Technical Annex

This note explains the methodological approach to estimating three sets of figures that appear in the Food and Land Use Coalition's report, *People, Health and Nature: a sub-Saharan African Transformation Agenda.* The note describes the data sources and assumptions used in each of the following three sets of analyses:

- **The Optimisation of food and land use demand** across environmental, health and economic impacts.
- **The Hidden Costs** of food and land use systems for 2018 across environmental, health and economic factors. (See Table 1 below.)
- **The Investment Requirements** to achieve a transformation of food and land use systems in line with the recommendations of the report. (See Table 2 below.)

All three of these sets of figures were based on modelling and estimates conducted as part of the Food and Land Use Coalition's work on its global report, *Growing Better: Ten Critical Transitions to Transform Food and Land Use,* which will be released on 16th September 2019. Projections of sustainable futures and investment requirements are based on the actions outlined in ten critical transitions that the report identifies to build sustinable food and land use systems globally. These are: (1) Healthy Diets, (2) Productive & Regenerative Agriculture, (3) Protecting & Restoring Nature, (4) A Healthy & Productive Ocean, (5) Diversifying Protein Supply, (6) Reducing Food Loss & Waste, (7) Local Loops & Linkages, (8) Digital Revolution, (9) Stronger Rural Livelihoods, (10) Gender & Demography

The outcomes and costs analysishave been reorganised to correspond to the four critical transitions and purposeful approach that are outlined in the sub-Saharan Africa.

We are confident that the actions outlined in each of the four critical transitions and purposeful approach highlighted would contribute to delivering on the ten critical transitions outlined in the global report at both a regional and global level. Fulfilling these actions would therefore help to deliver the outcomes and reduce the costs described by the work on the global report.

Global land, climate and food systems modelling

The primary modelling for the global report was produced by the International Institute of Applied Systems Analysis' (IIASA) Global Biosphere Management Model (GLOBIOM), informed by in-depth analytical work on specific sectoral issues. The model provides a link between agricultural production choices and their impact on the planet. Complementary modelling was done by the University of Washington on diets and health; in addition, we run scenarios on income and employment using the World Bank Shockwaves model. A more detailed exposition on the modelling will be released on 16th September 2019.[i]

The aim of the modelling is to offer broad insights into developments under two different scenarios.

The baseline scenario, "Current Trends", models a future grounded in historical trends. This future would see a degree of progress and innovation (for example with regards to agricultural productivity) following the development trends demonstrated over the past 50 years. Current Trends mainly relies on the standardized set of assumptions that has informed the analysis of the International Panel on Climate Change's 5th assessment, coupled with the matching set of climate assumptions.[ii] Under this scenario the world gets nowhere close to meeting the Sustainable Development Goals or the Paris Agreement targets.

The reform scenario, "Better Futures", is based on 10 assumptions of fundamental change, derived from ten critical transitions identified in the *Growing Better* global report. Strong (but not perfect) implementation of the ten critical transitions would be the key to achieving the outcomes described in this report.[2]

The key assumptions of the global modelling are:

1. Global average agricultural productivity continues to increase following historic trends at a rate of 0.9 percent a year under Current Trends. The Better Futures assumes an additional 12 percent increase in productivity by 2050 due to technological advancements, and a convergence of the lowest productivity farmers to the highest productivity farms of 25 percent, resulting in an annual rate of increase of 1.1 percent overall. This reflects renewed efforts in R&D and technological diffusion, and large investments in infrastructure, which would help raise yield and reduce the yield gap between more productive and less productive producers.
    1. The global average assumes a 25% convergence in the lowest productivty farmers to the maximum potential yield for each region. As Sub-Saharan Africa has the largest yield gap of all regions considered, it also has the highest relative yield increase. In the curent trends scenario, aggregate average agricultural productivity in SSA continues to increase following historic trends at a rate of 1.5 percent a year. Due to the effect of this yield gap convergence, the Better Futures assumes an additional 53 percent increase in productivity by 2050 due to technological advancements, i.e., an annual rate of increase of 2.2 percent overall.
2. By 2050, food loss and waste could be reduced by 25 percent.[3]
3. Negligible conversion of forests and other natural ecosystems from 2020 onwards is possible.
    a. This assumption is based on what exogenous climate modelling finds necessary to limit global warming to 1.5-degrees Celsius. It thus describes the necessary level of ambition. This report recognizes that ending deforestation next year is unrealistic under any assumptions. However, the essential point to take away from the modelling is that the reform agenda to halt deforestation needs to be put in place without delay. The reform agenda described in this report aims to achieve the desired result as soon as possible, realistically between 2025 and 2030 (this has a knock-on effect for biodiversity, as well, where the model has recovery starting in 2020, realistically that would happen gradually between 2025 and 2030, as deforestation is gradually halted).
4. Significant reductions in energy demand relative to current demand – achieved through systematic measures to increase energy efficiency globally – would help the planet stay within a 1.5-degree Celsius pathway.[4]

[2] A number of the key institutional features introduced in the critical transitions, such as structural changes that would lead to shorter supply chains, could not be modelled with the tools available. Their impacts are therefore described in more qualitative terms. These challenges were particularly strong when constructing socio-economic scenarios, given the limited number of variables that could be used to depict changes to livelihoods

[3] Note that the Sustainable Development Goal target is to reduce per capita global food waste at the retail and consumer levels by 50 percent, and to achieve a reduction in food losses along production and supply chains, including post-harvest losses by 2030. Recent analysis, however, demonstrate that achieving this goal is only achievable with breakthrough technologies and behavioural change. To avoid unrealistic assumptions, a 25 per cent reduction has been modelled for this report.

[4] Grubler et al (2018) illustrates how such a low energy demand scenario is possible based on rapid social and institutional changes in how energy services are provided and consumed, in addition to technological innovation. Trends in this direction are already observable (e.g. digitalization and device convergence reduce energy demand, with a smartphone providing a single integrated digital platform which potentially replaces over 15 different end-use devices). See Grubler et al. 2018. A

   a. Though fully achievable, this is an ambitious assumption. For this reason, and because a number of other 1.5-degree Celsius assumptions are also ambitious, an option is maintained to deforest, starting around 2040, some of the newly reforested land and use the biomass for bioenergy with carbon capture technologies (BECCs), if such a solution becomes imperative to avoid runaway climate change and if further analysis demonstrates the relative merits of such an option relative to relevant alternatives.[i] Note that if the BECCS alternative is implemented, there will be significant negative consequences for biodiversity from 2040 onwards.
5. Enough food will be produced in 2030 to deliver on the ambitions of SDG number 2, making it possible to eliminate food insecurity by 2030.
6. The world would converge towards "human and planetary health" diets by 2050, with significant progress in that direction by 2030. This would include a global convergence in calorie intake and average level and composition of protein consumption.
7. The ocean would deliver 40 percent more sustainable proteins over the next 30 years.
   a. Note that the potential is far larger, as chapter 3 demonstrates, but a number of uncertainties makes a conservative assumption more realistic.
8. Significant investments in human capital, technology diffusion and the digital revolution would support the emergence of a new generation of young rural entrepreneurs who can take advantage of the opportunities offered by the transformation of food and land use systems and create decent jobs in agriculture and in the processing of agricultural products.
9. Increased investment in rural infrastructure (e.g. roads, clean electrification) and connectivity would be the key to overall income growth, helping to drive off-farm value added and the creation of non-agricultural jobs.
   a. Countries in sub-Saharan Africa will need to drive significant improvements to 'catch up' with the quality and coverage of infrastructure in the rest of the world. As a result, the investment requirements to improve rural infrastructure make up a greater portion of global figures than other categories.
10. The combination of investments in rural assets and the design of new productive safety nets increases the resilience of the rural population in the face of possible dislocations caused by the transformation of food and land use systems and increasingly likely weather shocks.
11. The cost of trade increases globally, resulting in more local production. However, within sub-Saharan Africa, the cost of trade declines to support increased intra-regional trade.

These assumptions were tested by conducting sensitivity analysis around variable specifications. The narrative accounts for key uncertainties – such as the potential negative impact of climate change and the potential positive impacts of technology – on agricultural yields. In sum, the assumptions provide a realistic basis for the Better Futures scenario, though, again, that scenario depends on the full implementation of the ten critical transitions laid out in the global report – and corresponding four critical transitions in the *People, Health and Nature: a sub-Saharan African Transformation Agenda* report.

The main outcomes of the modelling at a global level include are outlined in the table below.

low energy demand scenario for meeting the 1.5 °C target and sustainable development goals without negative emission technologies. *Nature Energy 3* (6): 517-525.

Sub Saharan Africa: Summary of Environmental Indicators

	Today (2020)	Current Trend 2030	Current Trend 2050	Better Future 2030	Better Future 2050
Nitrogen Use	4.7 Million tons / year	57% increase from 2020	177% increase from 2020	68% increase from 2020	155% decrease from 2020
Water Use for Irrigation per year	125 km^3	158 km^3	213 km^3	153 km^3	186 km^3
Net AFOLU Emissions*	2.4 GT	2.4 GT	2.5 GT	0.3 GT	-0.3 GT
Biodiversity Abundance % Further Decline since 2010	-1% BII	-2.2% (1.2% further loss from 2020)	-4.6% (-3.6% further loss from 2020)	-0.3% (0.7% recovery from 2020)	-1%
Agricultural Land Use	0.78 billion Ha	0.81 billion Ha	0.88 billion Ha	0.66 billion Ha	0.57 billion Ha
Total Afforestation Since 2000	11 million Ha	38 million Ha	57 million Ha	61 million Ha	173 million Ha
Daily Protein Consumption Per Capita	59 grams protein/cap	63 grams protein/cap	70 grams protein/cap	66 grams protein/cap	75 grams protein/cap
Global Population	7.7 billion	8.4 billion	9.2 billion	8.5 billion	9.3 billion

Foot notes:

* Animal proteins exclude seafood
* Agricultural land: cropland and permanent pasture that is used for livestock production in the model – excludes e.g. rough grazing areas
* Population is exogenous in GLOBIOM –differences in the population numbers between CT and BF are based on GBD data (don't know the correct reference)

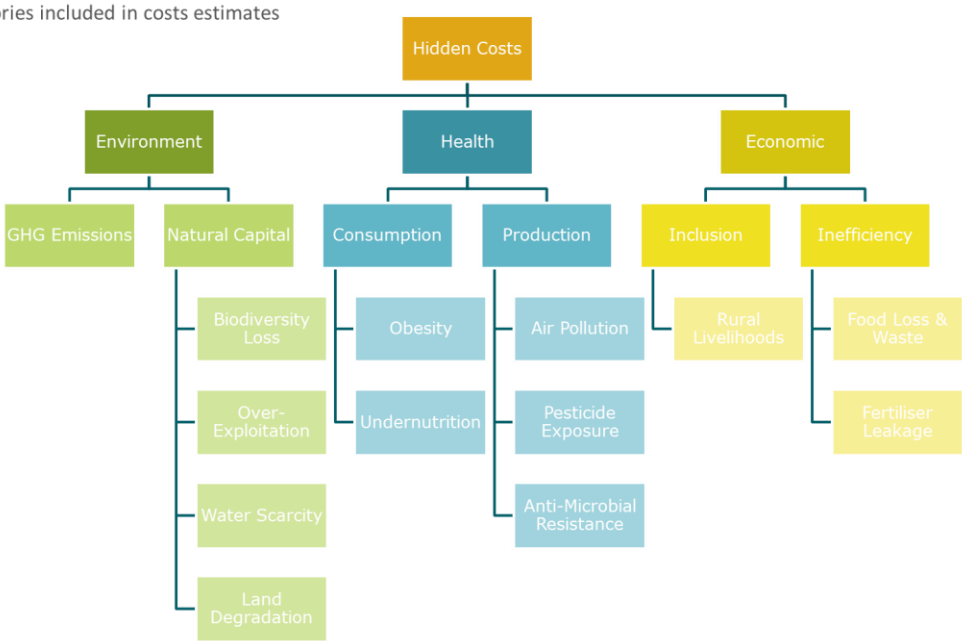
Source: *IIASA* GLOBIOM 2019

Hidden Costs

Hidden costs refer to the negative externalities and inefficiencies that arise from our current means of production and consumption of food. This includes economic, health and environmental costs. The full list of categories considered costs is shown in the diagram below. The categories of cost are the same for sub-Saharan Africa and global estimates.

Overview of Hidden Costs Categories

Structure of categories included in costs estimates



This analysis does not adopt a strict economic definition of externalities, but instead includes more broadly the top sources of lost value or of human and social costs related to global food and land use systems. Depending on the specific issue, this could include estimates of abatement costs, social costs, productivity losses or the lost economic value from inefficient resource use. In addition, the extent to which different losses or costs could be effectively quantified varies significantly across the three dimensions considered. As a result, this exercise provides a reasonably reliable indicative measure of the order of magnitude of hidden costs, but not in any way a conclusive answer. A key aim is to inform debate on this subject and inspire future research.

The key steps for calculating the costs for each category in sub-Saharan Africa are summarised below. Estimates and assumptions have been corroborated by third-party sources and expert interviews whenever possible, to validate estimation approaches, key metrics and scope. All costs are presented in 2018 prices.

Table 1: Summary of the calculations for the Hidden Costs analysis, with notes on the assumptions and input sources

Category	Cost	Value	Units	Comment	Source
Health	Obesity	8.7 million	DALYs	Loss of productive life measured by DALYs caused by over-consumption. Disability-adjusted life years (DALYs) = years of life lost to death or disability. Obesity & overweight proxied by DALYs related to high-BMI risk factor.	IHME GBD (2017)[iii]
		x			
		US$1,574	GDP/Capita (USD PPP)	Average output per capita for sub-Saharan Africa in 2018 international dollars.	World Bank (2018)[iv]
	+				
	Undernutrition	58.9 million	DALYs	Loss of productive life measured by DALYs caused by under-consumption. Undernutrition proxied by DALYs related to child growth failure, including child stunting, wasting and underweight.	IHME GBD (2017)
		x			
		US$1,574	GDP/Capita (USD PPP)	Average output per capita for sub-Saharan Africa in 2018 international dollars.	World Bank (2018)
	+				
	Air Pollution	28.4 million	DALYs	Loss of productive life measured by DALYs caused by ambient particulate matter and ozone pollution.	IHME GBD (2017)
		x			
		US$1,574	GDP/Capita (USD PPP)	Average output per capita for sub-Saharan Africa in 2018 international dollars.	World Bank (2018)
		x			
		23%	Percent	Proportion of total global GHG emissions from food and land use systems.	IPCC (2019)[v]
		+			
		60 million	DALYs	Loss of productive life measured by DALYs caused by pollution from household solid cooking fuels.	IHME GBD (2017)
		x			
		US$1,574	GDP/Capita (USD PPP)	Average output per capita for sub-Saharan Africa in 2018 international dollars.	World Bank (2018)
		x			
		90%	Percent	Proportion of solid cooking fuels from biomass (including agricultural residues, biomass, charcoal, dung, and wood).	IEA (2017)[vi]

	+				
	Pesticide Exposure	0.02/kg.	DALYs per kg.	Loss of productive life measured by DALYs caused by application of pesticides. Measured in DALYs per kilogram applied of insecticide, herbicide, fungicide & bactericide, respectively.	Fantke & Joliet (2016)[vii]
		x			
		50,000	Tonnes	Total annual pesticide application in sub-Saharan Africa. Calculated separately for insecticides, herbicides, fungicides & bactericides.	FAOSTAT (2016)[viii]
		x			
		US$1,574	GDP/Capita (USD PPP)	Average output per capita for sub-Saharan Africa in 2018 international dollars.	World Bank (2018)
	+				
	Anti-Microbial Resistance (AMR)	US$153	USD billions	Total annual GDP loss attributable to AMR in sub-Saharan Africa (net present value 2010-2050). Study covers HIV, tuberculosis, malaria and infections from E. coli, S. aureus, K. pneumoniae.	RAND (2014)[ix]
		x			
		22%	Percent	Percentage of AMR related to food systems.	CDC (2013)[x]
Environment	GHG Emissions	2.70	Gt. CO2 eq./year	Total sub-Saharan Africa annual GHG emissions from food and land use systems, including agricultural production, deforestation and supply chain.	GLOBIOM
		X			
		US$100	USD/ tonne CO2 eq.	Average of range of marginal abatement costs for global GHG emissions from 2020-2050.	CPLC (2017)[xi]
		+			
		363,000	Tonnes/year	Sub-Saharan Africa production of nitrogen fertiliser.	FAOSTAT (2016)[xii]
		x			
		6.2	CO2 eq./tonne	Average GHG emissions from production of nitrogen fertiliser.	Fertilizer Europe[xiii]
		x			
		US$100	USD/ tonne CO2 eq.	Average of range of marginal abatement costs for global GHG emissions from 2020-2050.	CPLC (2017)
	+				
	Land Degradation	176 million 241 million	Hectares Hectares	Total area of degraded cropland in sub-Saharan Africa. Total area of degraded pastureland in sub-Saharan Africa.	FAO GLASOD[xiv]
		x			
		US$322 US$36	USD per hectare USD per hectare	Annual value of crop production per hectare of cropland. Annual value of livestock production per hectare of grassland.	FAOSTAT (2016)
		x			
		8%	Percent	Yield loss from land degradation.	Panagos et al. (2017)[xv]
		+			

		417 million	Hectares	Total area of degraded land in sub-Saharan Africa.	FAO GLASOD
		x			
		US$897	USD per hectare	Economic value of soil ecosystem services per hectare.	Jónsson & Davíðsdóttir (2016)[xvi]
		x			
		25%	Percent	Loss of soil biodiversity from land degradation.	Expert opinion (2019)
	+				
	Water Scarcity	96 km³	Km³/year	Total annual freshwater withdrawals for agriculture in sub-Saharan Africa.	FAOSTAT (2016)
		x			
		US$1.15	USD per m³/year	Global average scarcity cost of water.	FAO (2014)[xviixviii]
		x			
		17%	Percent	Share of freshwater withdrawals for agriculture that are unsustainable or at risk of becoming unsustainable in sub-Saharan Africa (defined as extraction levels that are unsustainable for at least one month per year).	GLOBIOM
	+				
	Biodiversity Loss	US$5,324 US$232,103	USD per hectare USD per hectare	Economic value of ecosystem services from tropical forest per hectare Economic value of ecosystem services from mangroves per hectare	De Groot et al. (2012)[xix]
		x			
		650,000 1,680	Hectares Hectares	Annual rate of deforestation caused by agriculture Annual rate of mangrove loss caused by aquaculture	Global Forest Watch (2018)[xx]
	+				
	Over-Exploitation	US$32.5	USD billions	Total annual value of crop production reliant on pollinator services in sub-Saharan Africa.	IPBES (2018)[xxi]
		x			
		24%	Percent	Global average yield reduction from loss of pollinators.	Garibaldi et al. (2013)[xxii]
		+			
		US$10	USD billions	Total annual economic cost of over-fishing beyond maximum sustainable yield in sub-Saharan Africa.	World Bank (2017)[xxiii]
Economic	Rural Welfare	US$1.90	USD per day	Poverty line for low-income countries.	World Bank (2018)[xxiv]
		x			
		28%	Percent	Average rural poverty gap in sub-Saharan Africa.	Walsh & Rozenberg (2019)[xxv]
		x			

	354	Millions of people	Total rural population in sub-Saharan Africa living below US$1.90 poverty line.	Walsh & Rozenberg (2019)
+				
FLW	23%	Percent	Share of total food production that is lost or wasted in sub-Saharan Africa (measured in terms of weight).	FAO (2011)[xxvi]
	x			
	US$167	USD billions	Total annual value of agricultural production in sub-Saharan Africa.	FAOSTAT (2016)[xxvii]
+				
Fertiliser Leakage	44.0%	Percent	Average leakage rate of nitrate fertilisers.	YARA[xxviii]
	50.0%	Percent	Average leakage rate of phosphate fertilisers.	Roberts & Johnston (2015)[xxix]
	x			
	1.2 million	Tonnes	Total annual application of nitrate fertilisers in sub-Saharan Africa.	FAOSTAT (2016)[xxx]
	2.7 million	Tonnes	Total annual application of phosphate fertilisers in sub-Saharan Africa.	
	x			
	US$135	USD per tonne	Global average price of nitrates (nutrient).	World Bank (2019)[xxxi]
	US$74	USD per tonne	Global average price of phosphate (nutrient).	

Investment Requirements

The estimated investment requirements to deliver a sub-Saharan African transformation agenda are based on modelling and estimates conducted for the global report (described above) and focus on the additional capital investment expenditures (CAPEX) and long-term operational expenditure (OPEX) needed to deliver the ten critical transitions identified in the global report. The estimates do not include current investment requirements for food production outside the key areas of the transformation or investment requirements to meet goals not covered by the critical transitions. The cost of policy implementation or re-allocation of existing subsidies are also not included. Both public and private investments are included.

For each transition, a portion of the investment has been allocated to Sub-Saharan Africa, based on the population size, the number of farmers and farms targeted and/ or the estimated relative need for intervention in sub-Saharan Africa compared to other regions. For example, rural infrastructure, will require disproportionate investment in sub-Saharan Africa due to greater need for improvement in the region relative to the rest of the world.

A full account of the data sources and assumptions used in these calculations is provided below. Estimates have been generated for yearly investment requirements for the period 2018 to 2030, assuming the critical transitions for a new food and land use economy will be achieved by 2050, in line with the modelling for the "Better Futures" scenario outcomes in the global report. All costs are presented in 2018 prices. Estimates and assumptions have been corroborated by third-party sources and expert interviews wherever possible, to validate estimation approaches, key metrics and scope.

The estimated investment requirements are considered conservative to deliver the sub-Saharan African Transformation Agenda as described in the report because they are based on priority cost categories for the global transformation and therefore do not include some key interventions specific to the region. The need for a disproportionate focus on sub-Saharan Africa has been recognised in certain areas – for example, investment in rural infrastructure – yet additional investments will need to be made in the region that are not included in these estimates, such as local processing activities for nutritious food. In addition, the costs are based on assumptions around the extent of the transformation that can be achieved by 2030: further investment will be required to achieve transformation by 2050.

Table 2: Summary of Investment Requirement Calculations, Assumptions and Source Inputs

Category	CT	Investment requirement (million US$/yr)	Assumptions	Source
Nutritious Food	**1: Healthy Diets**	**US$2,400**	Sub-Saharan Africa Nutrition Targets US$7 billion annual investment is needed to meet the Global Nutrition Targets of reducing stunting, female anaemia and low birth weight, halting the increase of childhood overweight, increasing breastfeeding and reducing wasting.	*World Bank (2016)*[xxxii]*; WHO (2014)*[xxxiii]
			x	
			34 percent of total global population suffering from malnutrition located in Sub-Saharan Africa	*UNICEF, WHO, World*

				Bank (2018)[xxxiv]
		+		
		US$1,800	Targeted School Feeding Programmes 35 million school children with stunting and wasting receive targeted school feeding programmes	*UNICEF, WHO, World Bank (2018)[xxxv];*
			x	
			average cost of US$50 per child per year	*World Bank (2016)[xxxvi]*

Nature-Based Solutions	2: Regenerative & Productive Agriculture	US$580-680	Implementation of Regenerative Practices in SSA 30 percent of farms (68 million hectares) in Sub-Saharan Africa implement regenerative farming practices	*FAOSTAT (2016)[xxxvii]*
			x	
			average cost of US$103-120 per ha	*Interviews with experts and practitioners; McKinsey Global Institute (2011) [xxxviii]*
		+		
		US$8,500-9,500	Closing the Productivity Gap 16 million low-skilled farmers receive basic training	*World Bank (2019)[xxxix]*
			x	
			average cost of US$100-170 per farmer (depending on the crop type and geography)	*Interviews with experts and practitioners*
			+	
			Capital equipment is improved across 172 million hectares in Sub-Saharan Africa	*FAO, IFAD WFP (2015)[xl]; FAOSTAT (2016)[xli]*
			x	
			average cost of US$575-644 per hectare	*McKinsey Global Institute (2011)[xlii]*
		+		
		US$180	Irrigation Efficiency	

			Irrigation efficiency is improved across 5 percent of current irrigated cropland (7 million hectares)	*GLOBIOM*
			x	
			average cost of US$6,227 per hectare	*IFPRI (2017)*[xliii]
Nature-Based Solutions	2: Protecting & Restoring Nature	**US$5,000-8,300**	<u>Forest Restoration (incl. Peatlands)</u> 50 million hectare of Sub-Saharan Africa's forest and peatlands are restored by 2030	*GLOBIOM*
			x	
			average cost of US$1,200-2,000 per hectare (costs can range from US$454-7,373 per hectare and mainly depend on costs of labour and type of restoration intervention)	*Verdone (2016)*[xliv]*; Interviews with experts and practitioners*
		+		
		US$4,000	<u>REDD+ Programme for Forest Conservation</u> REDD+ financing to halt deforestation reaches US$50 billion per year in 2030, growing from US$1 billion per year spent in 2019	*Boucher (2008)*[xlv]
			x	
			Sub-Saharan Africa receives 30 percent of the additional investment	*GLOBIOM*
		+		
		US$250-380	<u>Conservation of Standing Forests</u> An additional 1.9 million hectares of standing forest are managed every year on average in the Better Futures scenario to reach a total of 23 million additional hectares by 2030	*GLOBIOM*
			x	
			average cost of US$20-30 per hectare per year	*Interview with experts and practitioners*

Nature-based solutions	4: A Healthy & Productive Ocean	**US$225**	<u>Mangrove Restoration</u> 25 percent (0.8 million hectare) of total destroyed mangroves are restored by 2030	*Ajonina et al (2008)*[xlvi]
			x	
			average cost of US$3,379 per hectare	*TEEB (2009)*[xlvii]
		+		
		US$110	<u>Aquaculture Sustainable Intensification Training</u> 3 million aquaculture farmers receive training on sustainable production	*FAO (2018)*[xlviii]

			x	
			average cost of US$450 per farmer	*Interviews with experts and practitioners*
Wider Choice & Supply	6: Reducing Food Loss & Waste	**US$3,250**	Postharvest Waste in Sub-Saharan Africa Postharvest waste during storage and transportation is reduced for 110 million hectares in Sub-Saharan Africa	*FAOSTAT (2016)[xlix]; FAO, IFAD, WFP (2015)[l]*
			x	
			average CAPEX and long-term OPEX of US$391 per hectare for perishables and US$230 per hectare for non-perishables (60 percent perishables; 40 percent non-perishables).	*McKinsey Global Institute (2011)[li]*
		+		
		US$13,700	Supply-Chain Waste in Developing Countries Supply chain waste is reduced for 110 million hectares in Sub-Saharan Africa through expanded and improved infrastructure (incl. cold chain supply)	*FAOSTAT (2016)[lii]; FAO, IFAD WFP (2015)[liii];*
			x	
			average CAPEX and long-term OPEX of US$1,338 per hectare	*McKinsey Global Institute (2011)[liv]*
Opportunity for All	9: Stronger Rural Livelihoods	**US$20,000-28,000**	Rural Infrastructure Better rural infrastructure to facilitate market access is built for 30 percent of farmland (1.05 billion hectares) in developing countries	*FAOSTAT (2016)[lv]*
			x	
			average cost of US$504-738 per hectare	*McKinsey Global Institute (2011)[lvi]*
			x	
			88 percent of the investments is allocated to Sub-Saharan Africa	*FAO, IFAD WFP (2015)[lvii]*
			+	
			Global energy access investment gap in rural areas of US$ 18.3 billion per year	*SE4All & CPI (2018)[lviii]*
			x	
			60 percent of investment need in Sub-Saharan Africa	*IEA (2018)[lix]*
		+		

	US$1,100	<u>Access to Clean Cooking</u> Access to clean cooking investment gap in rural areas of US$3 billion per year	*SE4ALL & CPI (2018)[lx]*
		x	
		30% of the investment need in Sub-Saharan Africa	*IEA (2018)[lxi]*
	+		
	US$2,300	<u>Irrigation Expansion</u> New irrigation infrastructure for 1.3 million ha of cropland by 2030	*GLOBIOM*
		x	
		average cost of US$20,880 per ha	*IFPRI (2017)[lxii]*
	+		
	US$4,100	<u>Connectivity</u> 198 million people in rural areas without internet in Sub-Saharan Africa are connected	*Our World in Data (2018)[lxiii]; GSMA (2018)[lxiv]*
		x	
		average cost of US$21 per person per year	*A4AI (2018)[lxv]*
	+		
	US$1,350-2,700	<u>Training of Entrepreneurs</u> 16 million young agricultural entrepreneurs are trained with management and technical skills	*Interviews with experts and practitioners*
		x	
		average cost of US$1000-2000/person	*Interviews with experts and practitioners*
	+		
	US$2,500-4,000	<u>Financing Needs of Smallholder Farmers</u> 24 million non-commercial smallholders	*Goldman et al. (2016)[lxvi]*
		x	
		short-term yearly financing of on average US$95-105 per farmer (for inputs, harvest, export)	*Goldman et al. (2016)[lxvii]*
		+	
		24 million non-commercial smallholders	*Goldman et al. (2016)[lxviii]*
		x	

			a one off payment of long-term financing of on average US$95-105 per farmer (for renovation and equipment)	*Goldman et al. (2016)*[lxix]
		+		
		US$5,000	Safety Nets for Climate Resilience Safety nets to build more resilience into rural economies (e.g. payments to poor and vulnerable households for cash and food payments for building local infrastructure or protecting the environment) are provided in Sub-Saharan Africa at an estimated cost of 0.3 percent of GDP	*Economist (2018)*[lxx]
			x	
			Sub-Saharan African GDP of US$1.7 trillion	*World Bank (2019b)*[lxxi]

Opportunity for All	**10: Gender & Demography**	**US$700**	Family Planning Contraception is made available to 50 percent of female population (51 million women) with unmet needs	*Darroch et al., (2017)*[lxxii]
			x	
			average cost of US$14 per person per year	*Darroch et al., (2017)*[lxxiii]
		+		
		US$6,500	Girls Education 19.1 million girls out of primary school requiring 12 years of school	*UNESCO (2016)*[lxxiv]
			x	
			average cost of US$1.25 per day for 170 days per year	*Global Partnership for Education (2017)*[lxxv]
			+	
			14.2 million girls out of lower secondary school requiring 6 more years of school	*UNESCO (2016)*[lxxvi]
			x	
			average cost of US$1.25 per day for 170 days per year	*Global Partnership for Education (2017)*[lxxvii]
			+	
			18.9 million girls out of upper secondary school requiring 3 more years of school	*UNESCO (2016)*[lxxviii]
			x	
			at an average cost of US$1.25 per day for 170 days per year	*Global Partnership for Education (2017)*[lxxix]

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