

SUPPLEMENTARY MATERIAL

S1. Weather for the monitoring period

The values for the main weather parameters (mean air temperature, total precipitation, rain), together with average values for measured SWC for various averaging intervals during the period covered by this study (2010 – 2019) are shown in Table S1 and Table S2.

Table S1. Values for measured mean air temperature (T), total precipitation (TP), rain and soil water content (SWC) based on daily data for the study period (2010 – 2019)

	All crops				Potatoes			
	Air T (°C)	TP (mm)	Rain (mm)	SWC (%)	Air T (°C)	TP (mm)	Rain (mm)	SWC (%)
Average	6.2	1231.3	956.9	26.9	6.4	1305.7	1034.0	27.4
GS¹	15.3	514.8	513.7	23.8	15.4	513.0	511.4	23.6
OGS¹	-0.8	716.6	443.1	29.3	-0.6	792.6	522.6	30.3
Spring	3.1	256.9	194.6	28.8	2.8	285.1	220.9	30.0
Summer	17.7	261.3	261.1	22.9	17.4	272.8	272.8	23.3
Fall	9.2	373.9	348.3	26.1	9.8	367.7	335.4	25.6
Winter	-5.2	339.2	152.9	29.7	-4.8	380.1	204.9	30.8
Jan	-6.4	86.8	34.2	29.7	-5.9	102.4	48.7	31.3
Feb	-6.8	113.3	31.8	29.8	-6.7	128.6	32.9	31.6
Mar	-3.1	80.1	34.3	29.7	-4.3	86.0	39.3	31.7
Apr	3.1	94.2	78.5	29.8	3.7	81.6	66.5	31.2
May	9.3	82.6	81.7	26.9	9.1	117.5	115.1	27.1
Jun	14.0	94.3	94.2	24.9	14.3	74.6	74.6	24.3
Jul	19.4	58.4	58.4	22.3	19.5	80.5	80.5	22.8
Aug	19.4	108.5	108.5	21.6	18.5	117.6	117.6	22.8
Sep	15.1	113.5	113.5	23.8	15.1	71.4	71.4	22.6
Oct	9.3	131.0	130.1	26.2	10.7	155.3	153.6	25.5
Nov	3.1	129.4	104.7	28.4	3.4	141.0	110.5	28.7
Dec	-2.6	139.1	86.8	29.7	-1.9	149.2	123.3	29.4

¹GS: Growing season (May 25th – October 30th; 159 days); OGS – Outside of the Growing Season (October 31st to May 24th of the next year)

Table S2. Annual averages for measured mean air temperature (T), total precipitation (TP), rain and soil water content (SWC), based on daily data for the study period (2010 – 2019)

Year	Rotation phase	Air T (°C)	TP (mm)	Rain (mm)	SWC (%)
2010 ¹	Clover	11.4	857.8	803.6	29.1
2011	Potato	6.7	1370.1	1081.0	28.1
2012	Barley	7.3	1078.6	847.0	25.3
2013	Clover	6.0	1158.8	912.6	25.5
2014	Potato	6.0	1453.9	1154.5	27.2
2015	Barley	5.4	1401.5	892.7	27.7
2016	Barley	6.6	1096.1	823.7	27.5
2017	Potato	6.5	1093.0	866.4	26.8
2018	Barley	6.0	1203.4	976.8	26.7
2019	Clover mixed with grasses	5.7	1226.9	1057.0	27.1

¹incomplete year (data starting in July 2010)

Annual average precipitation for the period of the study (2010-2019) varied between 1079 and 1453 mm with an average of 1230 mm (Table S1), including 275 mm falling as snow. The multi-year monthly averages (Table S2) show that 41.8% of the total precipitation occurs during the growing season (GS), indicating a slightly skewed distribution of precipitation during the year (i.e., 3.3 mm/d during GS vs. 3.5 mm/d during OGS). The first half of the GS (May – July) showed lower total precipitation monthly values than the multi-year monthly average, with the average for July ~46 mm below the total precipitation monthly average (i.e., 58 mm vs 103). The reduced amount of precipitation for July, in conjunction with the maximum monthly air temperature and crop evapotranspiration for July and August, are the driving factors for the SWC, which also reached its minimum during this period. The monthly precipitation recorded for each month of the studied period, showed high variability from year to year (Figure S1), however, it should be noted that the variability during the first half of the GSs was relatively low compared to other periods of the year (i.e. standard deviation of 45.8, 35.8 and 35.0 compared to a multi-year monthly standard deviation average of 45.1).

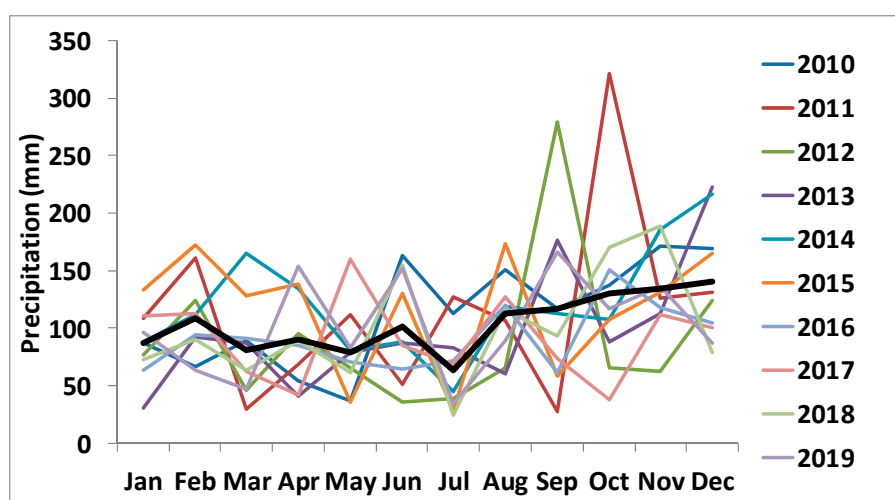


Figure S1. Monthly total precipitation amounts for each of the study years (black line - multi-year monthly average)

S2. Supplemental irrigation requirement for each year of the monitoring period (2010 – 2019)

Table S3. Supplemental irrigation requirement (mm¹) for the various irrigation levels and efficiency scenarios for each GS during the monitoring period

Irrigation scenario		SWC=0.9FC				SWC=0.8FC				SWC=0.7FC			
Irrigation efficiency		100 %	90 %	55 %	20%	100 %	90 %	55 %	20 %	100 %	90 %	55 %	20 %
Year	SWC(%)												
2011	23.0	303	337	551	1514	135	151	246	677	19	21	35	96
2014	24.4	126	139	228	628	57	63	103	283	19	22	35	97
2017	23.5	140	156	255	702	63	71	115	317	12	14	22	61
Average	23.6	190	211	345	948	85	95	155	426	17	19	31	85

¹the volume of water in m³ ha⁻¹ can be obtained by multiplying the values in the table by 10

Table S4. Supplemental irrigation requirement (mm¹) for the various irrigation levels and efficiency scenarios during tuber initiation and bulking stages of each growing season during the monitoring period

Irrigation scenario		SWC=0.9FC				SWC=0.8FC				SWC=0.7FC			
Irrigation efficiency		100 %	90 %	55 %	20 %	100 %	90 %	55 %	20 %	100 %	90 %	55 %	20 %
Year	SWC(%)												
2011	22.1	195	217	354	975	112	125	204	562	11	12	20	54
2014	23.7	85	95	155	426	30	33	55	150	2	2	3	9
2017	22.5	92	103	168	462	52	57	94	258	12	14	22	61
Average	22.8	124	138	226	621	65	72	118	323	8	9	15	41

¹the volume of water in m³ ha⁻¹ can be obtained by multiplying the values in the table by 10

S3. Average supplemental irrigation requirement for various extents of irrigated areas

Table S5 and Table S6 show the estimated total volume of water required (m³) and the comparison between irrigation supply requirement and aquifer annual recharge for various areal extents of irrigated land on a given area. The annual groundwater recharge was considered to be 400 mm (4000 m³ ha⁻¹). The reference area used for calculating the volume of irrigation water required the equivalent volume of recharge and the significance of irrigation water as percentage of annual groundwater recharge was 1 ha. In order to calculate the equivalent volume of water required for irrigation for an area of a different size, the values (i.e., volume of water and/or recharge) in the two tables below have to be multiplied by the respective area.

Table S5. Volume of irrigation water required (m³) during the average growing season for various areal extents of irrigated land

Extent of irrigated land (%)	Extensive irrigation (0.9FC)			Moderate irrigation (0.8FC)			Minimal irrigation (0.7FC)		
	90% <i>eff.</i>	55% <i>eff.</i>	20% <i>eff.</i>	90% <i>eff.</i>	55% <i>eff.</i>	20% <i>eff.</i>	90% <i>eff.</i>	55% <i>eff.</i>	20% <i>eff.</i>
25	527	862	2370	237	387	1065	47	77	212
50	1053	1724	4740	473	774	2129	94	154	424
75	1580	2585	7110	710	1161	3194	141	231	636
100	2107	3447	9480	946	1549	4259	188	308	848

Table S6. Comparison between the volume of irrigation water required during the growing season and the annual groundwater recharge for various areal extents of irrigated land

Extent of irrigated land (%)	Extensive irrigation (0.9FC)			Moderate irrigation (0.8FC)			Minimal irrigation (0.7FC)		
	90% <i>eff.</i>	55% <i>eff.</i>	20% <i>eff.</i>	90% <i>eff.</i>	55% <i>eff.</i>	20% <i>eff.</i>	90% <i>eff.</i>	55% <i>eff.</i>	20% <i>eff.</i>
25	345	564	1552	180	294	809	23	37	103
50	690	1128	3103	359	588	1617	46	75	206
75	1034	1693	4655	539	882	2426	69	112	309
100	1379	2257	6207	719	1176	3235	92	150	412