Food Security and Trade Under Climate Change in The Arab Region

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Crisis of present model of development

- Simultaneous multiple crises such as, unsustainable depletion of natural resources and the market failures.
- This model of development has
  - failed to give rise to productive and decent employment opportunities
  - has accelerated the phenomenon of climate change with its various effects on the types of natural resource depletion, loss of biodiversity, energy crisis, and food security

Motivation and Aim

- To evaluate the climate change-related threats to food security, food production and food trade in the Arab countries in light of the challenges of the current development model.
- To frame the analysis with links to several SDGs and to UN-wide initiatives for adaptation and mitigation.

The Arab region is characterized with several problems…

- scarce and declining natural resources
- increased demand arising from enlarged populations,
- long-lasting sociopolitical conflicts.

All related with food insecurity.

Conflicts lead to food insecurity by…

- affecting food production and block access to international/domestic markets.
- aggravating poverty and income inequality by impairing livelihoods,
- depriving governments of the revenue needed for social protection programmes.
- making food and water supplies limited and insecure, and health care less accessible,
- affecting food utilization factors, thus leading to malnutrition.
- creating a refugee problem with serious food security concerns (e.g. Syrian refugees in Jordan).

The region is exceptionally vulnerable to the impacts of climate change

Maghreb	Mashreq	Gulf countries	Least developed countries
Overall a hotter drier region	Overall a hotter drier region	Relatively uniform warming	Changes in river flows
Temperature increase of up to 5° C	Higher temperatures in both summer and winter	Possible increase in summer precipitation, but highly uncertain and localized	Variable changes in wetness and aridity, with areas nearer the tropics becoming wetter
Decrease in precipitation, fewer rainy days	Generally drier, especially in the rainy (winter) season	More severe rainfalls	More severe rainfalls
More droughts, especially in summer	Rainfall drop below growth threshold for some areas	Seawater intrusion	
Overall increase in aridity, with 20% less rainfall	Seawater intrusion and salinization, particularly in Egypt		
Seawater intrusion			

- Increasing income inequalities, migration, mismanagement of natural resources as well as unsustainable resource use in the region are also contributing to the climate change crisis, which particularly forms a major concern for food security in the region.

Impact on agriculture and food

- the yields of certain crops could decline by up to 30% in some areas as a result of an increased temperature of 1.5 to 2.5°C
- could even reach a yield drop of 60% in the case of a 3 to 4 °C increase
- direct effect on food availability and farmer incomes
- indirect effect on conflicts – food riots, rural to urban migration

Food Security

"Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"

Availability

Access

Utilization

Stability

Food insecurity causes…

- undernourishment and hunger,
- death of millions of people, including children,

- more than 2 billion people face moderate or severe food insecurity, where 704 million of them are in the state of severe food insecurity, mostly in Africa and Asia.

Is increasing food production the sole solution to solve food insecurity?

- in spite of the fact that food production has significantly increased over the last fifty years, around 850 million people are still undernourished.
- two sources of food: domestic production and food imports
- All countries import food, some due to diversity, some due to dependence.

Food security and self-sufficiency

- food self-sufficiency: "*the extent to which a country can satisfy its food needs from its own domestic production*".
- even if "*there is scant relation between national food security and the level of self-sufficiency in food production*", the concern about dependence on the world food market "*has risen as the world food balance in basic food commodities was disturbed by the weather, leading to dramatic temporary increases in market prices and an imposition of export prohibitions and restrictions*".

International Trade and Food Security

"trade can be thought of as a means of connecting 'those that have plenty of food with those that do not have enough'. Food security in that context is supported by stabilizing our interconnectedness."

thanks to trade openness, global agricultural production would take place in those regions most suited to it and enable food to flow from countries with abundant food supplies to ones with insufficient supplies

Trade openness can …

- increase *food availability* by providing sufficient quantities of food
- improve *access to food* by decreasing food prices in food-importing countries
- contribute to *food utilization* by promoting more balanced diets
- improve the *stability of food supplies* by mitigating local production risks and reducing the seasonal effects on food availability

International Trade and Food Security

are food imports at true world prices or are subsidized?

as subsidized overproduction in developed countries has been cheaper and in greater volume than those of developing countries, a shift towards greater food imports appeared as a secure and low-cost policy to secure provision of food.

clear disadvantage to developing countries that are aiming for self-sufficiency.

Trade openness can …

- decrease *food availability* by increasing food dependency and make consumers vulnerable to external shocks in food availability
- negatively affect *access to food* by changing the internal terms of trade and leading to price increases in food-exporting countries
- negatively affect *food utilization* as greater reliance on imported foods may lead to an increased consumption of cheaper and unhealthy foods
- decrease *food stability* by reducing the policy space of net food-importing countries to deal with shocks

High food dependency in the region

- a serious threat not only on food security, but also on national security
- the world's largest importer of wheat
- half of the region's calorie consumption comes from imports
- additional 4 million undernourished people after the food price crisis of 2008-2009

High food dependency in the region

- problems in access to food and water accompanied with rising food prices were one of the causing factors of the civil wars in Syria, Libya, Sudan and Yemen
- some GCC countries announced land investments abroad in the wake of the global food crisis, often in food-insecure countries like Sudan, Ethiopia and Pakistan
- region highly dependent on maritime chokepoints

High food dependency in the region

	Food Exports	Food Imports	Net Food Trade
Algeria	337.87	9141.31	-8803.44
Bahrain	327.72	1104.12	-776.40
Egypt	4963.59	11458.03	-6494.44
Jordan	1371.38	4047.54	-2676.16
Kuwait	572.04	5065.47	-4493.43
Lebanon	1654.91	5043.55	-3388.65
Mauritania	752.33	316.81	435.53
Morocco	5037.88	5095.37	-57.49
Qatar	15.74	3152.77	-3137.03
Oman	1317.91	3703.18	-2385.27
Saudi Arabia	3675.50	21245.70	-17570.20
Tunisia	1450.27	2228.89	-778.62
UAE	7172.32	20111.64	-12939.32

Wheat production and net exports

	2000-02	2003-05	2006-08	2009-11	2012-14	2015-17	2000-02	2003-05	2006-08	2009-11	2012-14	2015-17
Algeria	1,433,792	2,703,427	2,039,309	2,823,062	3,055,826	2,511,110	-5,301,028	-5,300,188	-5,436,214	-6,077,236	-6,689,646	-8,269,880
Bahrain							-62,272	-50,324	-27,857	-81,967	-91,691	-84,887
Djibouti							-46,857	-89,715	-131,943	-373,062	-596,111	-493,781
Egypt	6,481,168	7,387,836	7,876,760	8,035,840	9,018,561	9,250,091	-4,960,185	-4,703,630	-8,188,491	-9,835,686	-10,958,327	-10,638,120
Iraq	1,292,133	2,129,667	1,847,933	2,419,377	4,098,601	2,890,712	-2,858,294	-1,985,417	-2,740,089	-2,597,922	-1,931,024	-1,171,050
Jordan	29,499	30,018	17,253	18,137	25,058	26,115	-595,111	-741,686	-875,899	-834,663	-853,893	-1,195,172
Kuwait	466	561	462	103	70	26	-213,705	-283,631	-294,956	-337,777	-409,664	-428,628
Lebanon	122,200	132,267	137,767	106,467	143,333	136,484	-383,045	-442,550	-368,825	-478,509	-575,127	-580,222
Libya	125,000	125,000	104,000	134,413	200,000	172,537	-394,629	-401,825	-728,417	-1,466,685	-1,727,294	-1,216,619
Mauritania	493	632	2,191	2,905	6,612	7,712	-130,306	-178,684	-275,090	-342,071	-448,996	-530,136
Morocco	2,685,253	4,576,587	3,892,947	5,755,130	5,309,289	5,965,533	-3,378,349	-2,471,782	-3,197,600	-3,098,286	-3,994,044	-4,377,337
Oman	1,421	1,092	931	2,095	2,166	3,495	-238,008	-164,240	-218,486	-203,791	-438,713	-599,342
Qatar	45	24	27	37	46	5	-46,078	-46,967	-78,701	-123,307	-99,954	-177,883
S.Arabia	2,101,952	2,649,476	2,391,317	1,228,763	744,310	644,451	-7,562	-2,631	-84,506	-1,660,605	-2,531,990	-2,271,162
Sudan					354,000	585,867					-1,890,731	-1,678,036
Syria	4,208,517	4,706,401	3,704,133	3,547,738	2,938,513	2,380,831	236,967	592,513	702,313	-1,071,794	-809,104	-276,327
Tunisia	794,067	1,777,567	1,204,133	1,360,367	1,337,263	979,721	-1,551,683	-1,187,191	-1,568,433	-1,555,053	-1,593,658	-2,014,596
UAE	213	20	29	37	74	83	-1,049,538	-1,181,242	-895,578	-829,248	-1,695,269	-860,750
Yemen	142,120	106,674	179,380	239,967	224,890	103,619	-1,545,799	-1,754,683	-2,316,878	-2,746,346	-3,487,219	-2,949,637

Rice production and net exports

	2000-02	2003-05	2006-08	2009-11	2012-14	2015-17	2000-02	2003-05	2006-08	2009-11	2012-14	2015-17
Algeria	419	410	347	317	313	242	-67,686	-61,559	-78,598	-88,407	-115,877	-116,522
Bahrain							-40,796	-45,686	-48,161	-62,191	-74,704	-90,362
Djibouti							-18,162	-31,038	-39,426	-31,790	-88,763	-213,167
Egypt	5,777,550	6,217,979	6,961,734	5,175,004	5,700,861	5,502,279	470,828	841,485	748,903	387,163	76,001	27,642
Iraq	146,000	216,333	334,719	188,007	405,405	185,460	-1,206,280	-637,479	-1,038,968	-1,114,936	-1,210,766	-926,730
Jordan							-100,685	-133,841	-141,327	-145,279	-174,168	-193,311
Kuwait							-121,763	-136,137	-194,553	-220,641	-190,718	-217,340
Lebanon							-47,365	-45,084	-44,027	-49,744	-56,802	-69,054
Libya							-127,161	-137,100	-144,153	-98,661	-115,734	-123,333
Mauritania	70,806	78,843	78,263	115,346	226,661	230,644	-34,829	-39,093	-78,215	-124,627	-180,027	-58,167
Morocco	30,437	29,747	37,223	39,467	46,774	58,117	-2,170	-2,407	-5,919	-9,313	-11,312	-5,167
Oman							-117,317	-119,241	-185,749	-142,640	-204,928	-213,241
Qatar							-45,059	-51,709	-106,020	-146,164	-176,365	-201,862
SArabia							-784,443	-927,896	-1,053,321	-1,227,123	-1,289,026	-1,335,045
Sudan							-188,539	-212,153	-251,343	-275,116	-197,985	-80,173
Syria							-11,711	-16,587	-20,702	-11,875	-13,103	-23,611
Tunisia							-349,140	-404,796	-740,348	-716,537	-582,601	-819,659
UAE							-237,500	-310,583	-310,464	-364,423	-445,977	-458,072
Yemen							-67,686	-61,559	-78,598	-88,407	-115,877	-116,522

Pulses production and net exports

	2000-02	2003-05	2006-08	2009-11	2012-14	2015-17	2000-02	2003-05	2006-08	2009-11	2012-14	2015-17
Algeria	69,223	108,569	89,507	144,210	151,275	90,711	-167,725	-175,623	-180,711	-210,989	-210,865	-221,718
Bahrain	443	375	408	7	162	6	-5,938	-6,430	-5,845	-7,729	-9,165	-11,830
Djibouti	2,400	1,830	1,756	1,824	2,393	2,136	-169	-5,353	-753	-18,319	-19,994	-21,731
Egypt	478,778	402,449	366,315	337,118	260,638	240,705	-308,675	-423,656	-413,724	-360,939	-366,305	-347,899
Iraq	99,010	78,439	30,695	19,249	18,029	9,431	-28,427	-134,849	-31,146	-84,994	-76,072	-96,032
Jordan	4,803	4,280	2,424	4,111	13,814	8,652	-36,412	-41,532	-45,442	-49,197	-58,496	-63,144
Kuwait							-14,478	-17,646	-21,131	-17,639	-22,216	-30,226
Lebanon	13,782	11,877	8,252	8,582	10,080	9,526	-31,744	-28,099	-36,410	-29,266	-37,361	-29,039
Libya	11,539	8,745	7,900	8,107	7,199	7,209	-5,123	-7,105	-6,385	-13,059	-12,423	-10,542
Mauritania	43,414	44,893	46,953	49,406	49,584	51,224	-970	-2,208	-2,318	-618	-4,942	-1,782
Morocco	191,438	251,257	267,443	344,380	359,181	251,614	-54,593	-18,973	-35,022	-21,594	-16,974	-40,709
Oman							-3,126	-5,017	-6,924	-10,872	-14,721	-23,634
Qatar							-5,820	-7,339	-13,760	-19,113	-23,171	-22,445
S Arabia	8,222	9,049	10,188	11,643	13,981	14,843	-62,724	-77,333	-105,109	-122,286	-165,156	-179,456
Sudan					319,259	345,969					-108,708	-75,773
Syria	256,602	285,015	219,933	212,861	208,167	219,834	15,734	85,191	59,569	5,705	3,039	-12,947
Tunisia	50,744	77,900	86,854	102,624	108,325	96,775	-30,225	-31,191	-22,105	-25,703	-11,467	-21,155
UAE							-47,698	-52,361	-186,189	-232,949	-250,516	-303,959
Yemen	62,551	61,743	90,546	90,928	95,328	83,383	-34,714	-39,904	-46,087	-51,436	-63,686	-62,908

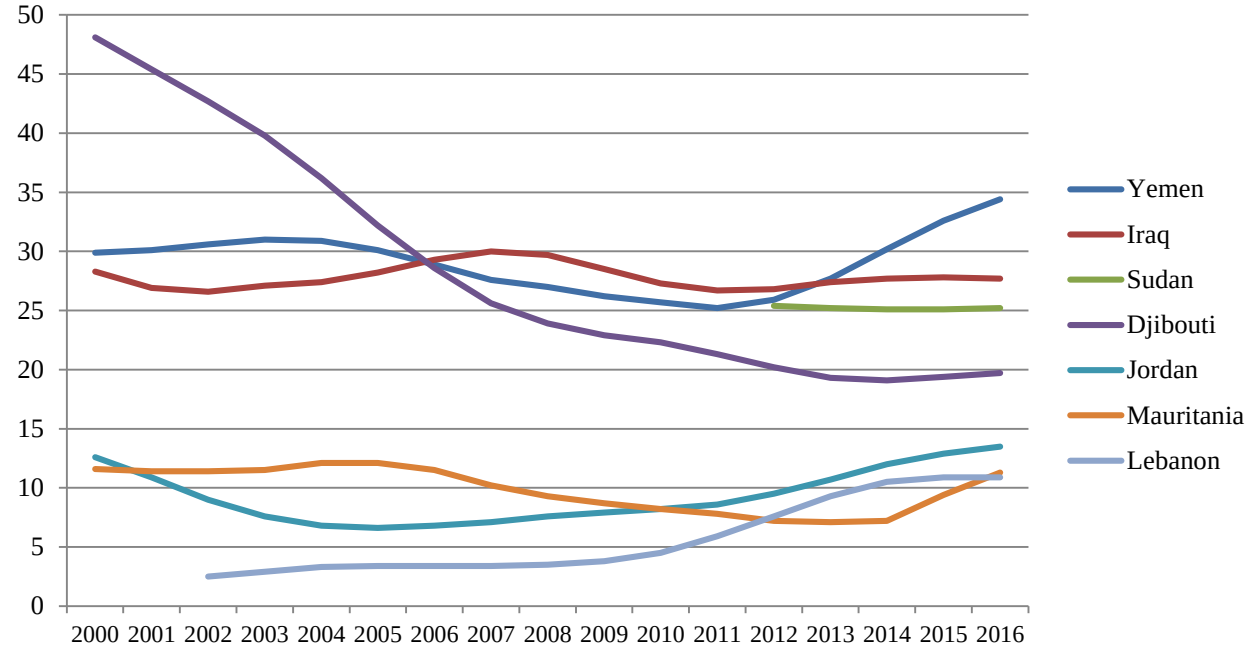
Food Security in the Arab Region

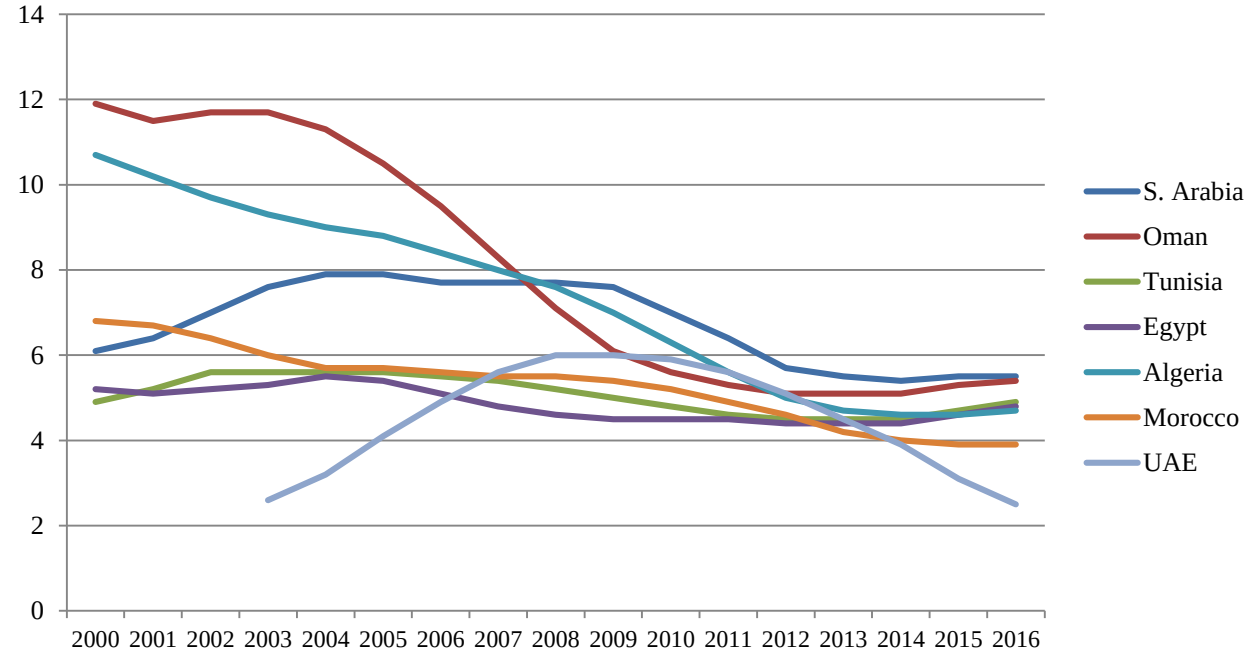
- one of the biggest challenges facing the Arab region
- the Region faces serious challenges on enhancing food self-sufficiency, due to several constraints, including aridity, limited cultivable land, scarce water resources and serious implications of climate change
- weak policies and insufficient R&D investments in agriculture

Food Security in the Arab Region

- affected by several factors such as unstable political and social environments which suppress economic growth, war and civil strife, high trade deficit, natural resource constraints, inadequate education, limited rural development, poor human resource development, poor health services, a limited role of women (especially in the rural areas), flood and droughts, locust infestation, and the absence of good governance

Prevalence of undernourishment





the share of the population which has an insufficient caloric intake to meet the minimum energy requirements defined as necessary for a given population

FAO's main indicator for food insecurity

	Average dietary energy supply adequacy*	Share of Dietary Energy Supply Derived from Cereals, Roots and Tubers**	Average protein supply**	Average supply of protein of animal origin**	Depth of the food deficit*
	(%)	(%)	(gr/caput/day)	(gr/caput/day)	(kcal/caput/day)
Algeria	143	55	75	25	32
Bahrain					
Djibouti	118	56	59	14	96
Egypt	152	65	64	25	32
Iraq	110	63	65	12	235
Jordan	132	46	100	28	28
Kuwait	140	43	115	52	15
Lebanon	125	39	102	29	39
Libya					
Mauritania	133	51	78	32	35
Morocco	145	60	68	26	25
Oman	123	38	87	45	47
Qatar					
Saudi Arabia	139	45	103	39	32
Sudan	105	39	69	29	184
Syria					
Tunisia	142	51	90	27	37
UAE	124	43	88	39	30
Yemen	101	62	45	13	201

Macro food security= food imports/ (total exports + net remittances) (%)

	2000-2002	2003-2005	2006-2008	2009-2011	2012-2014	2015-2017
Algeria	12.41	9.59	8.70	12.54	15.07	24.52
Bahrain	8.55	6.44	4.29	4.95	4.39	5.33
Egypt, Arab Rep.	18.42	14.38	14.40	17.82	21.32	19.65
Iraq						
Jordan	15.04	16.36	16.52	17.10	20.04	22.34
Kuwait	6.07	4.71	4.15	5.13	4.58	11.22
Lebanon		20.19	16.24	19.07	21.71	27.20
Libya		5.08	2.33			
Mauritania					16.22	17.35
Morocco	11.54	9.10	10.74	11.97	12.58	10.94
Oman	14.30	7.19	7.50	7.62	6.78	14.52
Qatar				2.73	1.96	4.53
Saudi Arabia	8.73	6.52	5.10	7.03	6.96	13.20
Sudan	15.05	12.67	6.87	15.42		
Syrian Arab Republic	10.43	13.52	11.17			
Tunisia	8.20	7.39	8.45	9.19	10.02	11.79
United Arab Emirates						
West Bank and Gaza						
Yemen		12.64	21.14	30.10	34.61	50.07

and there is climate change…

- warmer air will hold more moisture and this would make precipitation more intense
- extreme precipitation can directly damage crops
- faster evaporation, resulting in more droughts and water shortages -less water for irrigation
- each °C of global temperature increase would cause 5 to 15% yield reductions of a number of crops

temperatures will rise in the Arab region

- moderate emission scenario (RCP 4.5): an increase range of 1.2°C-1.9°C at mid-century, and 1.5°C-2.3°C by the end of the century
- high emission scenario (RCP 8.5): increase between 1.7°C and 2.6°C for the middle of the century and between 3.2°C and 4.8°C by the end of the century

Reduced and more variable rainfall

- rainfed agriculture is the dominant mode of agricultural system in the Arab region - nearly 83% of seasonal crop areas are rainfed.
- food security and variations in precipitation are highly correlated with each other
- most countries of the region are likely to receive less and more variable rain
- southern part of the region likely to encounter higher moisture and rain, as they remain under the influence of the inter-tropical climate

Frequency of climatic shocks /extreme events

In the analysis of 134 nations over a 53-year period from 1961 to 2013, “over half of all shocks to crop production systems were a result of extreme weather events (largely drought), reinforcing concern about the vulnerability of arable systems to climatic and meteorological volatility” (Cottrell et al., 2019).

Frequency of climatic shocks /extreme events

- Climatic shocks and extreme events can also disrupt food transport
- extreme weather increases the risk of spoilage and contamination and result in more food-borne illness
- less precipitation might impact the aridity of the Arab region: the number of drought days will expand in the next century
- 50% of droughts will be experienced around the Mediterranean shore

Projections to 2030 for the Arab Region

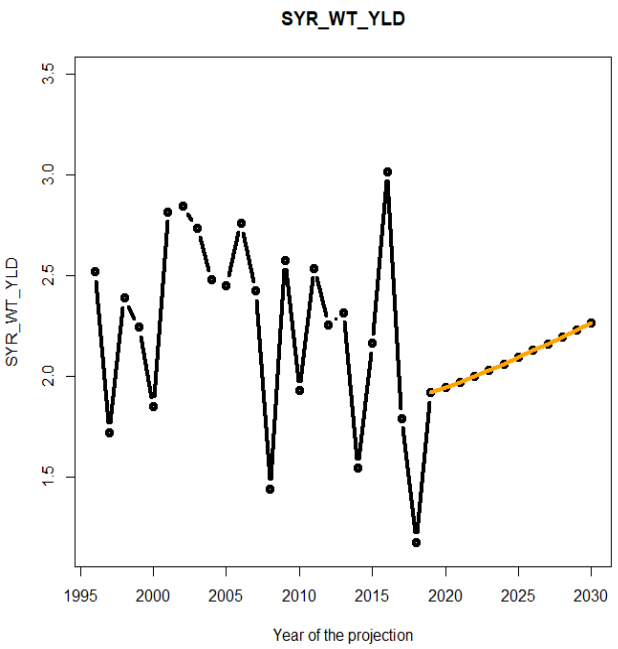
- baseline projections (i.e. business-as-usual scenario) in the absence of a new policy intervention or a climate-related shock
- The average values in the period 2016-2018 of harvested area, production, total consumption, exports and imports are presented to serve as the reference point in the past
- suggest huge variation among the region's countries. Some countries produce agricultural commodities substantially and export while others remain as net importers

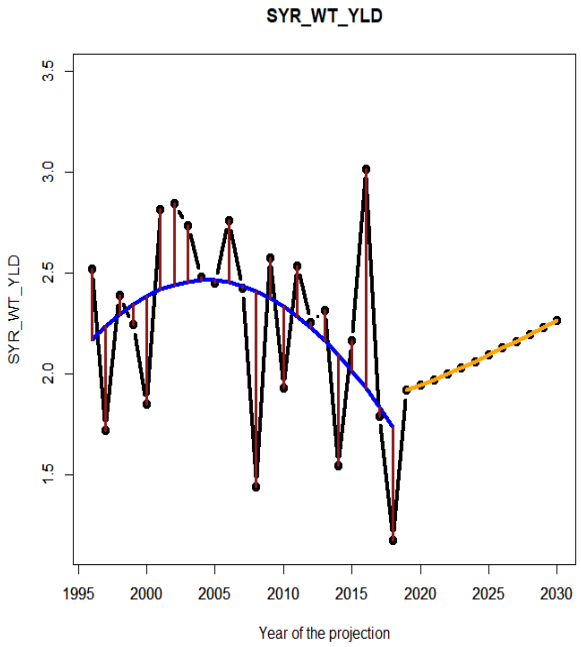
Some examples for 2019-28 baseline scenarios

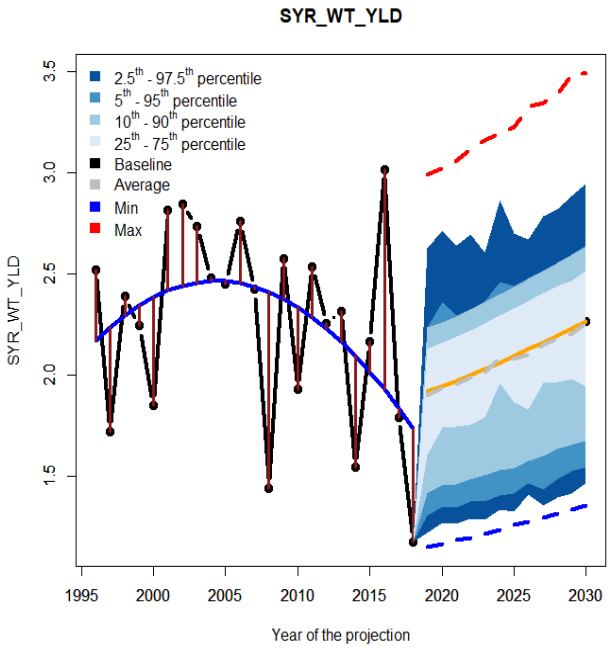
- UAE: beef and veal exports are expected to decrease
- Egypt: harvested area for and exports of wheat, rice, and other coarse grains are expected to diminish
- Jordan: harvested area, production, consumption, and exports of wheat are expected to increase while imports of wheat are expected to decrease

Crop yield projections under a scenario of stochastic climate variability

- stochastic analysis demonstrates uncertainty in major crop yields
- Historically, yields of major crops show different degrees of variation, but the baseline scenario does not account for yield variability
- factors such as technological change, intensification, policies, and weather variability







Deviations, measured as the difference between expected and observed yields, are put into two groups: North Africa and Western Asia:among close countries, weather patterns might affect yields similarly

The process uses a semiparametric Hierarchical Archimedean Copula (HAC) allowing for such correlation within the region

Following the estimation of the HAC, the next step is to generate 1000 simulations for the yield deviations.

These simulations provide a spread for the yield variables which represent 1000 possible yield outcomes

Yield variability as a proxy for climate change

- Aglink-Cosimo is an economic model; therefore, it does not include any biophysical variables to model climate change directly
- The model uses yield variability /harvest failure as an approximation for the representation of climate change.
- Harvest failure is defined as any simulation below the expected outcome. In other words, harvest failures are all the yield simulations below the projected yield or those within the 0th- 49th percentiles

Harvest failure

Crops	Country	Maximum Losses	Average Losses (range 0th - 49th percentiles)
Wheat	Mauritania	59.8%	20.4%
	Algeria	21.8%	11.7%
	Egypt	12.0%	1.4%
	Iran	34.7%	11.3%
	Iraq	40.5%	14.9%
	Syria	38.9%	14.5%
	Tunisia	55.8%	10.0%
Maize	Egypt	7.3%	1.7%
	Iran	26.3%	10.5%
Other Cereals	Mauritania	69.8%	30.2%
	Algeria	37.7%	18.6%
	Iran	38.7%	7.6%
	Sudan	43.4%	20.0%
	Syria	63.7%	30.7%

The future ahead…

- Climate crisis is real and pressing.
- Import dependency will increase
- More severe and more frequent extreme climatic events – more crop failures
- Conditions force the region to further trade openness in food products – risks above
- Conflicts in the region/neighborhood (e.g water conflicts between Ethiopia and Egypt, Syria and Turkey etc.)

What to do?

- If households and/or societies are manage to enrich themselves against the potential adverse effects of climate change, then food security could become less sensitive to climate
- Local/national/regional/international responses needed.

Facing a vicious cycle

- Increasing food production by 60% by 2050 to meet future consumption trends will increase greenhouse gas emissions from agriculture, particularly from regions with low current productivity.
- To limit global warming by 2°C above pre-industrial levels by 2100, IPCC scenarios indicate that agriculture must reduce emissions.

Possible responses

- Low emissions development (LED) options for producing food are needed to combine adaptation and mitigation, while ensuring food security

Possible responses

- Ensuring that adaptation actions are relevant to those most vulnerable to climate change
  - Social protection programs for adaption
  - Functioning markets – especially for the disadvantageous
  - Improvements in financial infrastructure
  - Public-sector involvement in information provision to farmers

Possible responses

- Investments in crop development and new technologies
  - e.g. Alternate Wetting and Drying (AWD), a water-saving technology that farmers can apply to reduce their irrigation water consumption in rice fields without decreasing its yield.
- Expansion of irrigation infrastructure
- Improve storage facilities
- Reduce production risk through index-based crop insurance

Possible responses

- Improve food utilization
  - Changing food consumption patterns - shifting from beef to lower emissions – high nutrition food
  - Reducing food waste and loss

Possible responses

No time to lose

Arab countries to the forefront against climate change

Thank you…

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