Foresight modeling of wheat self-sufficiency: perspectives for SSA

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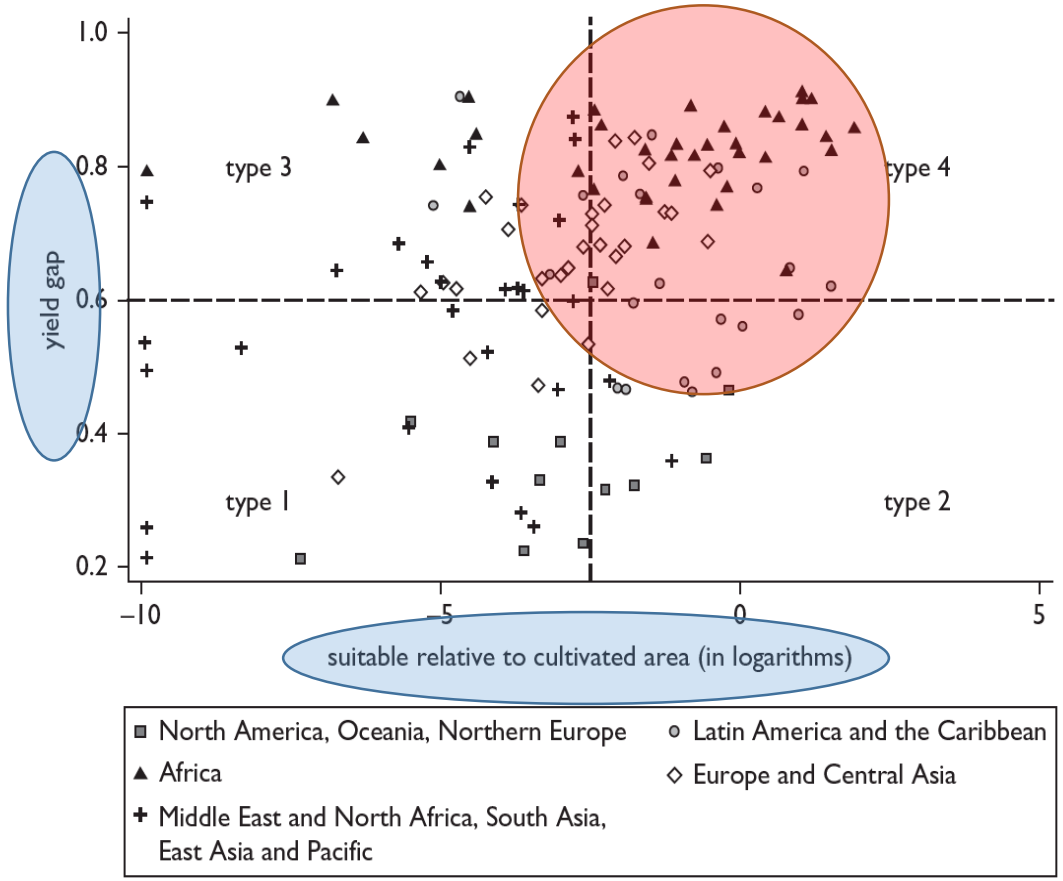
Outline of the presentation

1. Background: Yield gap and agricultural areas expansion
2. Objective of the study
3. Methodology
   A. Yield, adoption, and areas expansion scenarios
   B. Global partial equilibrium model (IMPACT)
4. Results of scenarios simulations
   A. Projections of average national yields
   B. Projections of total wheat production
   C. Projections of wheat import indicators
5. Conclusions and perspectives

Background: Yield gap and agricultural areas expansion

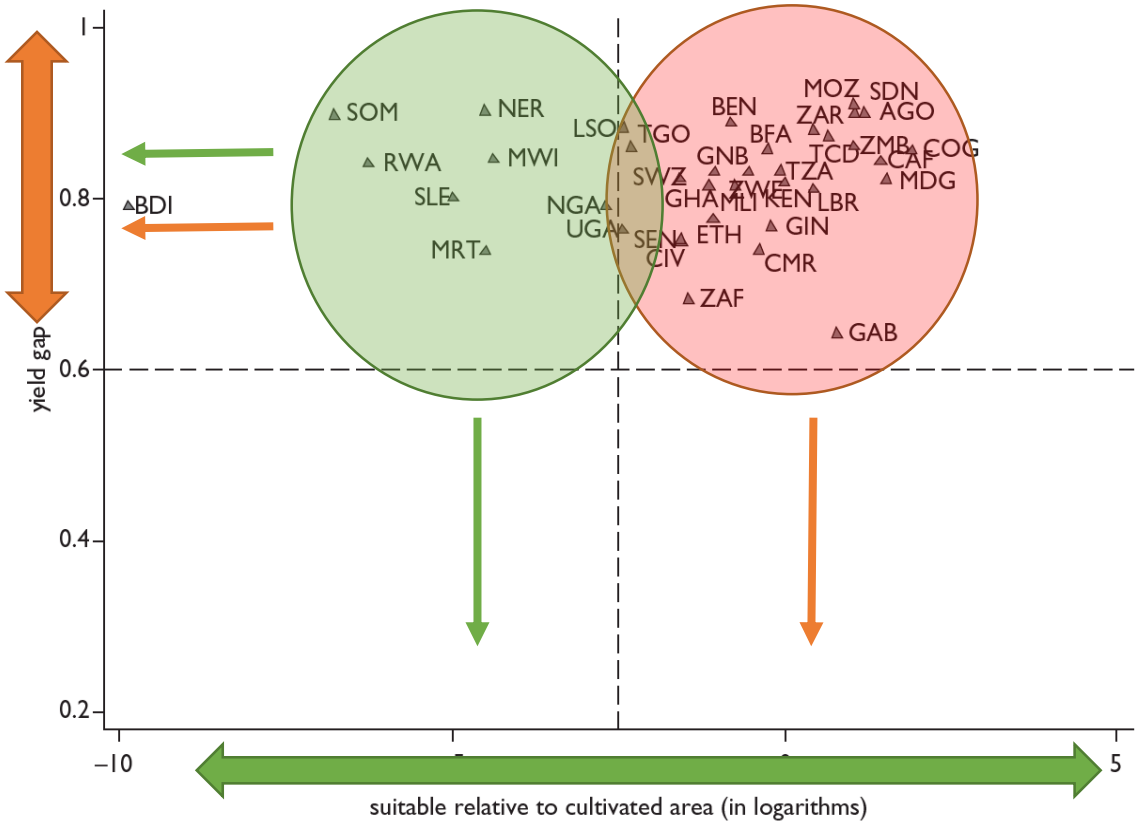
- Most of the African countries are mapped as type 4.
- Potential area of 200 million hectares could be converted to rainfed agriculture in SSA (World Bank, 2011).
- Of which 95 million hectares could be accessible without major investments in infrastructure.
- This area is roughly estimated as being 45% of the total area in the world suitable for expansion.



Yield Gaps and Relative Land Availability for Different Countries (Deininger et al., 2011)

Background: Yield gap (YG) and agricultural areas expansion

- In the 1960s, average cereal yields in Africa were about 57% of the world average. In the 1990s this average became only 42%.
- Partial narrowing of YG could have a significant impact on local and global food supplies in SSA (Larson et al., 2016).
- YG and poverty in the region are closely correlated (Dzanku et al., 2015)

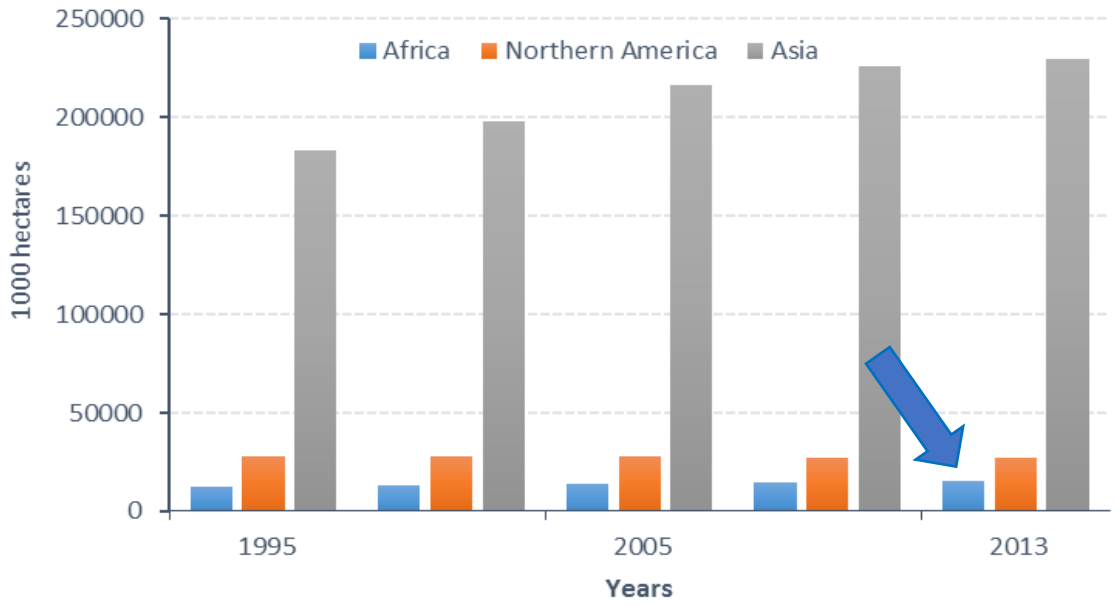


Potential Land Availability vs. Potential for increasing Yield in selected SSA countries (Deininger et al., 2011, in Fischer and Shah 2010)

Background: Yield gap and agricultural areas expansion

- Land development in Africa also offers the possibility to expand irrigated areas in the region due to the availability of water resources.
- Total volume of water resources in Africa is comparable to other continents.
- However, Irrigated areas in Africa are the lowest among other major continent: only about 14 Million hectares, compared to more than 200 Million hectares in Asia.

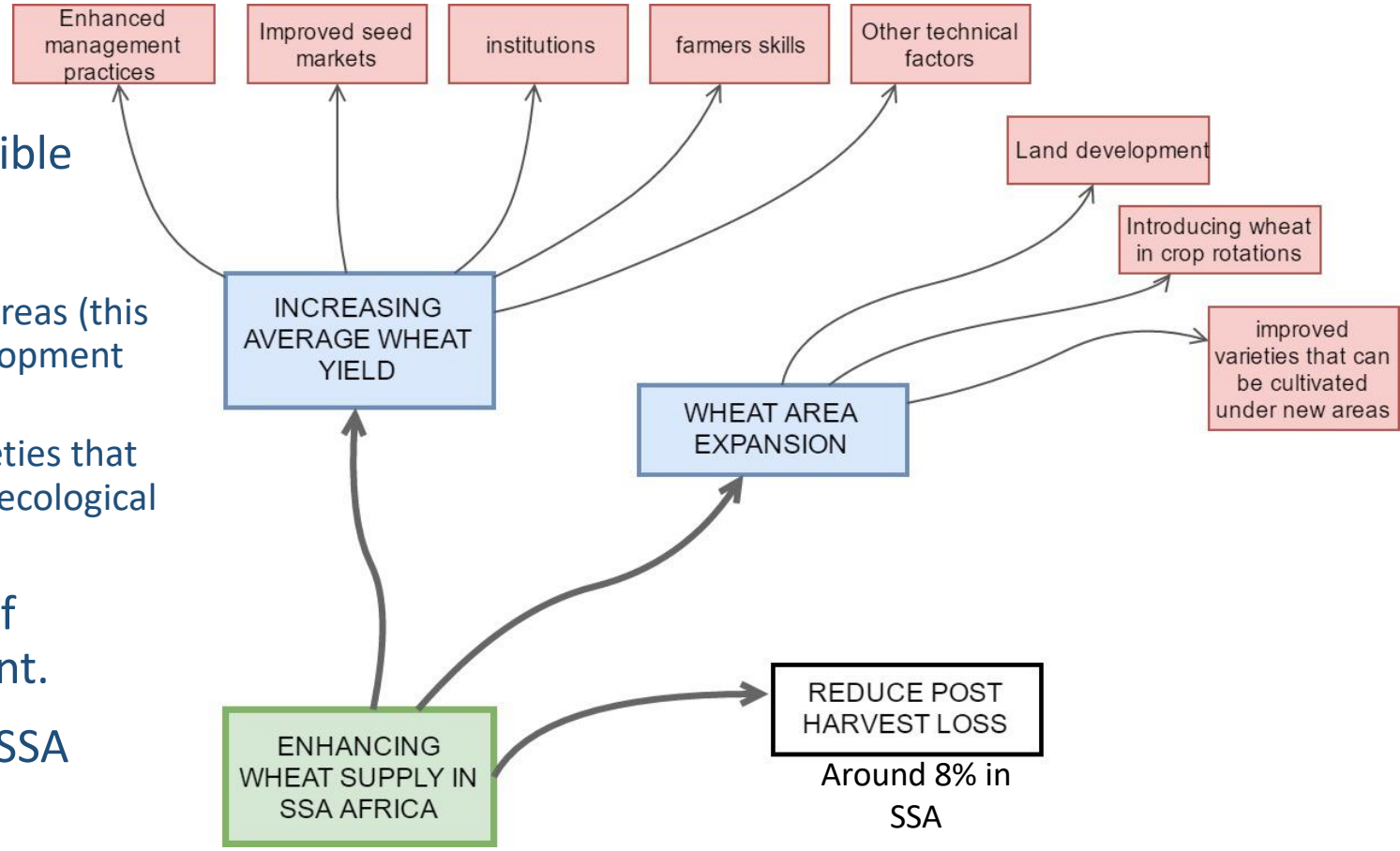
	North America	Asia	Africa	Europe
Wetlands, large lakes, reservoirs and rivers (Km3)	27 003	30 622	31 776	2 529
Groundwater (Km3)	4 300 000	7 800 000	5 500 000	1 600 000



Research objectives

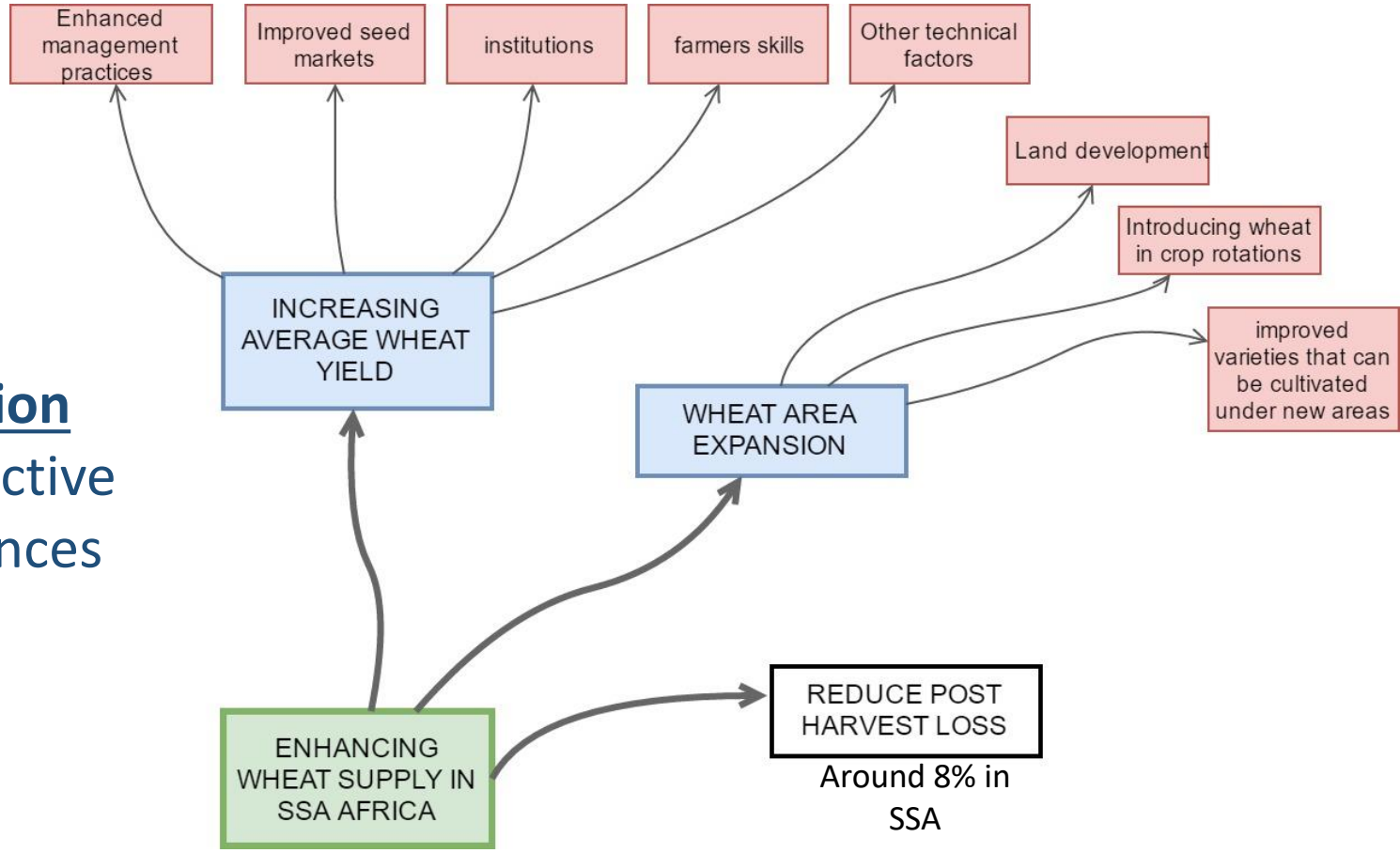
How to increase wheat Production in SSA? What are the scope and requirements for wheat self sufficiency in SSA?

1. Expanding the wheat areas which is possible through two main options:
   A. Further expansion of agricultural land through reclamation of suitable rangelands and forest areas (this can happen with and without major land development investments).
   B. development of improved adapted wheat varieties that can be suitable for cultivation under new agro-ecological areas in SSA
2. Closing the yield gap through upscaling of relevant wheat technologies/management.
3. Reducing postharvest losses of wheat in SSA (around 8%)



Research objectives

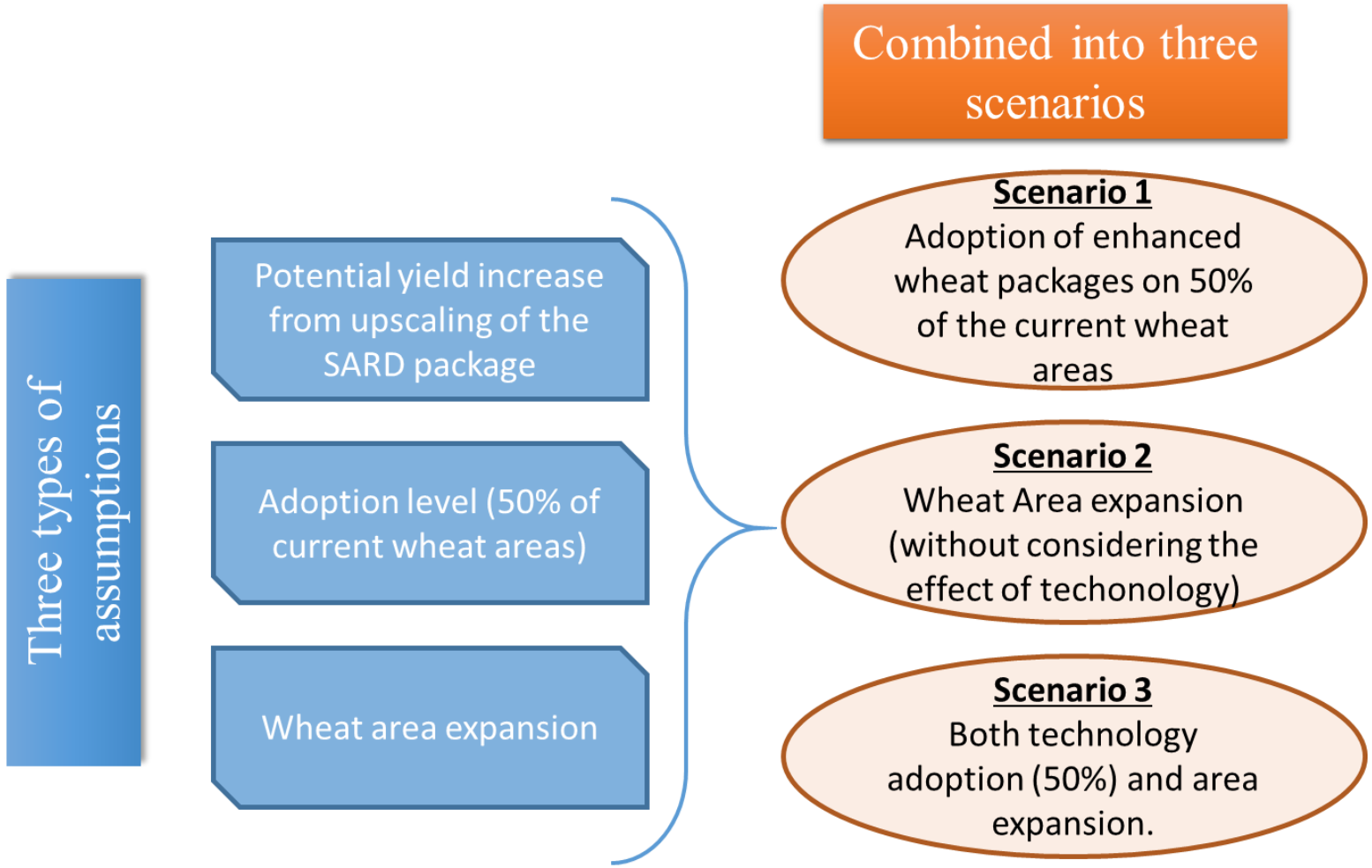
- To test different wheat **technology adoption** and wheat **areas expansion** scenarios and to assess their respective effects on wheat sectors performances in selected countries.



Scenarios on wheat yield, adoption, and areas expansion

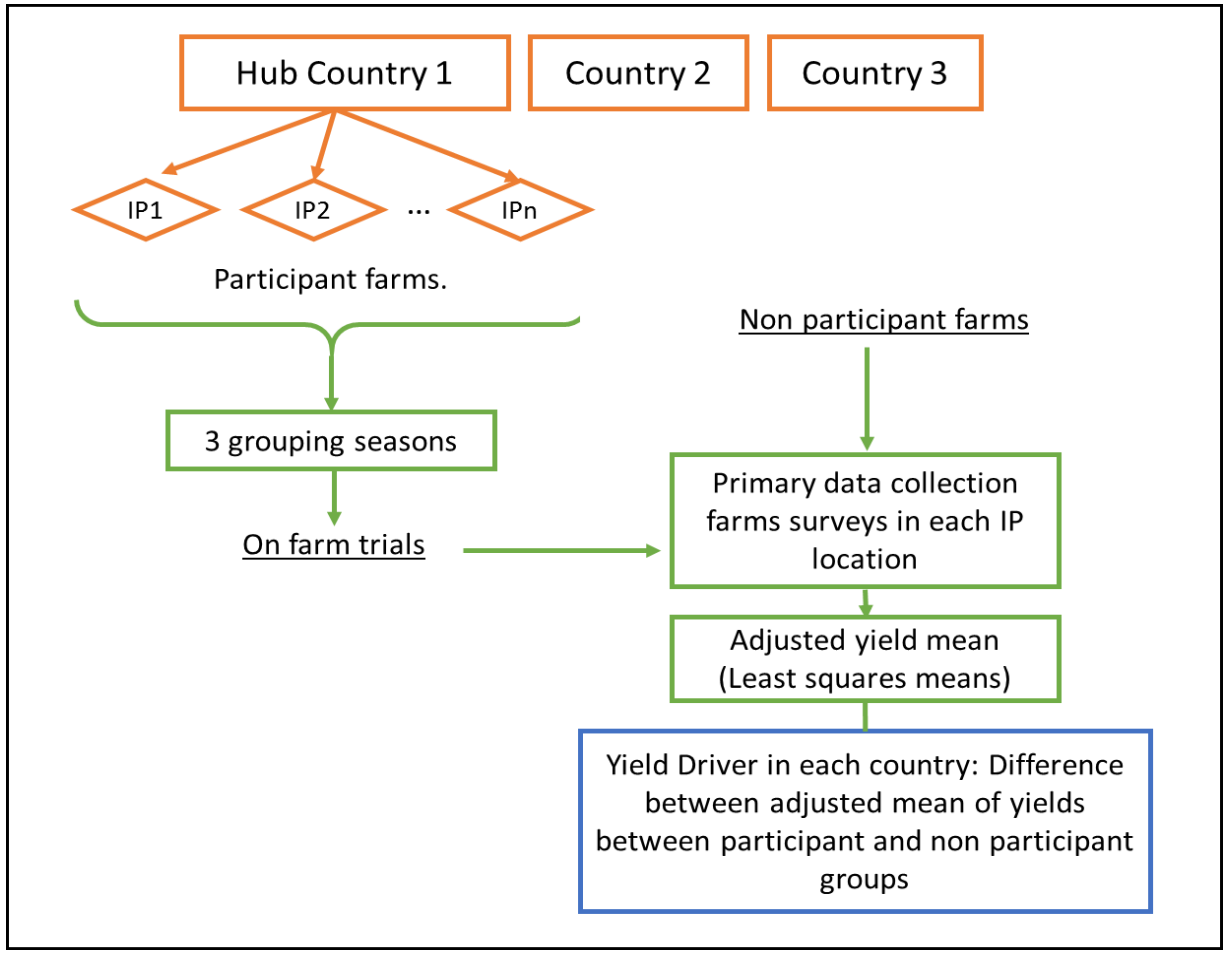
Methodology: Scenarios

- Three scenarios that offer different combinations of adoption rates and wheat areas expansion.



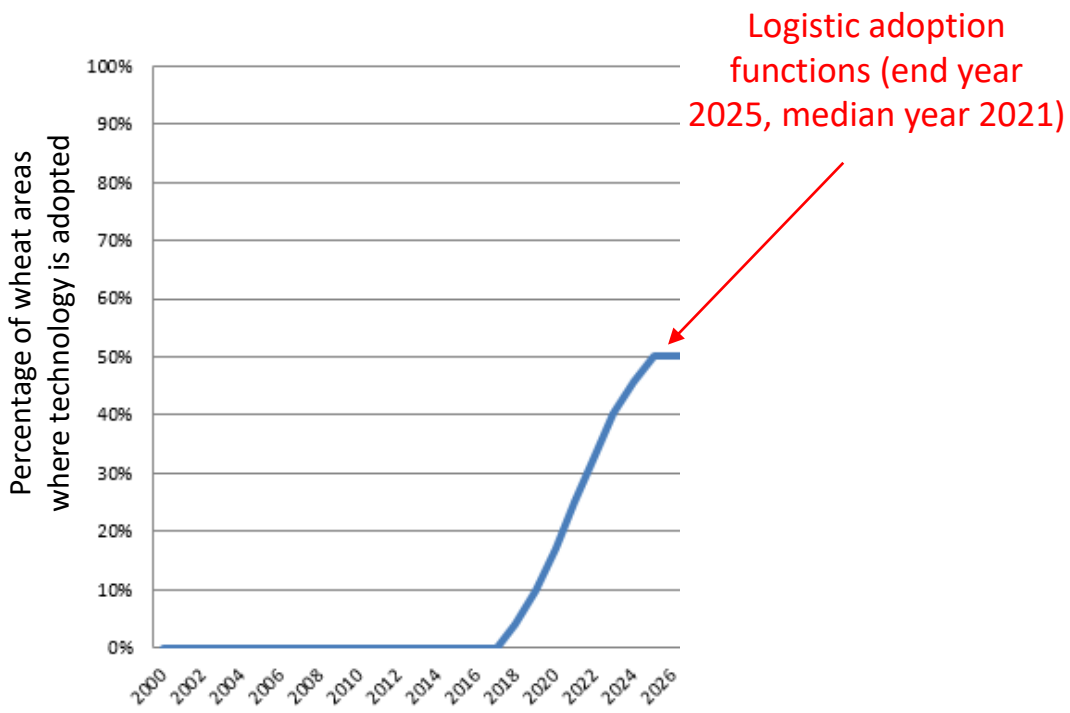
Yield / adoption scenarios

- Yield driver: is the resulting difference of wheat yield which is exclusively due to the adoption of the SARD-SC package.
- Primary baseline data collected from the different countries and action sites of the project.
- Adjusted mean values of yields (using multiple regressions) for beneficiary and non-beneficiary farmers.



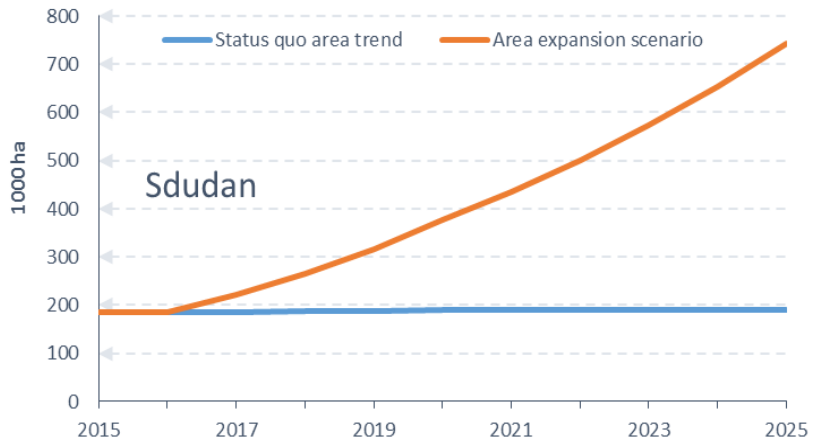
Yield / adoption scenarios

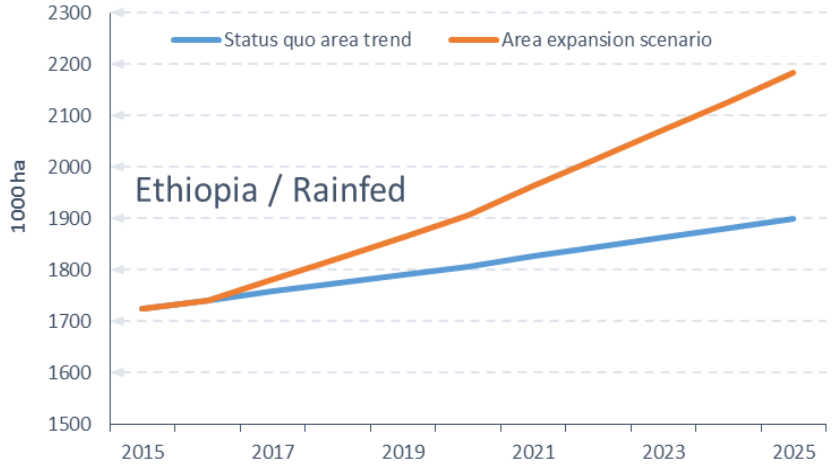
- We need to set beginning (2016) and end (2025) years of adoption, median year (2021), maximum adoption rate (50%), and the scale of the logistic adoption function (2).
- Annual adoption rates are calculated using a "diffusion model" where adoption levels of enhanced technologies increase over time until it reaches 50% of the wheat area.

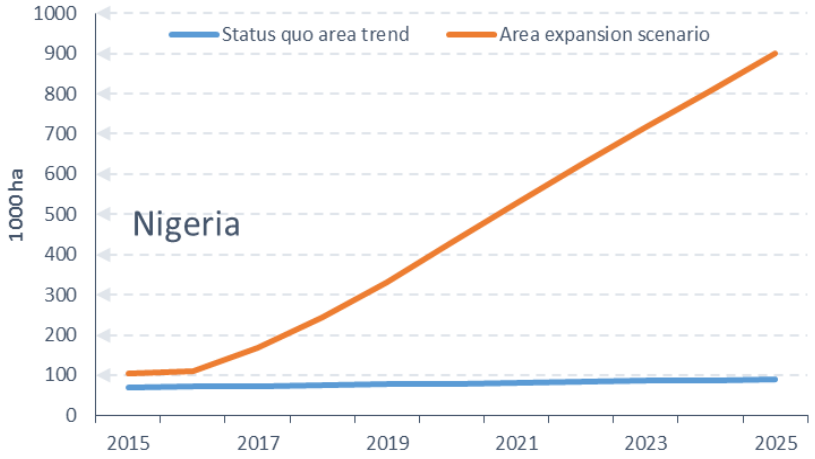


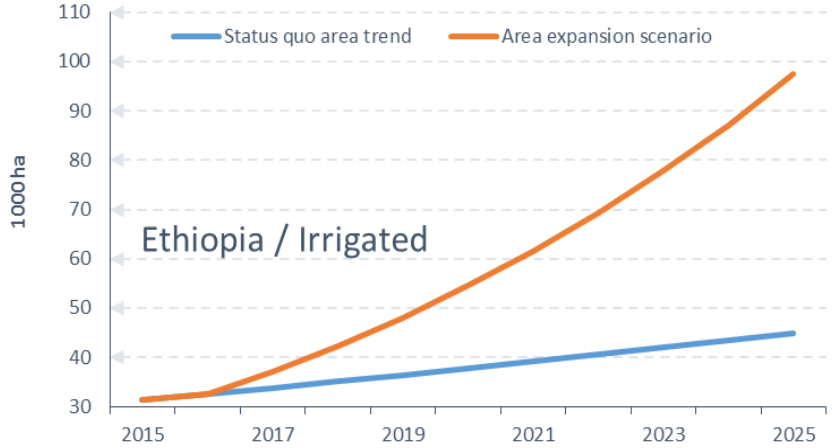
Area Expansion scenarios

- Sudan: from 188 000 ha of wheat to 730 000 hectares
- Ethiopia: from 1.76 million ha of wheat to 2.2 millions hectares
- Nigeria: from 105 700 ha of wheat currently to 890 000 hectares.









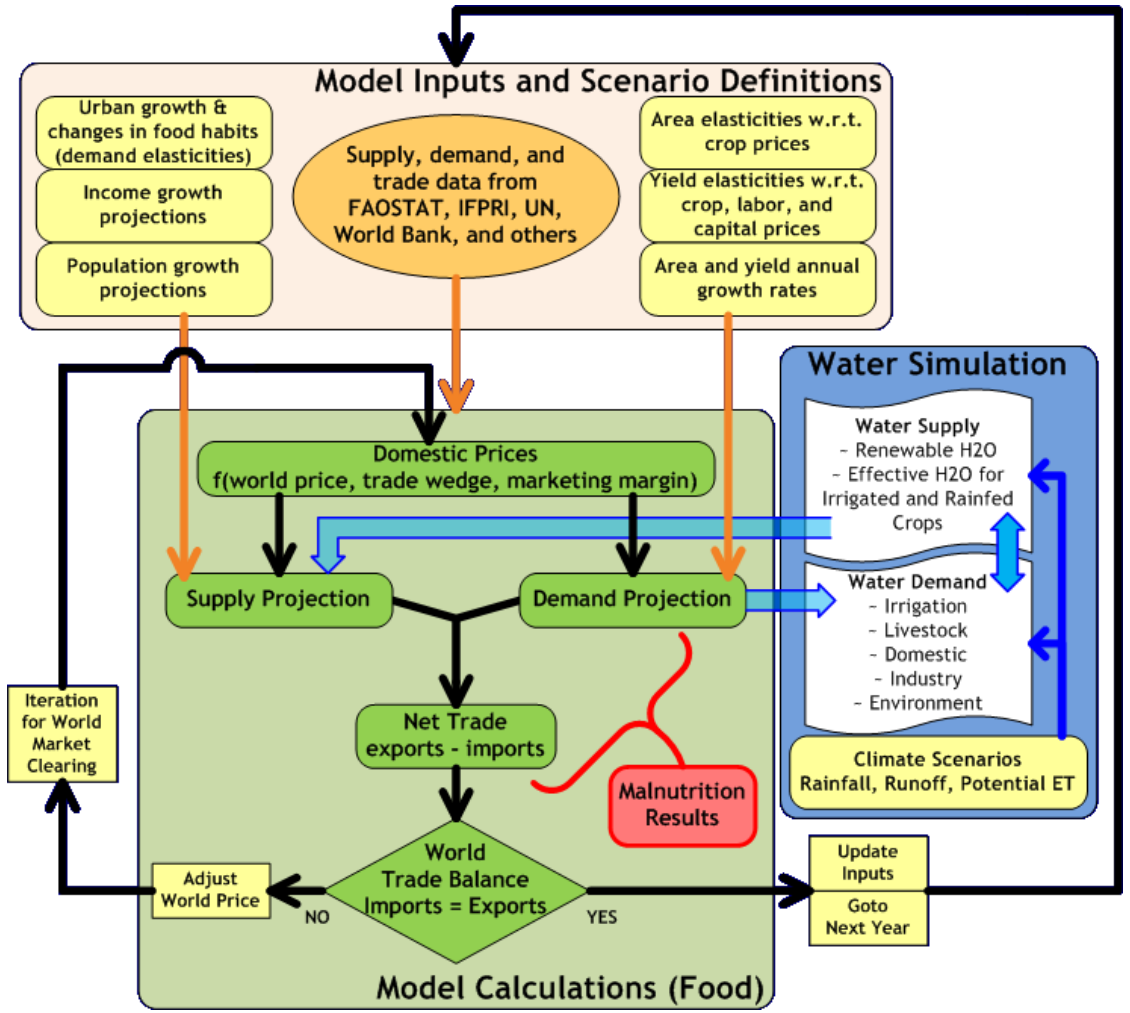
Wheat expansion scenarios considered for Ethiopia, Sudan, and Nigeria (only irrigated wheat is considered for Sudan and Nigeria, as suggested by expert opinions).

Resulting/final scenarios

Scenario Components	SQ Situation No technology adoption, No area expansion	SC1. Technical change only Enhanced wheat management and technical package	SC2. Wheat area expansion only Without considering technical change	SC3. Combination of SC1 and 2 Both area expansion and technical change
Sudan				
Wheat technology scenarios/drivers	Local Varieties, Poor management practices,	Improved varieties, improved management & sowing dates.	Local Varieties, Poor management practices,	Improved varieties, improved management & sowing dates.
Yield (Tons/Ha) by 2025	1.8 tons/ha	3.5	1.8	3.5
Wheat Area Expansion by 2025	188000 ha of wheat	255000	902000	902000
Maximum adoption rate (% Area where the technology might be adopted)	0%	50%	0%	50%
Time to full adoption	**	10 years	**	10 years

Methodology: The IMPACT model for long terms projections of supply and demand

- "International Model for Policy Analysis of Agricultural Commodities and trade"
- Disaggregated spatial allocation of crop production at sub-national level (countries, basins and food production units)
- Simulate effects of supply & demand drivers of 63 commodities in 153 countries.
- Iterative year-by-year demand and supply equilibration

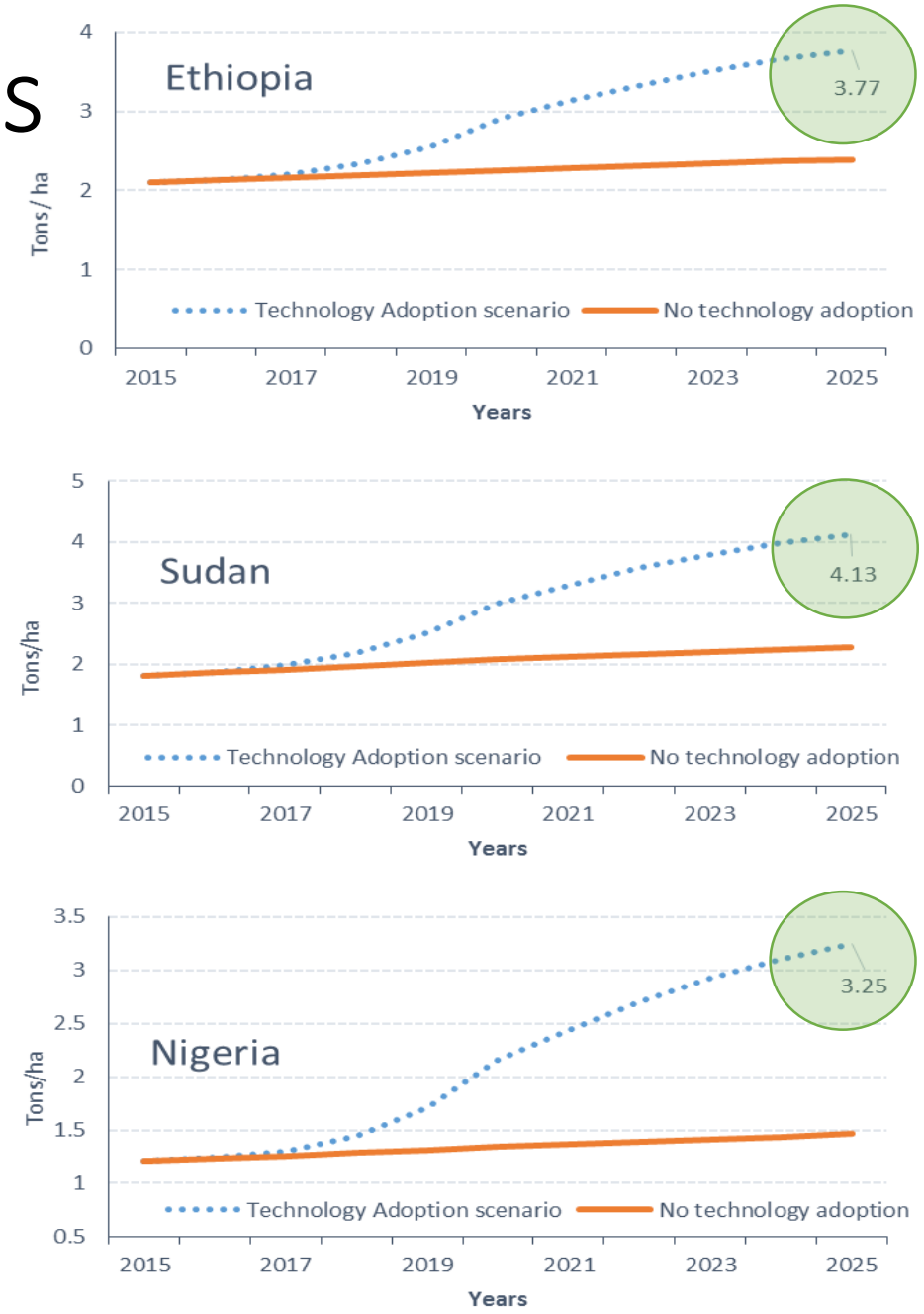


Reproduced from IMPACT Overview By IMPACT Development Team

Results

Results: average yield projections

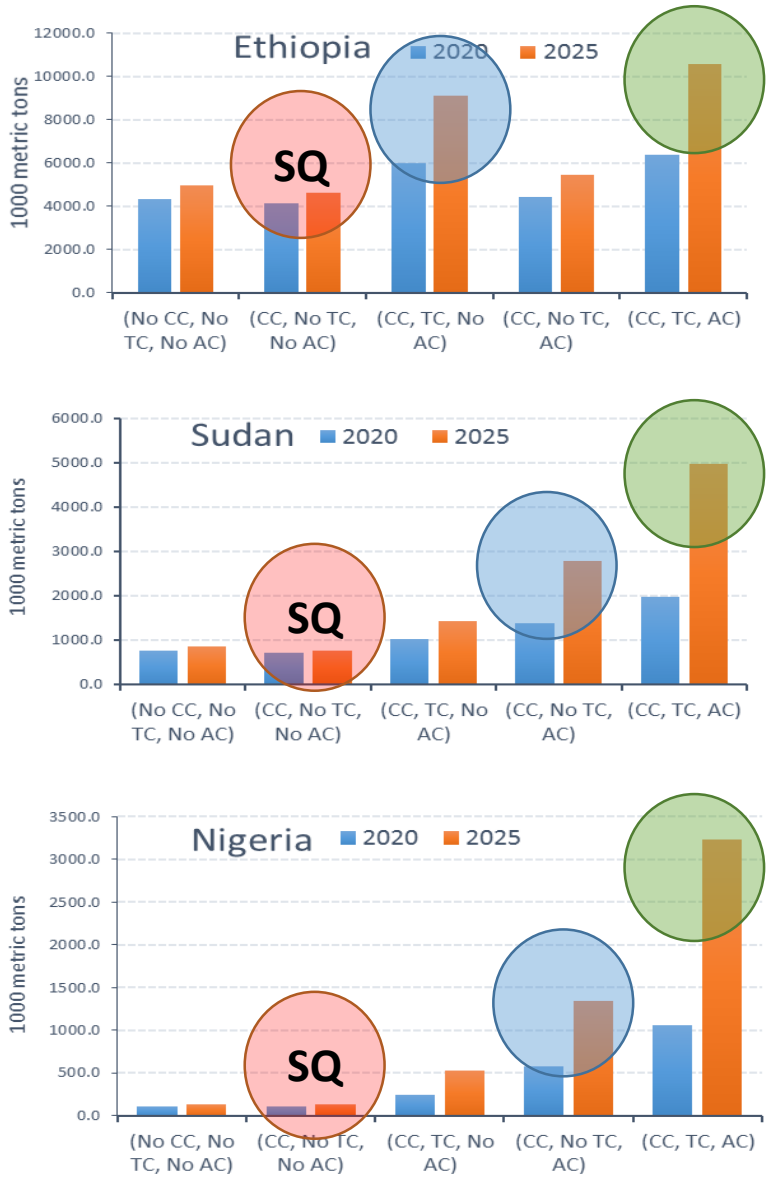
- These numbers show the levels of average national yields by 2025, if SARD-SC package will be progressively adopted on 50% of the wheat areas.
- Average yields in the three countries can go beyond 3 tons/ha.
- A maximum yield is recorded for Sudan where average national yield can reach 4.13 tons/ha, if the recommended package will be adopted in 50% of current wheat areas.
- These scenarios do not yet suppose wheat area expansion.



BAU yield trends (FAO data) vs projections of average yield of wheat under the 50% adoption scenario.

Results: Projections of wheat production

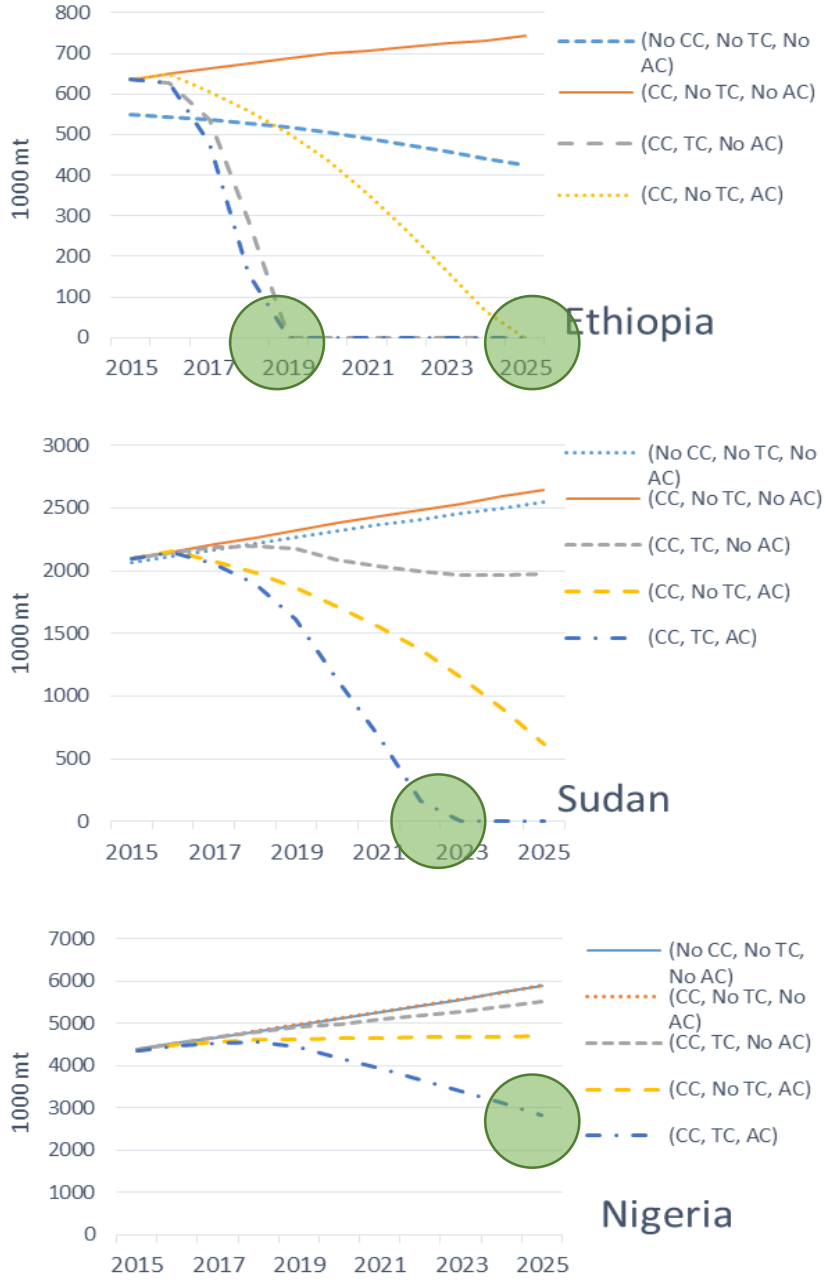
- Domestic production of wheat can almost be doubled (compared to the SQ situation) in all countries under the most optimistic scenario (CC, TC, and AC)
- The second best scenario in Ethiopia was found to be the one considering “CC, TC, and No AC”
- Even though area expansion is not considered in this scenario, it still shows better performances in terms of total wheat production compared to the scenario exclusively considering area expansion.
- This is mainly due to the fact that higher yields in Ethiopia combined with fixed/guaranteed wheat prices will implicit lead to increase wheat areas.



Total wheat production in Ethiopia, Nigeria, and Sudan (Legend: TC technical change; No TC: no technical change; AC: Area expansion: No AC: no area expansion).

Results: Wheat import projections

- Ethiopia:
  1. “CC, TC, and AC”: 2019 (4 years after the reference year 2016).
  2. “CC, TC, and No AC”, but guaranteed wheat prices: 2019.
  3. “CC, No TC, and AC”: 2025. 2.2 million hectares, including around 95 000 hectares of irrigated wheat, with No TC.
- Sudan:
  1. “CC, TC, and AC”: 2023 (8 years after the reference year of our scenarios: 2016).
  2. “CC, No TC, and AC”: dramatically decrease wheat importations in Sudan with 76% in 2025 compared to the BAU scenario
- Nigeria:
  1. Nigeria can cut its wheat importations by 50% under the “CC, TC, AC” scenario, compared to the BAU scenario



Total wheat import in Ethiopia, Nigeria and Sudan under different scenarios (values are expressed in 1000 tons)

Results: Net trade of wheat.

Net trade of wheat in the considered countries under different scenarios (in 1000 tons).

Scenarios	Ethiopia		Sudan		Nigeria	
	2020	2025	2020	2025	2020	2025
SQ scenario (No CC, No TC, No AC)	-507.4	-425.5	-2322.4	-2550.7	-5113.4	-5896.2
(CC, No TC, No AC)	-699.7	-744.2	-2381.8	-2644.8	-5119.7	-5905.0
(CC, TC, No AC)	1157.3	3688.1	-2082.2	-1979.0	-4989.9	-5528.2
(CC, No TC, AC)	-438.9	43.5	-1714.8	-618.9	-4651.7	-4708.8
(CC, TC, AC)	1527.1	5169.6	-1134.3	1557.0	-4179.5	-2846.0

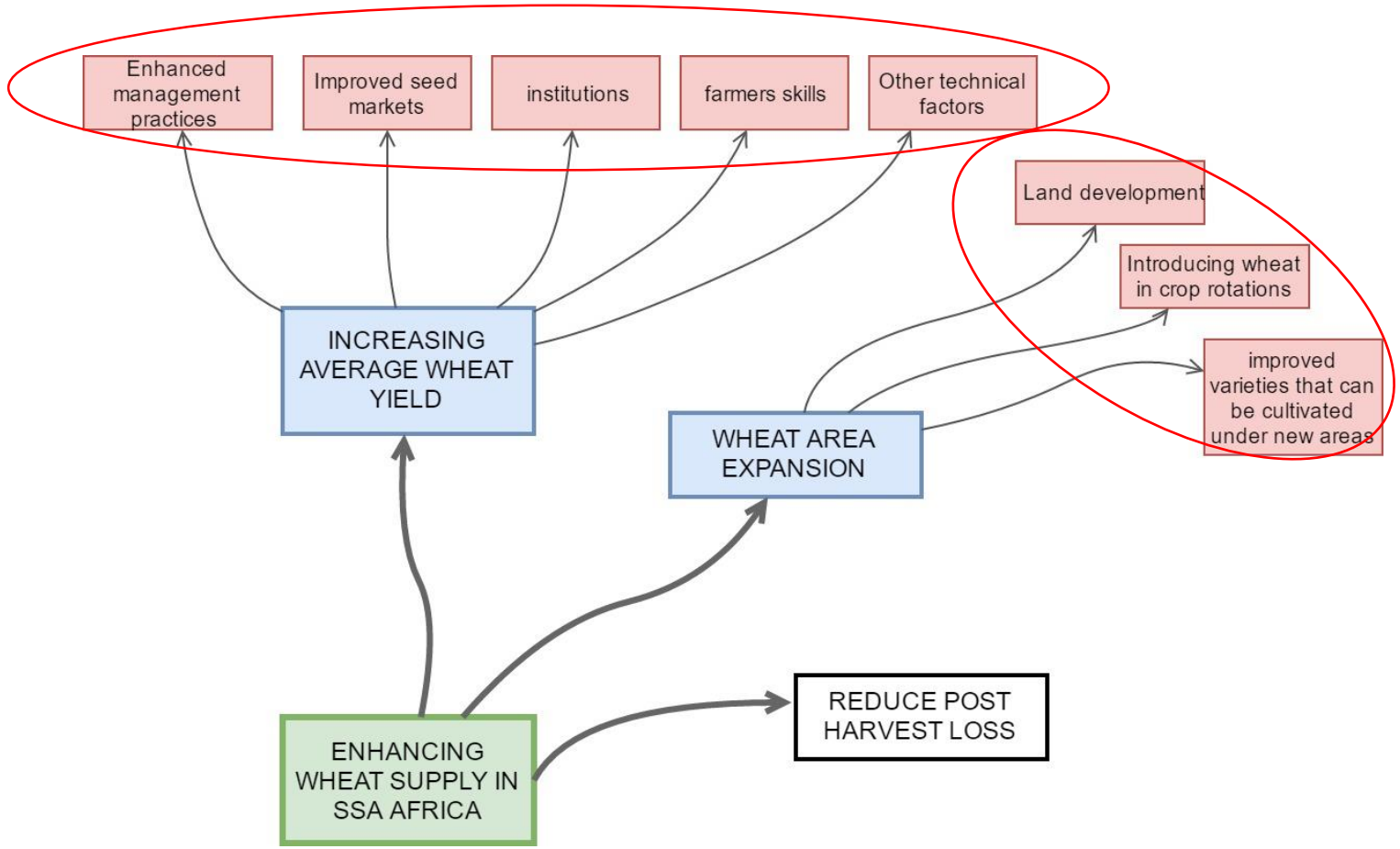
(Negative values indicate imported quantities; Positive values indicate overproduction)

Concluding remarks

- The three case-study countries show that the scope and timeline for wheat self-sufficiency is different from one country to another.
- Some African countries would be able to reach self-sufficiency for wheat in the short term by only improving their average national yields.
- This should be backed up by appropriate price incentives in the wheat market.
- For other countries self-sufficiency can only be reached in the medium term when both improvements of average national yields and large investments in expanding wheat areas can be implemented.

Concluding remarks

- It is easy to talk about self-sufficiency, but in reality, the concept involves a wide portfolio of policies, market incentives, and investments of different type.
- We only simulated the direct drivers of domestic wheat supply increase in Africa,
- These drivers can only be achieved through important policy, dissemination, and other related R&D efforts & investments.



Thank you!