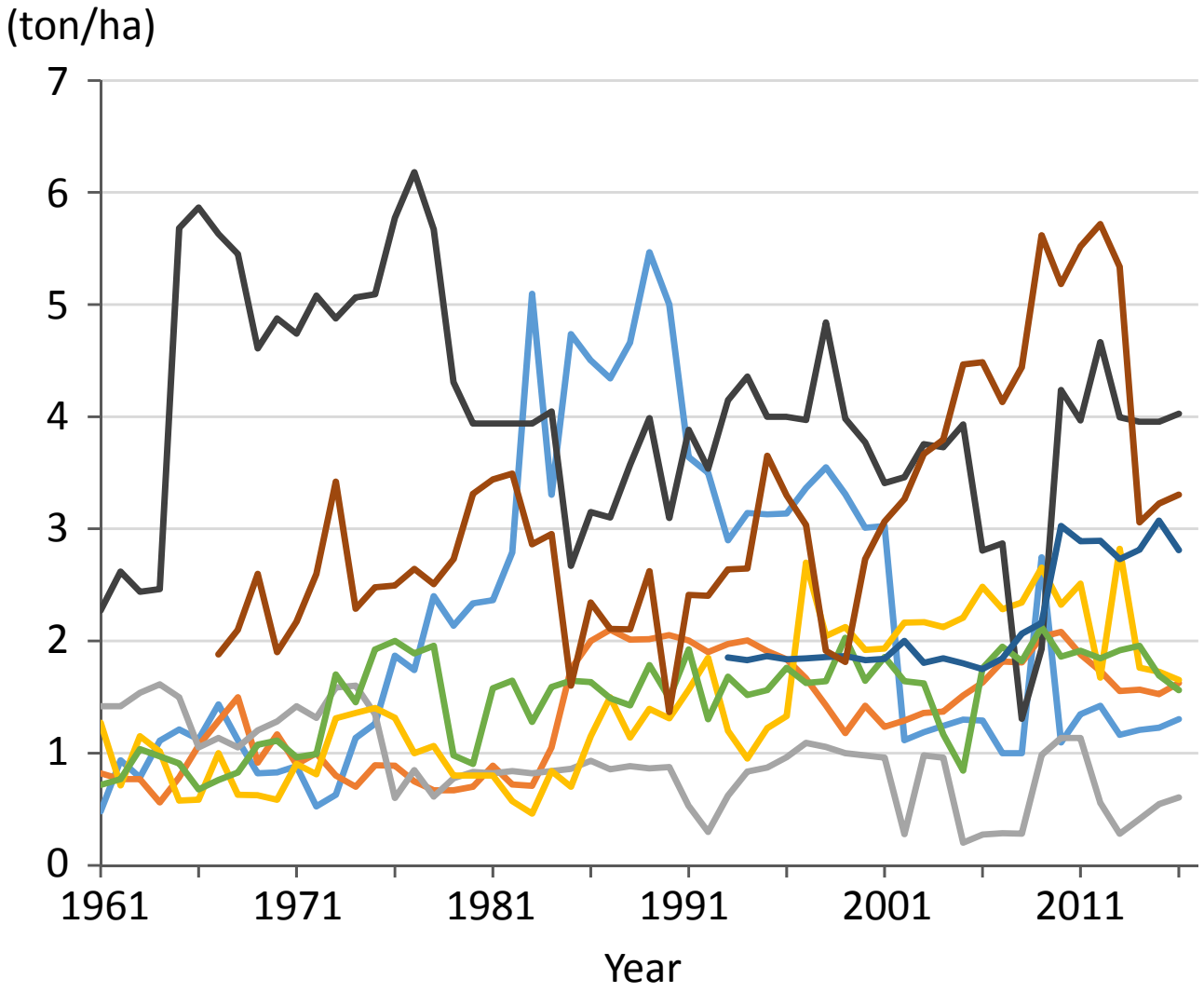


Fig. 18. Paddy Yield during 1961-2016 (Sub Saharan Africa Rank 17-24 rice production countries).

Data source: FAOSTAT 2018

It is necessary to take a careful look at the decline of yield in Kenya where irrigated rice fields are nearly 100%. Although Cameroon had huge SEMRY and other irrigation sites, upland rice cultivation is expanding in recent years, which resulted recent lower paddy yield. The increase of yield in Togo, Ethiopia and Rwanda suggests the Sawah based rice farming is expanding in these countries.

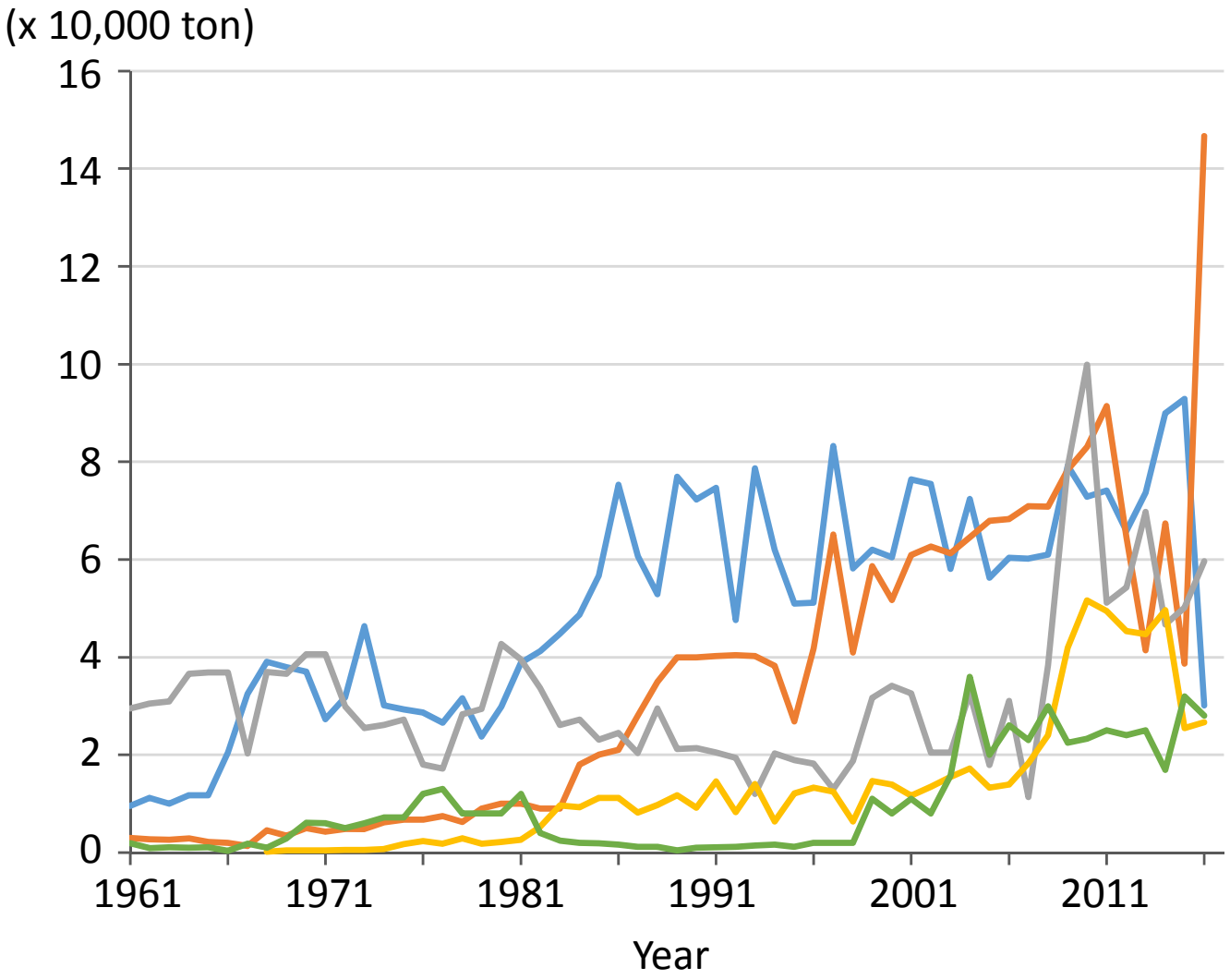


Fig.19. Paddy Production during 1961-2016 (Sub Saharan Africa Rank below 25 countries rice production countries)

Data source: FAOSTAT 2018

Recent expansion of paddy production in Burundi and Zambia is dramatic. Niger and Gambia are traditional rice producing countries. Paddy productions of Gambia and other countries have turned to increase in recently since 2005. Sudan has huge potential along Nile river flood plain. Sudd wetlands of South Sudan has huge potential for developing irrigated Sawah systems, equal to or higher than Nigeria. However, the paddy production is low at present because of political and social disasters.

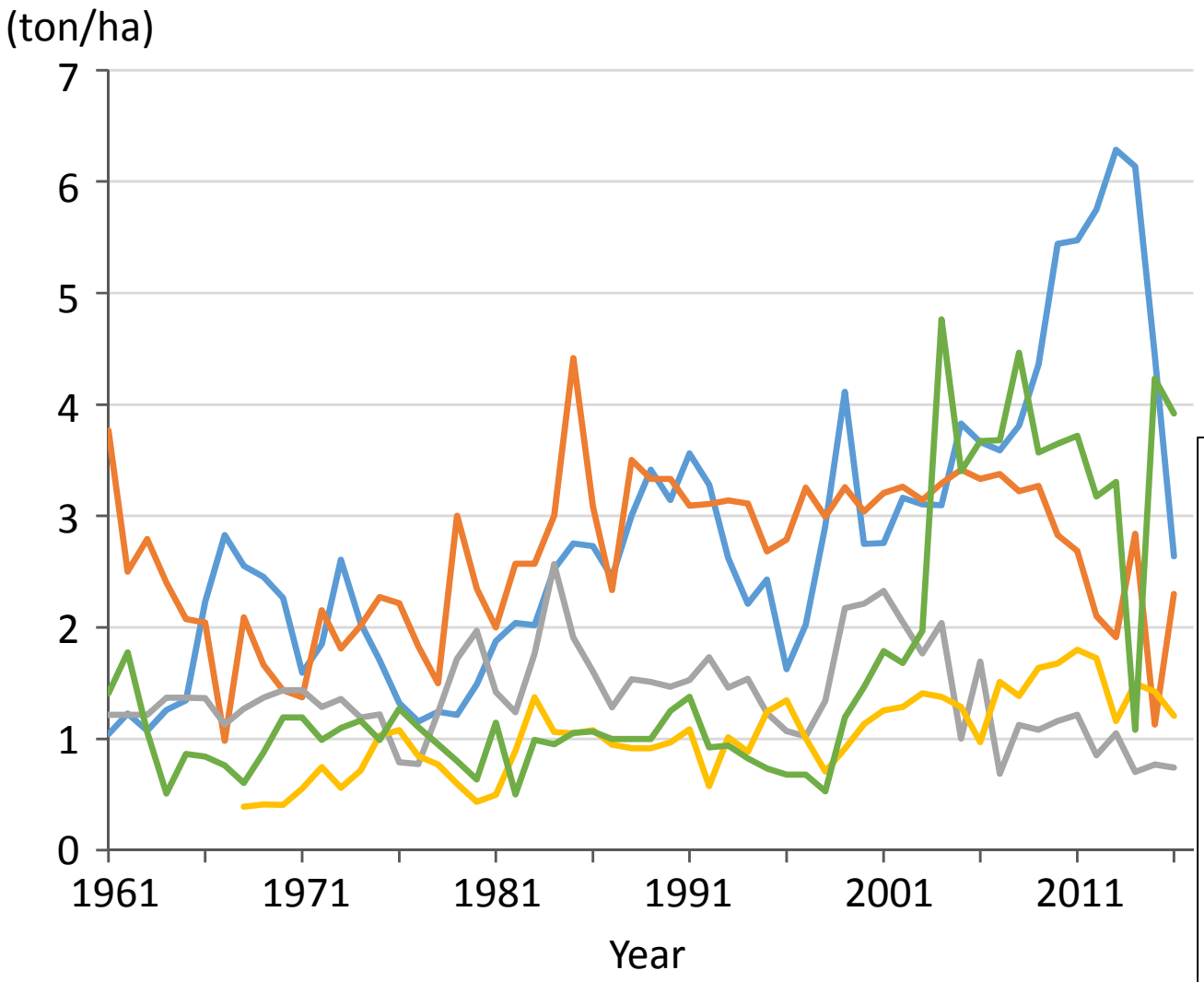


Fig. 20. Paddy Yield during 1961-2016 (Sub Saharan Africa Rank below 25 countries rice production countries).

Data source: FAOSTAT 2018

The high ratio of sawah equipped for irrigation and the high soil fertility contribute to the high yield in Burundi.
The recent high value in Sudan may be resulting from the spreading of Egyptian irrigated rice farming at Nile flood plains in recent years or the statistical data error caused by the independence of South Sudan.
Maybe the data of Niger needs careful examination.

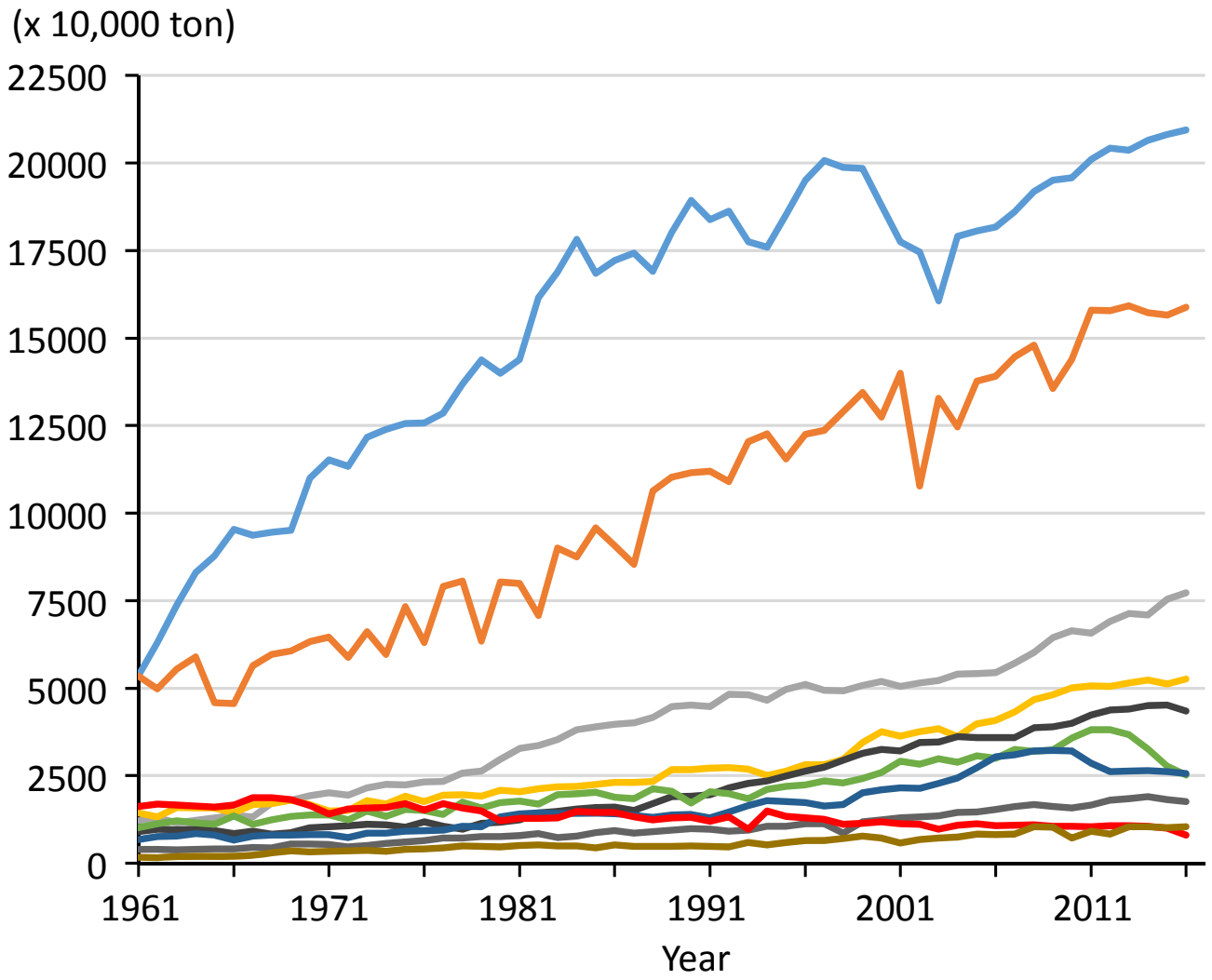


Fig.21. Paddy Production during 1961-2016.
（Asian Rank 1-10 rice production countries)

Data source: FAOSTAT 2018

China, India, Indonesia, Bangladesh and Viet Nam are the Top No. 5 countries. Thailand and Myanmar are following. Philippines and Pakistan are not clear expansion. Japan was once No.3, but now No.10

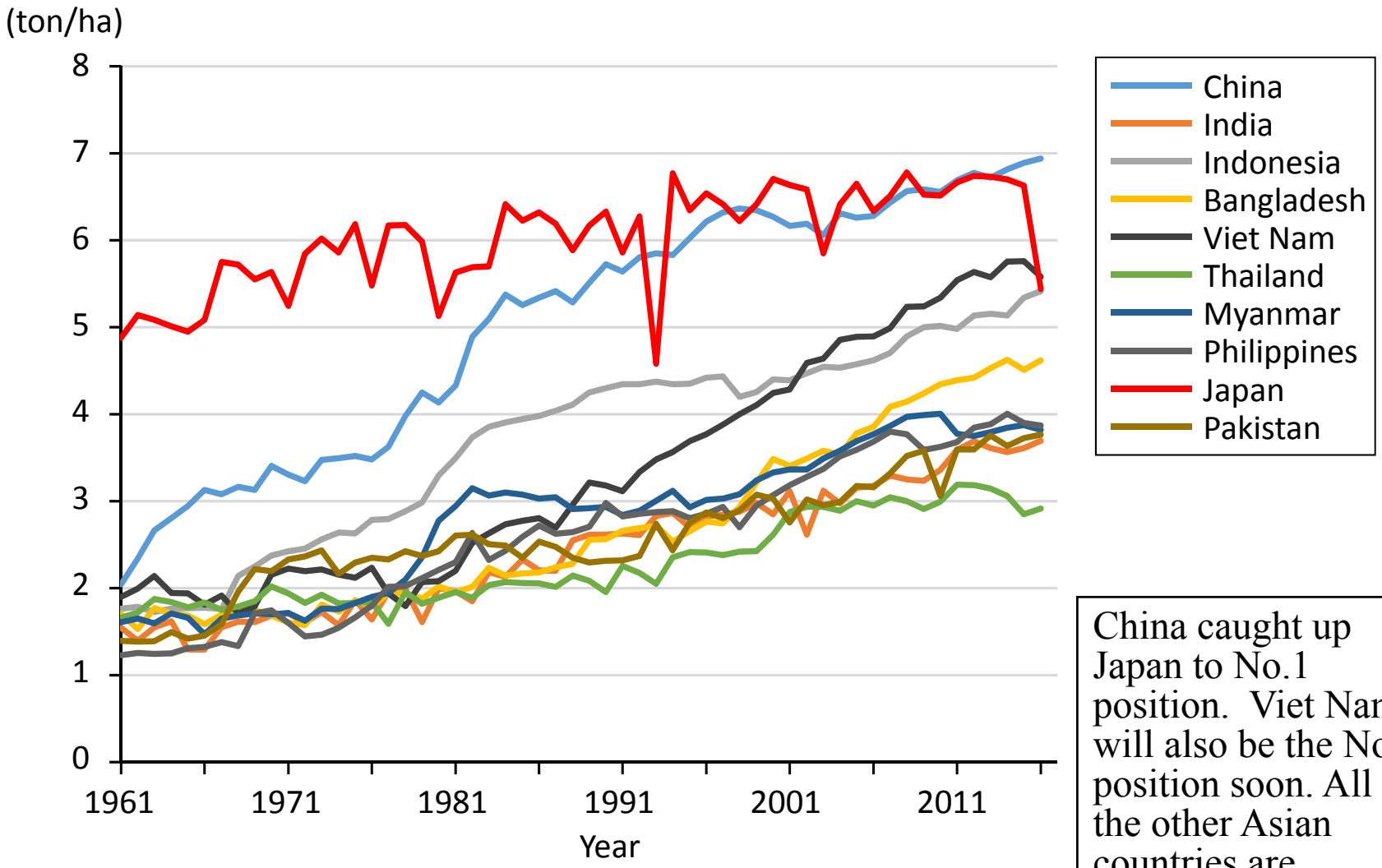


Fig.22. Paddy Yield during 1961-2016
（Asian Rank 1-10 rice production countries)

Data source: FAOSTAT 2018

China caught up Japan to No.1 position. Viet Nam will also be the No. position soon. All the other Asian countries are catching up these leading countries, too.

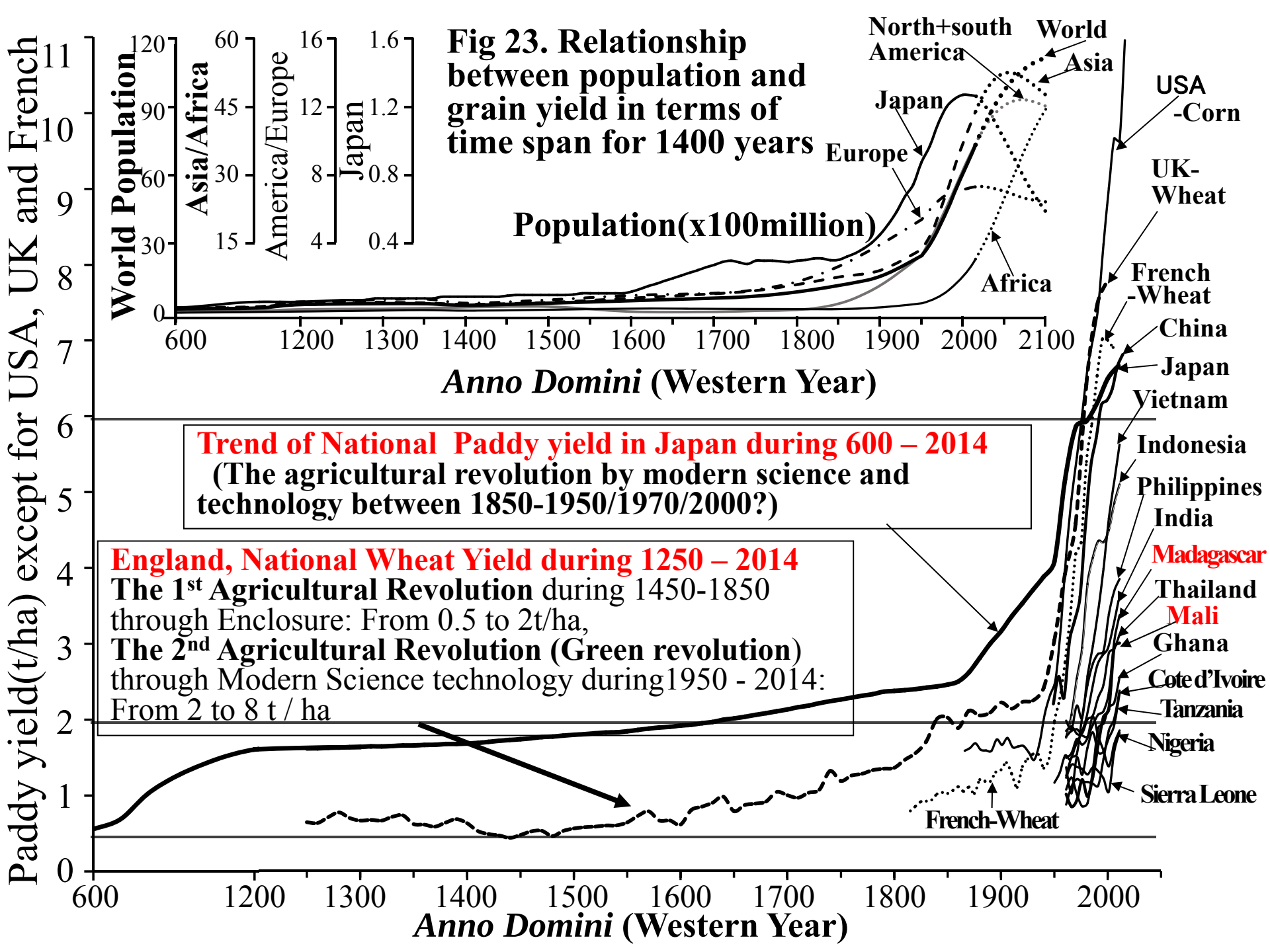


Fig 23. Relationship between population and grain yield in terms of time span for 1400 years
World Population
Asia/Africa
America/Europe
Japan
Population(x100million)
North+south America
World
Asia
Japan
Europe
Africa
USA -Corn
UK-Wheat
French -Wheat
China
Japan
Vietnam
Indonesia
Philippines
India
Madagascar
Thailand
Mali
Ghana
Cote d'Ivoire
Tanzania
Nigeria
Sierra Leone
French-Wheat
Anno Domini (Western Year)
Trend of National Paddy yield in Japan during 600 – 2014
(The agricultural revolution by modern science and technology between 1850-1950/1970/2000?)
England, National Wheat Yield during 1250 – 2014
The 1st Agricultural Revolution during 1450-1850 through Enclosure: From 0.5 to 2t/ha,
The 2nd Agricultural Revolution (Green revolution) through Modern Science technology during1950 - 2014: From 2 to 8 t / ha
Paddy yield(t/ha) except for USA, UK and French
Anno Domini (Western Year)

Fig.24. Historical Trend of Paddy yields of Japan during 1700-2014 as well as Major Asian and SSA paddy production countries (means of FAOSTAT 2017 and USDA 2017) during 1950 and 1961-2014. Wheat yields in England and French and Paddy yield in USA are also shown. Data Sources are Max Roser, Yields-Our World in Data, 2017, https://ourworldindata.org/yields/; FAOSTAT 2017; Overton M 1996; Hopper WD 1976; Takase K and Kano T, 1969; Mitchell 1998; Apostolides A, Broadberry S, Campbell B, Overton M, and Van Leeuwen B, 2008, http://www.basvanleeuwen.net/bestanden/agriclongrun1250to1850.pdf

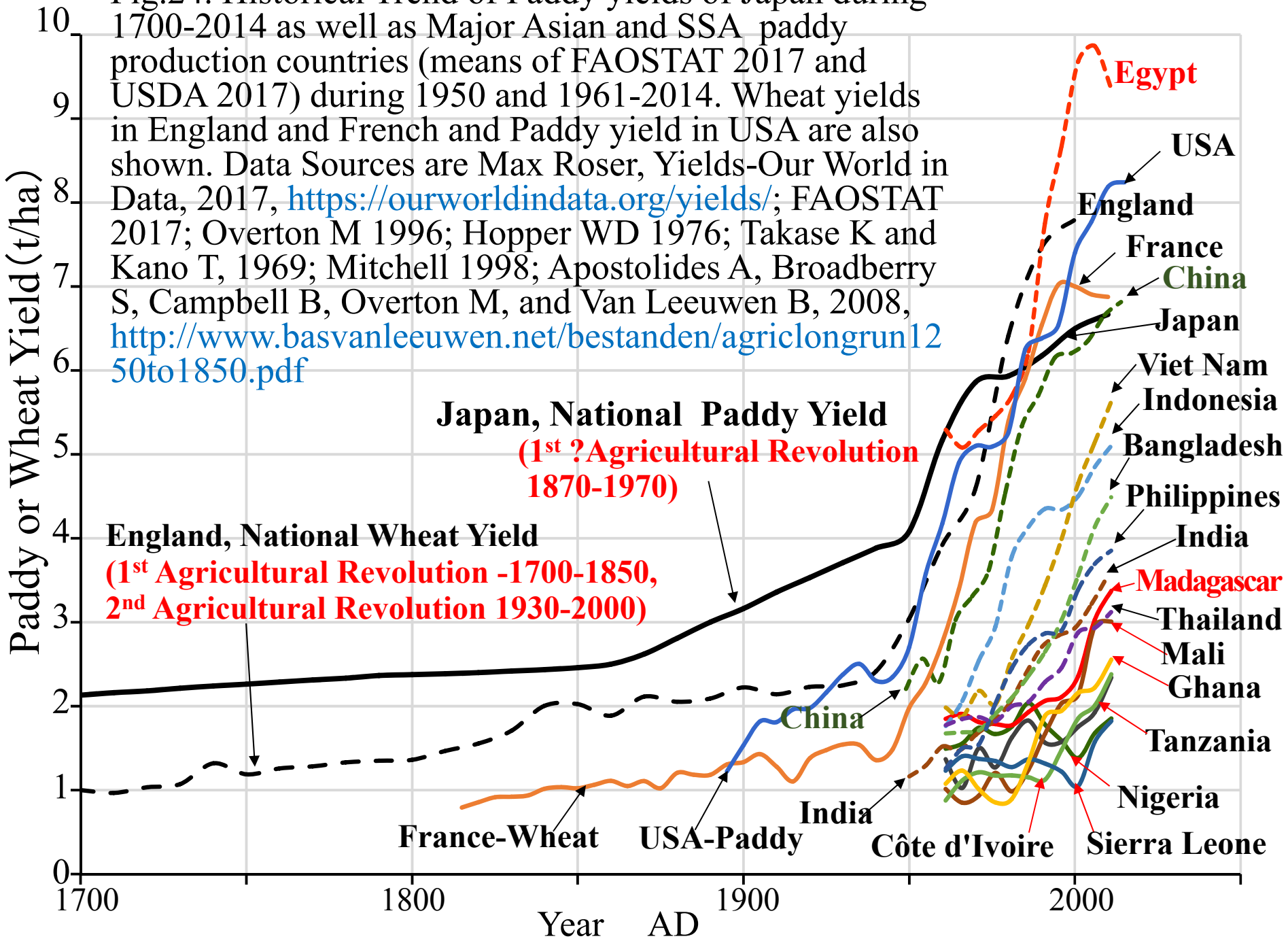


Table 13. Mean Paddy Production (x 1000 ton) and Paddy Yield (ton/ha) of No.1 to No.24 countries in SSA during 2014-2016 (FAOSTAT2018)

Rank	Country	Production	Yield	Rank	Country	Production	Yield	Rank	Country	Production	Yield
1	Nigeria*	6111	1.97	9	Ghana	644	2.76	17	Uganda	240	2.5
2	Madagascar	3842	4.27	10	Burkina Faso	338	2.26	18	GuineaBissau	163	1.57
3	UR Tanzania	2862	2.58	11	DR Congo	307	0.76	19	Togo	142	1.71
4	Mali	2426	3.19	12	Mauritania	278	5.18	20	Ethiopia	136	2.9
5	Guinea	1975	1.23	13	Liberia	277	1.31	21	Mozambique	133	0.52
6	Cote d'Ivoire	1954	2.48	14	Chad	268	1.47	22	Kenya	115	3.98
7	Sierra Leone	1212	2.01	15	Cameroon	263	1.25	23	Malawi	109	1.74
8	Senegal	783	3.96	16	Benin	240	3.23	24	Rwanda	94	3.2

*The FAOSTAT data did not include the dry season paddy production which started seriously on 2013 dry season