



AFRICA'S POTENTIAL FOR AGRICULTURE DATA BOOK

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ALL COUNTRIES



All Countries: Optimal Crop Choice

Project Description

- Breeding and disseminating standard seeds of nutritionally optimal crops for each country
- Ease of seed breeding depends on how efficiently each crop is multiplied
- Includes extension component to give out seeds and train farmers on new crop types
- Based on World Bank Ethiopian Seed Systems Project and Great Lakes Cassava Initiative

Extension								
	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Farmers per 100 Ha	53	250	53	119	139	9	39	91
Max. class size	30	30	30	30	30	30	30	30
Max. number of classes per instructor	2	9	2	4	5	1	2	3
Implementation costs per class	\$1,266 ¹	\$879 ²	\$2,122 ³	\$1,919 ⁴	\$1,107 ⁵	\$1,266 ¹	\$984 ⁶	\$1,440 ⁷
Class costs per instructor	\$2,531	\$7,907	\$4,245	\$7,677	\$5,535	\$1,266	\$1,968	\$4,320
Total farmland (Ha)	178,862	1,132,913	5,367,807	2,789,529	1,125,650	3,279,892	9,624,439	4,792,761
Farmland covered by one instructor (Ha)	100	100	100	100	100	100	100	100
Number of instructors required per country	1,789	11,329	53,678	27,895	11,257	32,799	96,244	47,928
Class costs per instructor (from above)	\$2,531	\$7,907	\$4,245	\$7,677	\$5,535	\$1,266	\$1,968	\$4,320
Total class costs	\$4,527,747	\$89,575,070	\$227,840,389	\$214,138,859	\$62,308,674	\$41,513,906	\$189,377,006	\$207,047,275
Number of instructors required per country (from above)	1,789	11,329	53,678	27,895	11,257	32,799	96,244	47,928
Training costs (per instructor)	\$1,163 ¹	\$1,049 ²	\$329 ³	\$499 ⁴	\$1,230 ⁵	\$1,163 ¹	\$1,419 ⁶	\$1,620 ⁷
Total training costs	\$2,080,380	\$11,890,477	\$17,652,077	\$13,919,026	\$13,846,372	\$38,149,085	\$136,378,301	\$77,642,728
One-time national coordination costs ⁸	\$29,251	\$29,251	\$29,251	\$29,251	\$29,251	\$29,251	\$29,251	\$29,251
One-time initial national curriculum consultancy ⁸	\$55,562	\$55,562	\$55,562	\$55,562	\$55,562	\$55,562	\$55,562	\$55,562
Total training and initial costs	\$2,165,194	\$11,975,290	\$17,736,890	\$14,003,839	\$13,931,185	\$38,233,898	\$136,463,114	\$77,727,541
Total class costs (from above)	\$4,527,747	\$89,575,070	\$227,840,389	\$214,138,859	\$62,308,674	\$41,513,906	\$189,377,006	\$207,047,275
TOTAL EXTENSION COSTS	\$6,692,940	\$101,550,360	\$245,577,279	\$228,142,698	\$76,239,859	\$79,747,804	\$325,840,120	\$284,774,816
TOTAL SEED-BREEDING COSTS	\$3,113,987	\$22,239,082	\$81,590,666	\$37,184,422	\$15,308,840	\$52,281,478	\$121,267,931	\$118,956,328
TOTAL COST OF PROGRAM (ONE-TIME)	\$9,806,927	\$123,789,442	\$327,167,945	\$265,327,120	\$91,548,699	\$132,029,282	\$447,108,051	\$403,731,144

BENEFIT	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Headwind reduction	0.3%	0.2%	0.0%	0.1%	0.0%	0.5%	0.0%	0.0%
Increased production (maize-eq. tonnes)	275,388	159,375	2,266,979	987,408	436,800	18,652,996	4,322,237	1,843,280
Cost/tonne of increased production	\$7	\$155	\$29	\$54	\$42	\$1	\$21	\$44

¹Regional average (Uganda, Rwanda, Burundi, Tanzania, and Malawi)

²Uses E. African regional average (Rwanda, Tanzania & Uganda)

³ICI Impact Brief No. 8: http://www.ici.org/c/document_library/get_file?uuid=5f01f5b-c7d4f45-8808-d3d72341873&groupId=58317

⁴Inventory and Evaluation of Farmer Field Schools in Zimbabwe: <http://www.sheddv.info/files/documents/1030.pdf>

⁵Rwanda Rural Sector Support Project: http://financing.ad/ad/regions/00/regions_projects/00/esp_pia.doc

⁶Farmer Field Schools in Mbeya – Review 2008: <http://www.sheddv.info/files/documents/1198.pdf>

⁷IFAD – East African Subregional Pilot Project on Farmer Field Schools in Kenya, Tanzania, and Uganda: <http://www.ifad.org/pst/ocs/05/05/050300.pdf>

⁸Average of values taken from Footnotes #5 & #7

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Fertilizer & Pesticides Conservation Ag

Project Description

- Teaches conservation agriculture techniques and increases use of inputs (fertilizer, pesticides, improved seeds) to US-conservation agriculture levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Fertilizer needs

	<u>Optimal crop mix (% of land)</u>								<u>Global avg. nutrient usage with cover crops^{1,2}</u>		
	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>	<i>N req. (kg/Ha)²</i>	<i>P req. (kg/Ha)</i>	<i>K req. (kg/Ha)</i>
Maize		43%	28%	7%	64%	16%	27%	9%	40	63	0
Sorghum	65%		26%	77%		54%	45%	<1%	100	70	125
Wheat		8%		1%	12%	13%	4%	2%	34	55	45
Groundnuts	35%			3%		14%			0	40	0
Cassava		49%	43%	13%	24%		22%	89%	0	53	8
Beans						1%	2%		0	64	10
Cowpeas						1%	<1%		0	30	0
Olives						2%			15	35	0

1st world conservation agriculture fertilizer usage targets	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
N usage weighted by optimal crop mix (kg/Ha)	66	20	26	79	31	69	67	6
Savings due to 86% reduction in N loss due to runoff ³	(10)	(3)	(4)	(12)	(5)	(10)	(10)	(1)
P usage weighted by optimal crop mix (kg/Ha)	60	57	59	66	60	63	65	54
Savings due to 99% reduction in P loss due to runoff ⁴	(11)	(11)	(11)	(12)	(11)	(12)	(12)	(10)
K usage weighted by optimal crop mix (kg/Ha)	82	8	29	96	10	79	72	8
Total Fertilizer use target (kg/Ha)	187	71	99	217	85	189	182	57
Current fertilizer usage (kg/Ha) ⁵	17.62	4.38	13.98	71.03	0.24	68.14	11.79	2.63
Difference between current and target usage (kg/Ha)	169	67	85	146	85	121	170	54

¹Average of Nitrogen (N), Phosphate (P), and Potassium (K) needs are taken from global usage data collected by the International Fertilizer Industry Assoc. – See World Fertilizer Use Manual (2014) int. Fertilizer Industry Assoc. Accessed Jan 2014: <http://www.fertilizer.org/ib/HomePage/IBFIBV/Orselection/WorldFertilizerUseManual/ibcommonpages>

²30% of nutrients left as crop residue are assumed to be available to the following planted crop (Sustainable Agriculture Network (2003) Managing Cover Crops Profitably 2nd Edition: <http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>). An average of 75 kg/Ha of Nitrogen and 10 kg/Ha Phosphat is provided by cover crops: (a) Mississippi soybean promotion board (2013) Cover Crops: www.MSSOY.org; (b) Florentin et al. (2011) ICM – Green manure/cover crops & crop rotation in Conservation Agriculture on small farms FAO: http://www.fao.org/fileadmin/user_upload/asp/12.pdf. An average of 75 kg/Ha of Potassium is provided by cover crops: Sullivan (2003) Overview of Cover Crops and Green Manures, ATTRA Pub: http://www.clemson.edu/sustainable/ag/024_covercrop.pdf

³FAOSTAT: <http://eostat.fao.org/>

⁴FAOSTAT: <http://eostat.fao.org/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Fertilizer & Pesticides Conservation Ag

Project Description

- Teaches conservation agriculture techniques and increases use of inputs (fertilizer, pesticides, improved seeds) to US-conservation agriculture levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Fertilizer & Pesticides	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Cost of legume cover crops (\$/Ha) ¹	\$28	\$36	\$65	\$137	\$93	\$28	\$123	\$103
<i>Difference between current and target usage (kg/Ha)</i>	169	67	85	146	85	121	170	54
Local fertilizer retail price in bulk amounts (50 kg) (\$/tonne) ²	\$800	\$929	\$552	\$875	\$933	\$723	\$731	\$983
Local fertilizer retail price in small quantity (20 kg) (\$/tonne) ³	\$920	\$1,068	\$635	\$1,006	\$1,073	\$831	\$841	\$1,130
Cost/Ha to reach US level (bulk)	\$163.20	\$98.24	\$111.92	\$264.75	\$172.31	\$115.48	\$247.27	\$156.08
Cost/Ha to reach US level (small quantity)	\$183.48	\$107.56	\$118.98	\$283.88	\$184.21	\$128.55	\$265.97	\$164.02
	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
Pesticide use/Ha (kg) ⁴	0.1	0.3	2	0.1	0.7	1.9	0	0
<i>Difference between current and recommended use under conservation ag⁵ (kg/Ha)</i>	17.5	17.3	15.6	17.5	16.9	15.7	17.6	17.6
Local pesticide retail price in bulk amounts (25 liter) (\$/kg) ²	\$3.09	\$3.63	\$3.29	\$5.45	\$3.31	\$0.97	\$2.97	\$3.52
Local pesticide retail price in small quantity (1 liter) (\$/kg) ³	\$3.55	\$4.17	\$3.78	\$6.27	\$3.81	\$1.12	\$3.42	\$4.05
Cost/Ha to increase to recommended levels (bulk)	\$54.08	\$62.80	\$51.32	\$95.38	\$55.94	\$15.23	\$52.27	\$61.95
Cost/Ha to increase to recommended levels (small qty.)	\$62.19	\$72.22	\$59.02	\$109.68	\$64.33	\$17.51	\$60.11	\$71.24
Total cost/Ha of cover crops fertilizer & pesticides (bulk)	\$217.28	\$161.04	\$163.24	\$360.13	\$228.25	\$130.71	\$299.54	\$218.03
Total cost/Ha of cover crops fertilizer & pesticides (small qty)	\$245.67	\$179.78	\$178.00	\$393.56	\$248.54	\$146.06	\$326.08	\$235.26
Total farmland (Ha)	178,862	1,132,913	5,367,807	2,789,529	1,125,650	3,279,892	9,624,439	4,792,761
Annual fertilizer/pesticide costs (bulk)	\$38,863,135	\$182,447,708	\$876,240,815	\$1,004,593,079	\$256,923,984	\$428,724,523	\$2,882,904,458	\$1,044,975,266
Annual fertilizer/pesticide costs (small qty.)	\$43,941,028	\$203,670,567	\$955,442,807	\$1,097,835,875	\$279,763,423	\$479,064,305	\$3,138,337,069	\$1,127,544,953
Total one-time start-up costs (bulk)⁶	\$1,593,389	\$7,480,356	\$35,925,873	\$41,188,316	\$10,533,883	\$17,577,705	\$118,199,083	\$42,843,986
Total annual costs (bulk, from above)	\$38,863,135	\$182,447,708	\$876,240,815	\$1,004,593,079	\$256,923,984	\$428,724,523	\$2,882,904,458	\$1,044,975,266
Total one-time start-up costs (small qty.)⁶	\$1,801,582	\$8,350,493	\$39,173,155	\$45,011,271	\$11,470,300	\$19,641,637	\$128,671,820	\$46,229,343
Total annual costs (small qty., from above)	\$43,941,028	\$203,670,567	\$955,442,807	\$1,097,835,875	\$279,763,423	\$479,064,305	\$3,138,337,069	\$1,127,544,953

¹Assuming average quarter bean seed prices (AMTSA [BUR,MW,RWA,TZA,UGA], MIR-[GHA]) and average planting rate of 62.5 kg/Ha; SAF and BOT estimated from correlated bean commodity prices

²Weighted average of local usage and retail prices (AMTSA: <http://amtisa.org/home.aspx>)

³Assuming 15% markup with small quantities (Source: Botswana Ag Ministry http://www.moa.gov.bw/prices/letstry/letstry_2013.pdf) and interviews)

⁴FAOSTAT: <http://faostat.fao.org/>

⁵Relative to manufacturer recommended usage of 27 kg/Ha of fungicides, herbicides & insecticide

⁶94% of inputs costs from World Bank Ethiopia National Fertilizer Sector Project: <http://www.worldbank.org/projects/20075/ethiopia-national-fertilizer-sector-project-2009>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Fertilizer & Pesticides Conservation Ag

Fertilizer								
	Diammonium phosphate (DAP)	Calcium ammonium nitrate (CAN)	Cost per tonne (% reported usage ⁶)				Total usage (Tonnes)	Weighted Cost per tonne
			NPK	UREA	Superphosphate (SSP)	Potassium-sulphate (MOP)		
Botswana ^{1,2}			\$864	\$876	\$660		4,600	\$800
Burundi ³	\$1,194 (<1%)		\$916 (61%)	\$961 (24%)		(15%)	5,777	\$929
Ghana ⁴			\$534 (32%)	\$601 (12%)		(55%)	94,198	\$552
Malawi ³		\$690 (14%)	\$920 (34%)	\$897 (50%)			243,576	\$875
Rwanda ³	\$1,111 (<1%)		\$963 (<1%)	\$933 (99%)			79	\$933
South Africa ⁵				\$733 (82%)		(2%)	801,339	\$723
Tanzania ³	\$892 (1%)	\$609 (15%)	\$847 (30%)	\$699 (54%)		(1%)	145,595	\$732
Uganda ³	\$1,168 (3%)	\$918 (<1%)	\$1,004 (64%)	\$912 (31%)	\$1,120 (2%)		21,189	\$983

¹Botswana lacks usage data so a simple average of fertilizer cost is taken

²Prices from Ministry of Agriculture monthly price bulletin: <http://www.moagov.bw/>

³Prices taken from AMISA; Feb. 2014: <http://amisa.org/home.aspx>

⁴m farms agribusiness solutions (accessed Feb 2014); <http://mfarms.org/>

⁵Personal communication from HGBF regarding price paid for N fertilizer in SAfrica (Feb 2014)

⁶FAO database: <http://faostat.fao.org/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Fertilizer & Pesticides Conservation Ag

Recommended usage (kg/Ha)¹

	<i>Insecticide</i>	<i>Fungicide</i>	<i>Herbicide</i>
Botswana	1.1	1.1	6.2
Burundi	0.5	1.4	9.6
Ghana	0.4	6.7	2.4
Malawi	1.1	0.4	7.6
Rwanda	0.8	2.1	7.1
South Africa	1.2	1.0	6.4
Tanzania	0.1	0.5	12.8
Uganda	1.0	1.0	7.3

Local retail prices (\$/kg)

	<i>Insecticide</i>	<i>Fungicide</i>	<i>Herbicide</i>	<i>Weighted sum retail price (\$/Ha)</i>
Botswana ²	\$0.67	\$9.23	\$9.37	\$69.03
Burundi ³	\$8.15	\$7.32	\$8.69	\$97.68
Ghana ⁴	\$12.21	\$39.95	\$4.75	\$285.99
Malawi ³	\$19.69	\$12.78	\$15.71	\$146.50
Rwanda ³	\$9.71	\$9.88	\$8.65	\$89.08
South Africa ⁵	\$3.77	\$2.99	\$2.91	\$26.00
Tanzania ³	\$10.79	\$9.64	\$8.11	\$94.57
Uganda ³	\$11.95	\$11.62	\$6.83	\$79.79

¹Based on optimal crop mix and pesticide manufacturer recommended usage directions

²Botswana Ministry of Agriculture - Feb. 2013 Ag Bulletin: http://www.moa.gov.bw/pricebulletin/february_2013.pdf

³AMIISA: <http://amisa.org/home.aspx>

⁴FAOSTAT: <http://faostat.fao.org/>

⁵Regional (BOT, TZA & MWI) average adjusted for relative purchasing power (purchasing power parity exchange ratio or 'national price levels' in 2013 from the world bank: <http://data.worldbank.org/>)

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Extension & Soil Testing Conservation Ag

Project Description

- Teaches conservation agriculture techniques and increases use of inputs (fertilizer, pesticides, improved seeds) to US-conservation agriculture levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Extension & Soil Testing	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Annual training, equipping, and paying community knowledge workers (CKWs) for testing ¹	\$18,002	\$13,518	\$6,133	\$8,236	\$16,647	\$68,842	\$6,609	\$9,400
Annual in-field soil testing kits (\$3.06 per test) ²	\$3,060	\$3,060	\$3,060	\$3,060	\$3,060	\$3,060	\$3,060	\$3,060
Pre-harvest focus groups	\$152	\$152	\$152	\$152	\$152	\$152	\$152	\$152
Post-harvest focus groups	\$152	\$152	\$152	\$152	\$152	\$152	\$152	\$152
Farmer information days	\$1,631	\$1,631	\$1,631	\$1,631	\$1,631	\$1,631	\$1,631	\$1,631
Training workshops for extension officers to work with CKWs practice Conservation Ag skills	\$6,524	\$6,524	\$6,524	\$6,524	\$6,524	\$6,524	\$6,524	\$6,524
One-time costs per 1,000 farms	\$8,459	\$8,459	\$8,459	\$8,459	\$8,459	\$8,459	\$8,459	\$8,459
Annual costs per 1,000 farms	\$21,062	\$16,578	\$9,193	\$11,296	\$19,707	\$71,902	\$9,669	\$12,460
Total number of farms	28,083	3,300,000	2,379,929	3,063,393	1,674,687	1,292,600	2,888,028	3,359,516
Total one-time local-level costs	\$237,554	\$27,914,700	\$20,131,819	\$25,913,241	\$14,166,177	\$10,934,103	\$24,429,829	\$28,418,146
Total annual local-level costs	\$591,484	\$54,707,400	\$21,878,687	\$34,604,087	\$33,003,057	\$92,940,525	\$27,924,343	\$41,859,569
National outreach event	\$3,625	\$3,625	\$3,625	\$3,625	\$3,625	\$3,625	\$3,625	\$3,625
Nat'l level administrative staff	\$204,136	\$153,287	\$69,547	\$93,392	\$188,770	\$780,629	\$74,940	\$106,591
Total one-time national costs	\$207,760	\$156,912	\$73,172	\$97,016	\$192,395	\$784,253	\$78,565	\$110,216
Total extension & soil-testing one-time costs	\$445,314	\$28,071,612	\$20,204,991	\$26,010,257	\$14,358,572	\$11,718,356	\$24,508,394	\$28,528,362
Total extension & soil-testing annual costs	\$591,484	\$54,707,400	\$21,878,687	\$34,604,087	\$33,003,057	\$92,940,525	\$27,924,343	\$41,859,569

¹Community knowledge workers (CKWs) are local farmers who are elected by their peers to receive a smartphone and provide crop & market information. They can administer soil tests using in-field kits and use applications to recommend fertilizer & seed decisions. Their pay is scaled by local wage rates. Based on Gates Foundation/Grameen Foundation CKW Program: <http://www.gatesfoundation.org/AfricaCenter/PressReleases/2019/10/Grameen-Foundation-Supports-Technology-Program-for-Farmers-in-Uganda>

²Bill & Melinda Gates Foundation/Archer D. Little, Inc.: http://hns.melin.org/SITE/DSE_DOCS/USA%20Technique%20B%20E%20D%20F%20Field%20Bases%20G%20D%20Invest%20Test.pdf
Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Mechanization Conservation Ag

Project Description

- Teaches conservation agriculture techniques and increases use of inputs (fertilizer, pesticides, improved seeds) to US-conservation agriculture levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Mechanization

Cost of machinery Retail price¹

Tractor (41 kW/55 hp, med. power, 4WD)	\$21,939
Roller/crimper	\$2,400
Combine harvester (9.1 m, self-propelled)	\$226,303
Planter (4-row, 900 mm)	\$15,455
Fertilizer spreader (4,000 l, double disc)	\$37,142
Boom sprayer (12 m)	\$3,851

One-time Unit Cost

One-time	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Machinery cost per package	\$307,090	\$307,090	\$307,090	\$307,090	\$307,090	\$307,090	\$307,090	\$307,090
Tractor registration ²	\$89	\$89	\$89	\$89	\$89	\$89	\$89	\$89
Storage shed ²	\$993	\$993	\$993	\$993	\$993	\$993	\$993	\$993
One-time cost per package	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172

Annual Unit Cost

Maintenance & repairs (\$/package) ³	\$21,572	\$21,572	\$21,572	\$21,572	\$21,572	\$21,572	\$21,572	\$21,572
Fuel (\$/package)	\$12,226	\$14,351	\$9,219	\$18,404	\$16,839	\$13,730	\$12,319	\$13,138
Lubricants (\$/package)	\$1,834	\$2,153	\$1,383	\$2,761	\$2,526	\$2,060	\$1,848	\$1,971
Annual package cost	\$35,632	\$38,076	\$32,174	\$42,737	\$40,937	\$37,362	\$35,739	\$36,681

Machinery penetration targets

	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Current machine package density (#/1,000 Ha) ^{4,5}	6.5	0.1	0.1	0.3	0.0	2.6	0.8	0.3
Current farmland (1,000 Ha) ⁴	179	1,133	5,368	2,790	1,126	3,280	9,624	4,793
Current number of total machine packages	1,155	57	537	698	0	8,364	7,699	1,438

Additional equipment packages to reach:

Best-in-Africa (Botswana)	-	7,245	34,027	17,375	7,248	12,854	54,480	29,543
US in 1950 (11.9/1,000 Ha)	974	13,411	63,239	32,556	13,374	30,703	106,858	55,626
US in 2011 (13.7/1,000 Ha)	1,287	15,393	72,633	37,438	15,344	36,443	123,701	64,014

¹South African Guide to Machinery Costs: <http://www.daff.gov.za/dsrs/statinfo/GuideMach1213.pdf>

²IFRR – Agricultural Mechanization in Ghana: <http://www.ifrr.org/sites/default/files/attachments/assowes30.pdf>

³Scaled as 7% of machinery costs (from footnote #2)

⁴Package density estimated from FAOSTAT ag machine counts, which include both combines and tractors as ag machines

⁵FAOSTAT: <http://faostat3.fao.org/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Mechanization Conservation Ag

Project Description

- Teaches conservation agriculture techniques and increases use of inputs (fertilizer, pesticides, improved seeds) to US-conservation agriculture levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Mechanization								
Best-in-Africa	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
One-time package cost	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172
Annual package cost	\$35,632	\$38,076	\$32,174	\$42,737	\$40,937	\$37,362	\$35,739	\$36,681
Target number of packages	-	7,245	34,027	17,375	7,248	12,854	54,480	29,543
One-time cost	\$0	\$2,232,706,140	\$10,486,168,644	\$5,354,488,500	\$2,233,630,656	\$3,961,242,888	\$16,789,210,560	\$9,104,325,396
Annual cost	\$0	\$275,860,620	\$1,094,784,698	\$742,555,375	\$296,711,376	\$480,251,148	\$1,947,060,720	\$1,083,666,783
US 2011 Target (Base case)	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
One-time package cost	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172	\$308,172
Annual package cost	\$35,632	\$38,076	\$32,174	\$42,737	\$40,937	\$37,362	\$35,739	\$36,681
Target number of packages	1,287	15,393	72,633	37,438	15,344	36,443	123,701	64,014
One-time cost	\$396,617,364	\$4,743,691,596	\$22,383,456,876	\$11,537,343,336	\$4,728,591,168	\$11,230,712,196	\$38,121,184,572	\$19,727,322,408
Annual cost	\$45,858,384	\$586,103,868	\$2,336,894,142	\$1,599,987,806	\$628,137,328	\$1,361,583,366	\$4,420,950,039	\$2,348,097,534
Labor savings from mechanization	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
Minimum wage/Ha worked ¹	\$120	\$138	\$275	\$332	\$1,354	\$28	\$296	\$61
% man-hours saved through mechanization ²	35%	35%	35%	35%	35%	35%	35%	35%
Mechanization gap ³	53%	100%	99%	98%	100%	81%	94%	98%
Total farmland (Ha)	178,862	1,132,913	5,367,807	2,789,529	1,125,650	3,279,892	9,624,439	4,792,761
Annual labor cost savings from mechanization	\$3,962,481	\$54,519,259	\$512,866,432	\$318,206,580	\$533,445,535	\$26,138,216	\$938,654,261	\$100,076,536
TOTAL ONE-TIME COST	\$396,617,364	\$4,743,691,596	\$22,383,456,876	\$11,537,343,336	\$4,728,591,168	\$11,230,712,196	\$38,121,184,572	\$19,727,322,408
TOTAL ANNUAL COST	\$41,895,903	\$531,584,609	\$1,824,027,710	\$1,281,781,226	\$94,691,793	\$1,335,445,150	\$3,482,295,778	\$2,248,020,998

¹ILO Global Wage Report: http://www.ilo.org/wcmsp5/groups/public/-/dca/ro/@@4d4mmf/@a44/documents/a/blicat/wcms_350025.pdf

²IFPRI, 2011: <http://www.ifpri.org/sites/default/files/publications/110707a.pdf>

³Gap between current and target tractor densities, calculated as: $1 - (\text{Current Tractor Density} / \text{Target Tractor Density})$

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Improved Seeds Conservation Ag

Project Description

- Teaches conservation agriculture techniques and increases use of inputs (fertilizer, pesticides, improved seeds) to US-conservation agriculture levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Improved seeds

Optimal crop mix (% of land)	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda	\$/Ha (1 st World Improved seed)	\$/Ha (improved seed users)
Maize		43%	28%	7%	64%	16%	27%	9%	\$286 ^{1,2}	\$244 ^{1,2}
Sorghum	65%		26%	77%		54%	45%	<1%	\$31 ^{1,2}	\$26 ^{1,2}
Wheat		8%		1%	12%	13%	4%	2%	\$123 ^{1,3}	\$25 ^{1,3}
Groundnuts	35%			3%		14%			\$481 ^{1,2}	\$83 ^{1,2}
Cassava		49%	43%	13%	24%		22%	89%	\$9 - \$26 ^{4,5}	\$9-\$26 ^{4,5}
Beans						1%	2%		\$932 ^{1,2}	\$747 ^{1,2}
Cowpeas						1%	<1%		\$63 ^{1,3}	\$28 ^{1,3}

	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Total farmland (Ha)	178,862	1,132,913	5,367,807	2,789,529	1,125,650	3,279,892	9,624,439	4,792,761
Current African improved seed use weighted by optimal crop	24%	1%	13%	14%	5%	28%	11%	7%
Farmland planted with African improved seed (Ha)	43,461	15,213	655,690	396,398	58,937	923,510	1,081,442	330,794
Seed cost for land currently planted with improved seed (\$/Ha) ⁶	\$31	\$166	\$122	\$144	\$123	\$168	\$243	\$179
Annual seed cost to upgrade from African improved seed to 1st world seed	\$1,347,717	\$2,522,288	\$80,149,704	\$57,096,847	\$7,229,724	\$155,077,903	\$263,060,652	\$59,094,400
Farmland planted with unimproved varieties seed (Ha)	135,401	1,117,700	4,551,083	2,421,026	1,066,713	2,323,583	8,545,971	4,465,556
Seed cost for land planted with unimproved varieties (\$/Ha) ⁷	\$225	\$145	\$88	\$31	\$204	\$124	\$95	\$40
Annual seed cost to upgrade from unimproved seed to 1st world seed	\$30,511,150	\$162,153,275	\$400,073,709	\$74,449,406	\$217,786,719	\$288,133,284	\$814,576,878	\$178,350,208
1st world improved-seed cost (annual)	\$31,858,867	\$164,675,563	\$480,223,413	\$131,546,252	\$225,016,443	\$443,211,187	\$1,077,637,530	\$237,444,608
Program overhead costs (annual)⁸	\$3,185,887	\$16,467,556	\$48,022,341	\$13,154,625	\$22,501,644	\$44,321,119	\$107,763,753	\$23,744,461

¹Seed prices can be found on p. 14 of the Data Book. Per Ha cost for improved seed users is the difference between first world improved seed and African improved seed (p. 14)

²Seeding rate - Department of Agriculture, Government of Sri Lanka: <http://www.agriculture.gov.lk/info.php?category=seeding>

³Seeding rate - Government of India: <http://seeds.gov.in/initial/3328.html>

⁴Estimated from average cost of planting a Ha of cassava from the CRS Great Lakes Cassava Initiative Report: <http://www.crs-namibia.org/wordpress/wp-content/uploads/2014/07/CRS-Great-Lakes-Cassava-Initiative-Report.pdf>

⁵BUR-119; GHA-40; MW-95; RWA-64; TZA-59; UGA-121

⁶Difference between African improved seed cost and 1st world seed (or equivalent) weighted by crop area currently under production (Production data from the FAO: <http://faostat.fao.org/>)

⁷1st world seed cost (or equivalent) weighted by optimal crop area under production (Production data from the FAO: <http://faostat.fao.org/>)

⁸Set as 10% of seed cost in AGRA/PASS Program: <http://www.agra.org/download/507554383c>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Improved Seeds Conservation Ag

Improved seeds

Crop	Average seeding rate (kg/Ha) ^{1,2}	\$/kg (African Improved Variety)	\$/kg (1 st World Improved Variety)	\$/Ha (1 st World Improved seed)	\$/Ha (African improved seed)
Maize	14.6	\$2.20 ³ e.g., DKC 80-53	\$19.62 ⁴ DKC 62-80 BR	\$286.47	\$42.65
Sorghum	5.6	\$0.98 ³ e.g., ZSV-15, Ruyuma	\$5.55 ⁷ Pannar 8816	\$31.07	\$5.49
Wheat	112.0	\$0.88 ⁵ Rwandan avg	\$1.10 ⁶ Syngenta Southwind	\$123.46	\$98.56
Groundnuts	156.9	\$2.54 ⁸ Serenut 4 (Pearl Seeds)	\$3.06 ⁹ Serenut8 + CruiserMaxx seed treatment	\$480.81	\$397.80
Beans	84.1	\$2.20 ¹² Kholoplethe – SUG-131	\$11.09 ¹³ Syngenta Carson	\$932.60	\$185.41
Cowpeas	21.0	\$1.67 ⁵ Nigerian avg	\$3.02 ¹⁴ AATF Bt cowpeas	\$65.51	\$35.07

Cassava Multiplication	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Cassava multi. cost per farm ¹⁰	No Cassava in optimal crop mix	\$10.40	\$16.80 ¹¹	\$16.80 ¹¹	\$9.80	No Cassava in optimal crop mix	\$32.20	\$28.90
Average farm size (Ha) ¹⁵		0.4	1.9	0.8	0.7		2.5	1.1
Cost per Ha		\$26.00	\$8.84	\$21.00	\$14.00		\$12.88	\$26.27

¹Maize, Sorghum & beans (Michigan State University Revised extension bulletin E2017: <http://fieldcrop.msu.edu/uploads/documents/E2107.pdf>); Wheat (UC Davis Small grain production manual: <http://anrcatalog.ucdavis.edu/pdf/8208.pdf>)

²Groundnuts (Univ. of GA 2013 Peanut production guide: http://www.ces.uga.edu/commodities/fieldcrops/peanuts/documents/2013_UCGAPeanutProductionGuide.pdf); Cowpea (ITA – Farmer's guide to Cowpea production in W. Africa: <http://www.icrisat.org/tropicallegumesII/pdfs/Cowpea.pdf>)

³AMISA: <http://amisa.org/home.aspx>

⁴SA Grain: http://www.seswes.co.za/files/main_articles/2011/10/7/milieu_monsanto.jpg; includes 15% price increase to improved seed to the latest GM technology, based on price change from Monsanto VT3 (\$295/unit) to SmartStax corn (\$340/unit)

⁵Price date from AGRA: <http://www.agra.org/>

⁶Reisig Seeds LLC, Russel KSP Price quote (Feb 2013)

⁷SA Grain: http://www.seswes.co.za/files/main_articles/2011/10/7/sorghum_pannar.jpg

⁸IFDC: http://api.ning.com/files/.../gender_study_gulu_hub_report_march2011.doc

⁹Growing Georgia: <http://growinggeorgia.com/news/2011/10/georgia-peanuts-saving-seed-2012-three-considerations-and-word-caution/>

¹⁰Pioneer Field Facts: http://www.champdseed.com/information%20for%20website/Soybean%20Agronomy/Soybean%20tech%20sheet/Field_Facts_Soybean_Seed_Trim_Pop.pdf

¹¹Catholic Relief Services Great Lakes Cassava Initiative (cost vary by country): <http://www.crs.org/program/ultivore/storage/pubs/agan/eld-final-report.pdf>

¹²Program average – Catholic Relief Services Great Lakes Cassava Initiative

¹³CIAT: <http://community.ciat.org/59e3f19/Common%20bean%20varieties.pdf>

¹⁴Johnnie's Selected Seeds: http://www.johnniesseeds.com/p6952_carson.aspx

¹⁵Based on a current price of \$0.76/lb (UC Davis Agriculture and Natural Resources Publication 8030: <http://anrcatalog.ucdavis.edu/pdf/8030.pdf>) with a price increase to account for the utilization of Bt technology (See AATF, "Maruca-Resistant Cowpea project Progress Report" 2011: <http://www.aatf-africa.org/userfiles/cowpea-2011-progress-report.pdf>) based on the price change from RR1-Brazil (\$0.75/unit) to RR2-Intacta (\$1.36/unit)

¹⁶FAO database: <http://faostat.fao.org/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Improved Seeds Conservation Ag

Crop	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Area (Ha) planted with African improved seed ¹								
Beans						21,369	139,943	
Cassava		4,575	270,473	80,479	25,828		140,348	92,826
Cowpeas						5,543	2,975	
Groundnuts	4,113			83,686		28,127		
Maize		9,761	311,169	195,267	27,632	524,783	623,745	231,548
Sorghum	39,349		74,048	36,471		35,292	153,888	3,588
Wheat		877		495	5,477	308,397	20,543	2,832
Total area	43,461	15,213	655,690	396,398	58,937	923,510	1,081,442	330,794

Crop	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Area (Ha) planted with unimproved varieties ²								
Beans						11,430	52,545	
Cassava		550,552	2,037,684	282,160	244,328		1,977,029	4,172,732
Cowpeas						27,256		
Groundnuts	58,489					431,058		
Maize		477,392	1,191,817		692,784		1,974,853	199,801
Sorghum	76,912		1,321,582	2,111,466		1,735,850	4,177,110	
Wheat		89,756		27,400	129,601	117,989	364,434	93,024
Total area	135,401	1,117,700	4,551,083	2,421,026	1,066,713	2,323,583	8,545,971	4,465,556

¹FAO database: <http://foostat.fao.org/>

²Current farmland weighted by optimal crop mix minus area planted with African improved seed

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Summary Conservation Ag

Project Description

- Teaches conservation agriculture techniques and increases use of inputs (fertilizer, pesticides, improved seeds) to US-conservation agriculture levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

All programs								
<u>One-time</u>	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
Fertilizer/pesticides	\$1,593,389	\$7,480,356	\$35,925,873	\$41,188,316	\$10,533,883	\$17,577,705	\$118,199,083	\$42,843,986
Extension & soil testing	\$445,314	\$28,071,612	\$20,204,991	\$26,010,257	\$14,358,572	\$11,718,356	\$24,508,394	\$28,528,362
Mechanization	\$396,617,364	\$4,743,691,596	\$22,383,456,876	\$11,537,343,336	\$4,728,591,168	\$11,230,712,196	\$38,121,184,572	\$19,727,322,408
Improved seeds	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$398,656,067	\$4,779,243,564	\$22,439,587,740	\$11,604,541,909	\$4,753,483,623	\$11,260,008,257	\$38,263,892,049	\$19,798,694,756
Annual								
Fertilizer/pesticides	\$38,863,135	\$182,447,708	\$876,240,815	\$1,004,593,079	\$256,923,984	\$428,724,523	\$2,882,904,458	\$1,044,975,266
Extension & soil testing	\$591,484	\$54,707,400	\$21,878,687	\$34,604,087	\$33,003,057	\$92,940,525	\$27,924,343	\$41,859,569
Mechanization	\$41,895,903	\$531,584,609	\$1,824,027,710	\$1,281,781,226	\$94,691,793	\$1,335,445,150	\$3,482,295,778	\$2,248,020,998
Improved seeds	\$35,044,753	\$181,143,120	\$528,245,754	\$144,700,878	\$247,518,087	\$487,532,305	\$1,185,401,283	\$261,189,069
Total	\$116,395,275	\$949,882,837	\$3,250,392,966	\$2,465,679,270	\$632,136,921	\$2,344,642,503	\$7,578,525,862	\$3,596,044,902
5-Year Cost of 1st-World Farming	\$980,632,444	\$9,528,657,747	\$38,691,552,569	\$23,932,938,257	\$7,914,168,227	\$22,983,220,774	\$76,156,521,359	\$37,778,919,267

BENEFIT	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
Headwind reduction	2.90%	3.60%	2.40%	2.10%	2.70%	3.30%	3.10%	2.40%
Increased production (maize-eq. tonnes)	920,180	584,464	8,909,628	3,729,723	829,288	17,435,561	14,703,846	5,477,318
Cost/tonne of increased production	\$213	\$3,261	\$869	\$1,283	\$1,909	\$264	\$1,036	\$1,379

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Fertilizer & Pesticides

Traditional Ag

Project Description

- Increases use of inputs (fertilizer, pesticides, improved seeds) to US-levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Fertilizer & Pesticides	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Fertilizer usage/Ha (kg) ¹	17.62	4.38	13.98	71.03	0.24	68.14	11.79	2.63
Difference between current and US usage (kg/Ha) ²	317	228	249	323	246	287	344	214
Local fertilizer retail price in bulk amounts (50 kg) (\$/tonne) ³	\$800	\$929	\$552	\$875	\$933	\$723	\$731	\$983
Local fertilizer retail price in small quantity (20 kg) (\$/tonne) ⁴	\$920	\$1,068	\$635	\$1,419	\$902	\$831	\$940	\$1,129
Cost/Ha to reach US level (bulk)	\$253.60	\$211.81	\$137.45	\$282.63	\$229.52	\$207.50	\$251.46	\$210.36
Cost/Ha to reach US level (small quantity)	\$291.64	\$243.50	\$158.12	\$458.34	\$221.89	\$238.50	\$323.36	\$241.61
	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Pesticide use/Ha (kg) ¹	0.1	0.3	2	0.1	0.7	1.9	0	0
Difference between current and recommended use ⁵ (kg/Ha)	26.8	26.6	24.9	26.8	26.2	25	26.9	26.9
Local pesticide retail price in bulk amounts (25 liter) (\$/kg) ³	\$3.09	\$3.63	\$3.29	\$5.45	\$3.31	\$0.97	\$2.97	\$3.52
Local pesticide retail price in small quantity (1 liter) (\$/kg) ³	\$3.55	\$4.17	\$3.78	\$6.27	\$3.81	\$1.12	\$3.42	\$4.05
Cost/Ha to increase to recommended levels (bulk)	\$82.81	\$96.56	\$81.92	\$146.06	\$86.72	\$24.25	\$79.89	\$94.69
Cost/Ha to increase to recommended levels (small qty.)	\$95.23	\$111.04	\$94.21	\$167.97	\$99.73	\$27.89	\$91.88	\$108.89
Total cost/Ha of fertilizer & pesticides (bulk)	\$336.41	\$308.37	\$219.37	\$428.69	\$316.24	\$231.75	\$331.35	\$305.05
Total cost/Ha of fertilizer & pesticides (small qty.)	\$386.87	\$354.54	\$252.33	\$626.31	\$321.62	\$266.39	\$415.24	\$350.50
Total farmland (Ha)	178,862	1,132,913	5,367,807	2,789,529	1,125,650	3,279,892	9,624,439	4,792,761
Annual fertilizer/pesticide costs (bulk)	\$60,170,965	\$349,358,648	\$1,177,525,086	\$1,195,829,239	\$355,973,305	\$760,118,251	\$3,189,096,360	\$1,462,041,329
Annual fertilizer/pesticide costs (small qty.)	\$69,196,342	\$401,667,507	\$1,354,431,901	\$1,747,101,539	\$362,033,804	\$873,720,590	\$3,996,452,050	\$1,679,843,559
Total one-time start-up costs (bulk)⁶	\$2,467,010	\$14,323,705	\$48,278,529	\$49,028,999	\$14,594,905	\$31,164,848	\$130,752,951	\$59,943,694
Total annual costs (bulk, from above)	\$60,170,965	\$349,358,648	\$1,177,525,086	\$1,195,829,239	\$355,973,305	\$760,118,251	\$3,189,096,360	\$1,462,041,329
Total one-time start-up costs (small qty.)⁶	\$2,837,050	\$16,468,368	\$55,531,708	\$71,631,163	\$14,843,386	\$35,822,544	\$163,854,534	\$68,873,586
Total annual costs (small qty., from above)	\$69,196,342	\$401,667,507	\$1,354,431,901	\$1,747,101,539	\$362,033,804	\$873,720,590	\$3,996,452,050	\$1,679,843,559

¹FAOSTAT: <http://faostat3.fao.org/>

²Relative to current US usage of 125 kg/Ha

³Weighted average of local usage and retail prices (AMTISA: <http://amitisa.org/home.asp>)

⁴Assuming 15% markup with small quantities (Source: Botswana Ag Ministry http://www.moa.gov.bw/niche/letty/lettyeav_2013.pdf) and interviews

⁵Relative to manufacturer recommended usage of 27 kg/Ha of fungicides, herbicides & insecticides

⁶40% of input costs from World Bank Ethiopia National Fertilizer Sector Project: <http://www.worldbank.org/projects/P000751/morrel-fertilizer-sector-project-2009>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Extension & Soil Testing Traditional Ag

Project Description

- Increases use of inputs (fertilizer, pesticides, improved seeds) to US-levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Extension & Soil Testing	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Annual training, equipping, and paying community knowledge workers (CKWs) for testing ¹	\$18,002	\$13,518	\$6,133	\$8,236	\$16,647	\$68,842	\$6,609	\$9,400
Annual in-field soil testing kits (\$3.06 per test) ²	\$3,060	\$3,060	\$3,060	\$3,060	\$3,060	\$3,060	\$3,060	\$3,060
Pre-harvest focus groups	\$152	\$152	\$152	\$152	\$152	\$152	\$152	\$152
Post-harvest focus groups	\$152	\$152	\$152	\$152	\$152	\$152	\$152	\$152
Farmer information days	\$1,631	\$1,631	\$1,631	\$1,631	\$1,631	\$1,631	\$1,631	\$1,631
Training workshops for extension officers to work with CKWs	\$3,262	\$3,262	\$3,262	\$3,262	\$3,262	\$3,262	\$3,262	\$3,262
One-time costs per 1,000 farms	\$5,197	\$5,197	\$5,197	\$5,197	\$5,197	\$5,197	\$5,197	\$5,197
Annual costs per 1,000 farms	\$21,062	\$16,578	\$9,193	\$11,296	\$19,707	\$71,902	\$9,669	\$12,460
Total number of farms	28,083	3,300,000	2,379,929	3,063,393	1,674,687	1,292,600	2,888,028	3,359,516
Total one-time local-level costs	\$145,963	\$17,151,961	\$12,369,833	\$15,922,181	\$8,704,293	\$6,718,371	\$15,010,710	\$17,461,299
Total annual local-level costs	\$591,489	\$54,707,321	\$21,879,058	\$34,603,940	\$33,003,286	\$92,939,937	\$27,923,731	\$41,859,569
National outreach event	\$3,625	\$3,625	\$3,625	\$3,625	\$3,625	\$3,625	\$3,625	\$3,625
Nat'l level administrative staff	\$204,136	\$153,287	\$69,547	\$93,392	\$188,770	\$780,629	\$74,940	\$106,591
Total one-time national costs	\$207,760	\$156,912	\$73,172	\$97,016	\$192,395	\$784,253	\$78,565	\$110,216
Total extension & soil-testing one-time costs	\$353,724	\$17,308,873	\$12,443,005	\$16,019,197	\$8,896,688	\$7,502,625	\$15,089,275	\$17,571,515
Total extension & soil-testing annual costs	\$591,489	\$54,707,321	\$21,879,058	\$34,603,940	\$33,003,286	\$92,939,937	\$27,923,731	\$41,859,569

¹Community knowledge workers (CKWs) are local farmers who are elected by their peers to receive a smartphone and provide crop & market information. They can administer soil tests using in-field kits and use applications to recommend fertilizer & seed decisions. Their pay is scaled by local wage rates. Based on Gates Foundation/Grameen Foundation CKW Program: <http://www.gatesfoundation.org/News/Press-Releases/2019/10/Gates-Foundation-Expands-Technology-Program-for-Poor-Farmers-in-India>

²Bill & Melinda Gates Foundation/Author D. Little, Inc.: <http://dx.doi.org/10.24646.1.2017.0001>
Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Mechanization

Traditional Ag

Project Description

- Increases use of inputs (fertilizer, pesticides, improved seeds) to US-levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Mechanization

Cost of machinery	Retail price¹							
Tractor (41 kW/55 hp, med. power, 4WD)	\$21,939							
Plough	\$2,332							
Combine harvester (9.1 m, self-propelled)	\$226,303							
Planter (4-row, 900 mm)	\$12,157							
Fertilizer spreader (4,000 l, double disc)	\$37,142							
Boom sprayer (12 m)	\$3,851							
One-time Unit Cost	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
One-time								
Machinery cost per package	\$303,724	\$303,724	\$303,724	\$303,724	\$303,724	\$303,724	\$303,724	\$303,724
Tractor registration ²	\$89	\$89	\$89	\$89	\$89	\$89	\$89	\$89
Storage shed ²	\$993	\$993	\$993	\$993	\$993	\$993	\$993	\$993
One-time cost per package	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806
Annual Unit Cost								
Maintenance & repairs (\$/ package) ³	\$21,336	\$21,336	\$21,336	\$21,336	\$21,336	\$21,336	\$21,336	\$21,336
Fuel (\$/package)	\$12,226	\$14,351	\$9,219	\$18,404	\$16,839	\$13,730	\$12,319	\$13,138
Lubricants (\$/package)	\$1,834	\$2,153	\$1,383	\$2,761	\$2,526	\$2,060	\$1,848	\$1,971
Annual package cost	\$35,396	\$37,840	\$31,938	\$42,501	\$40,701	\$37,126	\$35,503	\$36,445
Machinery penetration targets	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
Current machine package density (#/1,000 Ha) ^{4,5}	6.5	0.1	0.1	0.3	0.0	2.6	0.8	0.3
Current farmland (1,000 Ha) ⁴	179	1,133	5,368	2,790	1,126	3,280	9,624	4,793
Current number of total machine packages	1,155	57	537	698	0	8,364	7,699	1,438
Additional equipment packages to reach:								
Best-in-Africa (Botswana)	-	7,245	34,027	17,375	7,248	12,854	54,480	29,543
US in 1950 (11.9/1,000 Ha)	974	13,411	63,239	32,556	13,374	30,703	106,858	55,626
US in 2011 (13.7/1,000 Ha)	1,287	15,393	72,633	37,438	15,344	36,443	123,701	64,014

¹South African Guide to Machinery Costs: <http://www.dhff.gov.za/files/statinfo/Guidemachi213.pdf>

²IFRR – Agricultural Mechanization in Ghana: <http://www.ifrr.org/sites/default/files/attachments/essow90.pdf>

³Scaled as % of machinery costs (from footnote #2)

⁴Package density estimated from FAOSTAT ag machine counts, which include both combines and tractors as ag machines

FAOSTAT: <http://faostat.fao.org/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Mechanization Traditional Ag

Project Description

- Increases use of inputs (fertilizer, pesticides, improved seeds) to US-levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Mechanization								
Best-in-Africa	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
One-time package cost	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806
Annual package cost	\$35,396	\$37,840	\$31,938	\$42,501	\$40,701	\$37,126	\$35,503	\$36,445
Target number of packages	-	7,245	34,027	17,375	7,248	12,854	54,480	29,543
One-time cost	\$0	\$2,208,319,470	\$10,371,633,762	\$5,296,004,250	\$2,209,233,888	\$3,917,976,324	\$16,605,830,880	\$9,004,883,658
Annual cost	\$0	\$274,150,800	\$1,086,754,326	\$738,454,875	\$295,000,848	\$477,217,604	\$1,934,203,440	\$1,076,694,635
US 2011 Target (Base case)	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
One-time package cost	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806	\$304,806
Annual package cost	\$35,396	\$37,840	\$31,938	\$42,501	\$40,701	\$37,126	\$35,503	\$36,445
Target number of packages	1,287	15,393	72,633	37,438	15,344	36,443	123,701	64,014
One-time cost	\$392,285,322	\$4,691,878,758	\$22,138,974,198	\$11,411,327,028	\$4,676,943,264	\$11,108,045,058	\$37,704,807,006	\$19,511,851,284
Annual cost	\$45,554,652	\$582,471,120	\$2,319,752,754	\$1,591,152,438	\$624,516,144	\$1,352,982,818	\$4,391,756,603	\$2,332,990,230
Labor savings from mechanization	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
Minimum wage/Ha worked ¹	\$120	\$138	\$275	\$332	\$1,354	\$28	\$296	\$61
% man-hours saved through mechanization ²	35%	35%	35%	35%	35%	35%	35%	35%
Mechanization gap ³	53%	100%	99%	98%	100%	81%	94%	98%
Total farmland (Ha)	178,862	1,132,913	5,367,807	2,789,529	1,125,650	3,279,892	9,624,439	4,792,761
Annual labor cost savings from mechanization	\$3,962,481	\$54,519,259	\$512,866,432	\$318,206,580	\$533,445,535	\$26,138,216	\$938,654,261	\$100,076,536
TOTAL ONE-TIME COST	\$392,285,322	\$4,691,878,758	\$22,138,974,198	\$11,411,327,028	\$4,676,943,264	\$11,108,045,058	\$37,704,807,006	\$19,511,851,284
TOTAL ANNUAL COST	\$41,592,171	\$527,951,861	\$1,806,886,322	\$1,272,945,858	\$91,070,609	\$1,326,844,602	\$3,453,102,342	\$2,232,913,694

1. ILO Global Wage Report: http://www.ilo.org/wcmsp5/groups/public/-/dgreps/-/documents/inbrief/wcms_140050.pdf
4FFR, 2011: http://www.ilo.org/wcmsp5/groups/public/-/dgreps/-/documents/inbrief/wcms_140050.pdf

³Gap between current and target tractor densities, calculated as: $1 - (\text{Current Tractor Density} / \text{Target Tractor Density})$

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Improved Seeds

Traditional Ag

Project Description

- Increases use of inputs (fertilizer, pesticides, improved seeds) to US-levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

Improved seeds										
Optimal crop mix (% of land)	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda	\$/Ha (1 st World Improved seed)	\$/Ha (improved seed users)
Maize		43%	28%	7%	64%	16%	27%	9%	\$286 ^{1,2}	\$244 ^{1,2}
Sorghum	65%		26%	77%		54%	45%	<1%	\$31 ^{1,2}	\$26 ^{1,2}
Wheat		8%		1%	12%	13%	4%	2%	\$123 ^{1,3}	\$25 ^{1,3}
Groundnuts	35%			3%		14%			\$481 ^{1,2}	\$83 ^{1,2}
Cassava		49%	43%	13%	24%		22%	89%	\$9 - \$26 ^{4,5}	\$9-\$26 ^{4,5}
Beans						1%	2%		\$932 ^{1,2}	\$747 ^{1,2}
Cowpeas						1%	<1%		\$63 ^{1,3}	\$28 ^{1,3}
<hr/>										
	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda		
Total farmland (Ha)	178,862	1,132,913	5,367,807	2,789,529	1,125,650	3,279,892	9,624,439	4,792,761		
Current African improved seed use weighted by optimal crop	24%	1%	13%	14%	5%	28%	11%	7%		
Farmland planted with African improved seed (Ha)	43,461	15,213	655,690	396,398	58,937	923,510	1,081,442	330,794		
Seed cost for land currently planted with improved seed (\$/Ha) ⁶	\$31	\$166	\$122	\$144	\$123	\$168	\$243	\$179		
Annual seed cost to upgrade from African improved seed to 1st world seed	\$1,347,717	\$2,522,288	\$80,149,704	\$57,096,847	\$7,229,724	\$155,077,903	\$263,060,652	\$59,094,400		
Farmland planted with unimproved varieties seed (Ha)	135,401	1,117,700	4,551,083	2,421,026	1,066,713	2,323,583	8,545,971	4,465,556		
Seed cost for land planted with unimproved varieties (\$/Ha) ⁷	\$225	\$145	\$88	\$31	\$204	\$124	\$95	\$40		
Annual seed cost to upgrade from unimproved seed to 1st world seed	\$30,511,150	\$162,153,275	\$400,073,709	\$74,449,406	\$217,786,719	\$288,133,284	\$814,576,878	\$178,350,208		
1st world improved-seed cost (annual)	\$31,858,867	\$164,675,563	\$480,223,413	\$131,546,252	\$225,016,443	\$443,211,187	\$1,077,637,530	\$237,444,608		
Program overhead costs (annual)⁸	\$3,185,887	\$16,467,556	\$48,022,341	\$13,154,625	\$22,501,644	\$44,321,119	\$107,763,753	\$23,744,461		

¹Seed prices can be found on p. 14 of the Data Book. Per Ha cost for improved seed users is the difference between 1st world improved seed and African improved seed (p. 14)

²Seeding rate - Department of Agriculture, Government of Sri Lanka: http://www.agriculture.gov.lk/index.php?option=com_content&view=article&id=123

³Seeding rate - Government of India: <http://www.sasra.gov.in/Manual/SMB.pdf>

⁴Estimated from average cost of planting a Ha of cassava from the CRS Great Lakes Cassava Initiative Report: <http://www.crsprogram.org/Shared/CRS/Reports/CRS%20GLI%20Cassava%20Initiative%20Report.pdf>

⁵UR - 11.9; GH - 4.7; MW - 9.5; RW - 6.4; TZ - 5.4; UG - 12.1

⁶Difference between African improved seed cost and 1st world seed (or equivalent) weighted by crop area currently under production (Production data from the FAO: <http://faostat3.fao.org/>)

⁷1st world seed cost (or equivalent) weighted by optimal crop area under production (Production data from the FAO: <http://faostat3.fao.org/>)

⁸Seeded as 10% of seed cost in AGRIP/FASS Program: <http://www.aas.com/dv/dv/m/15/6/25/03/3/c/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: 1st-World Farming – Summary Traditional Ag

Project Description

- Increases use of inputs (fertilizer, pesticides, improved seeds) to US-levels
- Provides soil testing & improved extension services via specially trained smartphone-equipped local farmers
- Increases mechanization to 1st-world standards by increasing mechanization penetration

All programs								
<u>One-time</u>	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
Fertilizer/pesticides	\$2,467,010	\$14,323,705	\$48,278,529	\$49,028,999	\$14,594,905	\$31,164,848	\$130,752,951	\$59,943,694
Extension & soil testing	\$353,724	\$17,308,873	\$12,443,005	\$16,019,197	\$8,896,688	\$7,502,625	\$15,089,275	\$17,571,515
Mechanization	\$392,285,322	\$4,691,878,758	\$22,138,974,198	\$11,411,327,028	\$4,676,943,264	\$11,108,045,058	\$37,704,807,006	\$19,511,851,284
Improved seeds	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$395,106,056	\$4,723,511,336	\$22,199,695,732	\$11,476,375,224	\$4,700,434,857	\$11,146,712,531	\$37,850,649,232	\$19,589,366,493

Annual								
Fertilizer/pesticides	\$60,170,965	\$349,358,648	\$1,177,525,086	\$1,195,829,239	\$355,973,305	\$760,118,251	\$3,189,096,360	\$1,462,041,329
Extension & soil testing	\$591,489	\$54,707,321	\$21,879,058	\$34,603,940	\$33,003,286	\$92,939,937	\$27,923,731	\$41,859,569
Mechanization	\$41,592,171	\$527,951,861	\$1,806,886,322	\$1,272,945,858	\$91,070,609	\$1,326,844,602	\$3,453,102,342	\$2,232,913,694
Improved seeds	\$35,044,753	\$181,143,120	\$528,245,754	\$144,700,878	\$247,518,087	\$487,532,305	\$1,185,401,283	\$261,189,069
Total	\$137,399,378	\$1,113,160,950	\$3,534,536,220	\$2,648,079,915	\$727,565,287	\$2,667,435,095	\$7,855,523,716	\$3,998,003,661

5-Year Cost of 1st-World Farming								
	\$1,082,102,948	\$10,289,316,084	\$39,872,376,831	\$24,716,774,797	\$8,338,261,291	\$24,483,888,008	\$77,128,267,812	\$39,579,384,799

BENEFIT	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
Headwind reduction	2.9%	3.6%	2.4%	2.1%	2.7%	3.3%	3.1%	2.4%
Increased production (maize-eq. tonnes)	889,443	578,294	8,909,628	3,488,345	798,779	16,679,029	13,772,253	5,418,764
Cost/tonne of increased production	\$243	\$3,559	\$895	\$1,417	\$2,088	\$294	\$1,120	\$1,461

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: Grain Storage

Project Description

- Provide small scale (Purdue PICS bags) and large scale (on farm & commercial silos) storage for farmers
- PICS Bags (small scale):
 - Distribute vouchers for the purchase of PICS hermetic storage bags
 - Develop manufacturing capacity in regions without ready supply of bags (e.g. South and Eastern Africa) by purchasing equipment to upgrade regional plastics factories
 - Bags are assumed to have a 3 year lifespan
- Large scale storage
 - Percent roads paved used as a proxy for the proportion of large scale storage
 - 60% (US average) of storage built on farm as cement or steel silos
 - Commercial silos built and maintained for the remaining 40% of large scale storage

	Botswana	Malawi	S. Africa	Burundi	Rwanda	Tanzania	Uganda	Ghana
Total Production w/ reduced postharvest loss	108,222	8,031,874	16,411,858	2,018,739	3,493,969	17,765,975	10,250,839	15,468,823
% Large Scale Storage ¹	33%	45%	17%	10%	19%	15%	23%	13%
% Stored in PICS Bags ²	67%	55%	83%	90%	81%	85%	77%	87%
Production stored in PICS Bags (tonnes)	72,942	4,415,924	13,572,607	1,807,982	2,830,115	15,118,844	7,893,146	13,519,751
1st bag run (10 bags/tonne; current production)	729,417	44,159,243	135,726,066	18,079,822	28,301,146	151,188,444	78,931,457	135,197,515
Storage voucher cost (\$/bag)	\$3	\$3	\$3	\$3	\$3	\$3	\$3	\$3
Initial voucher program total (current production)	\$2,188,251	\$132,477,730	\$407,178,199	\$54,239,467	\$84,903,437	\$453,565,332	\$236,794,370	\$405,592,544
Annual bag replacement set-aside (current production)²	\$729,417	\$44,159,243	\$135,726,066	\$18,079,822	\$28,301,146	\$151,188,444	\$78,931,457	\$135,197,515

Crop storage costs scale linearly with improved production as more interventions (e.g. optimal crop choice and 1st world farming) are selected

Factory cost share ³	0.44%	32.58%	66.98%	6.08%	10.38%	53.69%	29.85%	NA
	Factory 1 (Serving Botswana, S. Africa & Malawi) Located in S. Africa			Factory 2 (Serving Burundi, Rwanda, Tanzania & Uganda) Located in Tanzania			NA	
Initial regional bag need (current production)	180,614,727			276,500,869			150,547,307	
Machine price ⁴	\$400,000			\$400,000				
Number of machines	3			6				
Machine cost (current production)	\$1,200,000			\$2,400,000				
Max annual bag output ⁵	61,813,187			123,626,374				
Bags available after 3-year ramp-up	185,439,560.44			370,879,120				
Annual bag replacement (1/3 of regional need)	60,204,909			92,166,956				

	Botswana	Malawi	S. Africa	Burundi	Rwanda	Tanzania	Uganda	Ghana
Initial voucher program total (current production)	\$2,188,251	\$132,477,730	\$407,178,199	\$54,239,467	\$84,903,437	\$453,565,332	\$236,794,370	\$405,592,544
Initial factory cost	\$5,240	\$391,024	\$803,736	\$145,817	\$249,226	\$1,288,565	\$716,392	\$0
One-time small scale storage cost	\$2,193,491	\$132,868,754	\$407,981,935	\$54,385,283	\$85,152,663	\$454,853,897	\$237,510,763	\$405,592,544
Annual small scale storage cost	\$729,417	\$44,159,243	\$135,726,066	\$18,079,822	\$28,301,146	\$151,188,444	\$78,931,457	\$135,197,515

¹The proportion of large scale storage is equal to the percent of roads paved as infrastructure is a limiting factor on the build out of these storage options. Small scale storage is equal to 100% - %roads paved

²Annual voucher replacement costs are 1/3 of the initial voucher costs assuming an average lifespan of 3 years per PICS bag

³Factory cost share is equal to each country's share of regional production given current yields and reduced postharvest loss due to improved grain storage

⁴Average price of moderate to high volume plastic extruders (e.g. up to 1500-2000 kg/hr), Lake Partners Analysis using pricing on new (<http://www.plasticextruders.com>) and used (<http://www.usedextruders.com/extrudersfor-sale.htm>) extruders

⁵Output based on 13.7 bags/kg and extruders operating at 1500 kg/hr for two 6 hour shifts 5 days a week 50 weeks per year

⁶Increased production assuming additional land, optimal crop choice and first world farming interventions in addition to improved grain storage

⁷5 year cost are equal to the one-time cost plus 5 years of annual costs.

⁸District and village level costs do not include factory costs

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

All Countries: Grain Storage

<i>Large Scale Storage</i>	Botswana	Burundi	Ghana	Malawi	Rwanda	South Africa	Tanzania	Uganda
% Large Scale Storage ¹	33%	10%	13%	45%	19%	17%	15%	23%
Production stored at large scale (tonnes)	35,280	210,756	1,949,072	3,615,950	663,854	2,839,251	2,647,130	2,357,693
Production stored in on farm silos (tonnes) ²	21,169	126,454	1,169,444	2,169,570	398,313	1,703,551	1,588,279	1,414,616
On farm silo cost (one tonne silo) ³	\$387	\$62	\$99	\$150	\$351	\$877	\$89	\$135
On farm silo construction cost	\$8,192,403	\$7,840,148	\$115,774,956	\$325,435,500	\$139,807,863	\$1,494,014,227	\$141,356,831	\$190,973,160
Production stored in commercial silos (tonnes) ²	14,111	84,302	779,628	1,446,380	265,541	1,135,700	1,058,851	943,077
Commercial silos needed (10,000 tonne capacity)	2	9	78	145	27	114	106	95
Commercial Silo Cost (per silo)	\$1,266,585	\$202,600	\$323,372	\$490,721	\$1,147,541	\$2,870,406	\$290,539	\$442,649
Commercial silo construction cost	\$2,533,170	\$1,823,400	\$25,223,016	\$71,154,545	\$30,983,607	\$327,226,284	\$30,797,134	\$42,051,655
Annual Maintenance Contracts (one per 2 silos)	1.0	4.5	39.0	72.5	13.5	57.0	53.0	47.5
Annual maintenance cost (per contract)	\$126,658	\$20,260	\$32,337	\$49,072	\$114,754	\$287,040	\$29,054	\$44,265
Annual large scale storage cost	\$126,658	\$91,170	\$1,261,143	\$3,557,720	\$1,549,179	\$16,361,280	\$1,539,862	\$2,102,588
Annual small scale storage cost	\$729,417	\$18,079,822	\$135,197,515	\$44,159,243	\$28,301,146	\$135,726,066	\$151,188,444	\$78,931,457
Total annual cost	\$856,075	\$18,170,992	\$136,458,658	\$47,716,963	\$29,850,325	\$152,087,346	\$152,728,306	\$81,034,044
On farm silo construction cost	\$8,192,403	\$7,840,148	\$115,774,956	\$325,435,500	\$139,807,863	\$1,494,014,227	\$141,356,831	\$190,973,160
Commercial silo construction cost	\$2,533,170	\$1,823,400	\$25,223,016	\$71,154,545	\$30,983,607	\$327,226,284	\$30,797,134	\$42,051,655
Small scale storage one-time cost	\$2,193,491	\$54,385,283	\$405,592,544	\$132,868,754	\$85,152,663	\$407,981,935	\$454,853,897	\$237,510,763
Total one-time cost	\$12,919,064	\$64,048,831	\$546,590,516	\$529,458,799	\$255,944,133	\$2,229,222,446	\$627,007,862	\$470,535,578
5-YEAR COST⁴								
Countrywide	\$17,199,438	\$154,903,792	\$1,228,883,803	\$768,043,616	\$405,195,756	\$2,989,659,179	\$1,390,649,393	\$875,705,799
District-level ⁵	\$1,911,049	\$9,111,988	\$122,888,380	\$27,430,129	\$81,039,151	\$332,184,353	\$53,486,515	\$11,372,803
Village-level ⁶	\$18,165	\$5,469	\$43,238	\$23,133	\$25,918	\$1,011,778	\$36,653	\$7,738
BENEFIT	<i>Botswana</i>	<i>Burundi</i>	<i>Ghana</i>	<i>Malawi</i>	<i>Rwanda</i>	<i>South Africa</i>	<i>Tanzania</i>	<i>Uganda</i>
Headwind reduction	3.1%	3.7%	4.3%	1.5%	4.1%	1.2%	2.5%	4.3%
Increased production (maize-eq. tonnes)	16,081	525,263	2,432,829	1,156,517	595,720	2,279,795	2,781,244	1,919,906
Cost/tonne of increased production	\$214	\$59	\$101	\$133	\$136	\$262	\$100	\$91

¹The proportion of large scale storage is equal to the percent of roads paved as infrastructure is a limiting factor on the build out of these storage options. Small scale storage is equal to 100% minus % roads paved.
²43% of large scale storage capacity is provided with on farm silos and the remaining 40% is provided through commercial silos. Based on modern US storage levels - USDA Grain Stocks reports (1991-2010): <http://usda.mannlib.cornell.edu/MannLib/data/homenaasdc>

³5-year cost are equal to the one-time cost plus 5 years of annual costs.

⁴Distric level village level cost do not include factory costs

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

BOTSWANA



Botswana: Trade Barriers

Project Description

- Improve training of export and import officials
- Open up Botswana-grown products to new markets via trade deals and streamlined export regulations
- Improve quality control, infrastructure, and provide incentives to increase the value of agricultural exports

ASSUMPTIONS	Country-Level	District- & Village-Level	Notes
Rural industry subsidies	\$777,798	NS ¹	Fund to provide subsidies and infrastructure support to firms who locate in rural areas ²
Report on rural export products	\$30,912	NS ¹	Ministry of Trade and Industry will commission a brief report on current rural products ready for export ²
Develop a database of international standards	\$23,184	NS ¹	One staff position to develop database ²
Develop product quality and standards requirements	\$23,184	NS ¹	Research staff (1) assistance for the Bureau of Standards ²
Develop local assessment capacity	\$23,184	NS ¹	One staff position to provide training to staff of local governments or institutions so that they may function as assessors for local producers ²
Ensure production of goods meet national and international standards	\$30,912	NS ¹	Support funds to the Bureau of Standards and Ministry of Trade and Industry to (1) develop a national campaign to encourage standardization and certification and (2) develop policies that require the adherence to product quality standards ²
Increase the availability of export services (e.g. clearing & forwarding)	\$154,560	NS ¹	Budget support to the Bureau of Standards to conduct training for new private sector export agents (workshop costs) ²
Conduct a study on Botswana's niche products and markets	\$463,679	NS ¹	Commission study to identify niche products and market targets for export ²
Implement Botswana's "Investment Strategy" to increase FDI	\$927,357	NS ¹	Budget support to Botswana export development & investment authority to implement investment strategy and developing special economic zones with reduced regulatory burdens for start-ups ²
Trade pacts	\$2,318,393	NS ¹	Train and establish 20 skilled negotiators; Travel and other expenses to negotiate new trade deals with priority partners (US, UK and other EU nations, Zimbabwe and other African nations) ²
Improve skills in trade sector	\$309,119	NS ¹	Conduct industry skills audits and create sector specific education-industry liaison committees to improve the skills of graduates (agriculture, mining and manufacturing sectors primarily) ²
Technical training in import/export sector for private & public firms	\$1,545,595	NS ¹	Conduct needs assessment for individual companies; Create training unit to conduct ongoing technical trainings; Develop country profiles for common export markets; Develop a booklet on export requirements for targeted markets ²
Decrease number of documents needed for export	\$463,679	NS ¹	Reduce the number of documents and provide computer terminals at all customs points ²
Infrastructure planning & maintenance	\$1,545,595	NS ¹	Finance study to identify infrastructure areas that require upgrades, Develop export support infrastructure master plan; Expedite the development of trans-Kalahari corridor and dry port facility ²
Study to further decrease transportation costs	\$154,560	NS ¹	Commission a study on ways to reduce Botswana's high transport costs ²
Temporary commercial trade assistance	\$4,636,785	NS ¹	Install trade attaches in embassies of major trade partners (UK, US, Southern African Custom Union members, and non-Uk EU countries) and targets to ease import and export burdens on businesses; Budgeted for 5 years at \$927,357/yr ²
Increase hours at primary border crossings	\$154,560	NS ¹	Budget subsidy to department of immigration for increased hours ²
TOTAL COSTS	Country-Level		Notes
Total one-time cost	\$13,578,053		
Total annual cost	\$-		
5-year cost	\$13,578,053		
BENEFIT			
Headwind reduction	1.4%		
Increased production (maize-eq. tonnes)	1,086		
Cost/tonne of increased production	\$2,500		

¹Cannot be scaled to the village or district level as interventions are primarily national in scope

²National Export Strategy (2010-16) - Republic of Botswana, Ministry of Trade and Industry, Jan 2010: http://www.mti.gov.bw/webfm_send/178

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Botswana: Water Resource Management

Project Description

- Teach drylands farming techniques such as soil moisture and drought crop management or no-till farming
- Provide training to villagers and local government officials in water conservation, community organizing, and drought monitoring

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Local government “drylands” training (per village)	\$7,900	\$7,900	\$7,900	Average cost for extension agent to instruct local government officials in water management and conservation and drought monitoring ¹
Village volunteer “drylands” training (per village)	\$2,000	\$2,000	\$2,000	Average cost for extension agent to instruct local townspeople in water conservation and drought monitoring ¹
Number of “villages”	504	56	2	
Total drylands training costs	\$4,989,600	\$554,400	\$19,800	
Max. number of classes per instructor	2	2	2	
Annual costs per class ²	\$1,266	\$1,266	\$1,266	
<i>Annual class costs per instructor</i>	<i>\$2,531</i>	<i>\$2,531</i>	<i>\$2,531</i>	
Total farmland (Ha)	178,862	19,874	200	
Farmland covered by one instructor (Ha)	100	100	100	
<i>Number of instructors required</i>	<i>1,789</i>	<i>199</i>	<i>2</i>	
Class costs per instructor (from above)	\$2,531	\$2,531	\$2,531	
<i>Annual class costs</i>	<i>\$4,527,747</i>	<i>\$503,669</i>	<i>\$5,062</i>	
5-year class costs	\$22,638,734	\$2,518,495	\$25,310	Farmer trainings budgeted for 5-years before phase out
Number of instructors required (from above)	1,789	199	2	
Training costs (per instructor) ²	\$1,163	\$1,163	\$1,163	
<i>Total training costs</i>	<i>\$2,080,380</i>	<i>\$231,437</i>	<i>\$2,326</i>	
One-time national coordination costs ³	\$29,251	\$29,251	\$29,251	Develop strategy for program management, training and recruitment
One-time initial national curriculum consultancy ³	\$55,562	\$55,562	\$55,562	Develop curriculum focused on arid farming techniques (e.g. no till farming, intercropping, soil moisture and drought crop management)
Total training and initial costs	\$2,165,194	\$316,250	\$87,139	

TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time & 5-year cost	\$29,793,528	\$3,389,145	\$132,249	5-seasons of farmer field schools are considered one-time costs

BENEFIT	
Headwind reduction	1.1%
Increased production (maize-eq. tonnes)	875
Cost/tonne of increased production	\$6,810

¹South Eastern Dry Areas Project – Republic of Zimbabwe Loan Proposal; IFAD, September 1995; http://expexters.ifad.org/extension/65016/315112/D1_E52_X11.pdf

²Regional average (Uganda, Rwanda, Burundi, Tanzania, and Malawi); See earlier “Optimal Crops” extension component for details

³Average of values taken from Rwanda Rural Sector Support Project; http://rta.fao.org/rel/regions/10/regions_projects/av_rssn_ea_rty_&IFAD-East African Subregional Pilot Project on Farmer Field Schools in Kenya, Tanzania, and Uganda; <http://www.ifad.org/ebdocs/eb/65/e/65r30.pdf>

Special Cost Note: When combined with other interventions the total combined one-time costs should be discounted as follows to removed redundant extension/paranet costs: Optimal Crop Choice (37%) & 1st World Farming (1.1%)

Botswana: Time to Start a Business

Project Description

- Streamline and modernize business registration process and develop an online registration portal
- Create and staff registration centers at regional government offices

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Review and streamline business registration process	\$154,560	\$154,560	NS ¹	Budget support to facilitate a review of the business registration process ²
Modernize business registration systems	\$1,171,000	\$1,171,000	NS ¹	Project coordination, temporary staff, training and technical cost of building modern registration system USAID ³
Total business registration upgrade cost	\$1,325,560	\$1,325,560	NS¹	
Registration center setup cost (per office)	\$170,000	\$170,000	NS ¹	Cost of 3 computer terminals and 2 servers ⁴
Registration center training (per office)	\$7,900	\$7,900	NS ¹	Cost of district training for administrative staff ⁵
Number of centers/offices (one per district)	9	1	NS ¹	1 person per office paid at an average service wage rate ⁶
Total setup and training cost	\$1,601,100	\$177,900		
Staff position for registration center (annual cost per office)	\$21,112	\$21,112	NS ¹	
Number of centers/offices (one per district)	9	1	NS ¹	
Annual staff cost	\$190,008	\$21,112		
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$2,926,660	\$1,333,460	NS ¹	
Total annual cost	\$190,008	\$21,112	NS ¹	
5-year cost	\$3,876,700	\$1,439,020	NS¹	

BENEFIT

Headwind reduction	0.2%
Increased production (maize-eq. tonnes)	121
Cost/tonne of increased production	\$6,408

¹Not Scalable to the village level

²Botswana Confederation of Commerce, Industry and Manpower and Ministry of Trade and Industry - Private Sector Development Strategy (PSDS) 2009-13, Sep 2008 www.bccim.co.bw/downloadfile?tr_id=3

³Development Assistance Grant/Agreement between the government of the United States of America and the government of Guyana for Improving fiscal management in Guyana, Millennium Challenge (USAID) Account Threshood Program, Aug 2007: <http://www.mcc.gov/documents/agreements/daga-guyana.pdf>

⁴Multinational (Burundi/Rwanda) Project to Develop Roads (Mugina-Mabanda-Lake Nyanza and Rubavu-Gisiza) and Facilitate transport on the north-south corridor – Phase III, African Development Fund, Mar 2012: <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/MULTINATIONAL%20BURUNDI-RWANDA%20-AR%20-%20Project%20to%20develop%20roads%20and%20facilitate%20transport%20on%20the%20North-South%20corridor%20-%20Phase%20III.pdf>

⁵South Eastern Dry Areas Project – Republic of Zimbabwe Loan Proposal: IFAD, September 1995: <http://openstax.ifad.org/documents/FS4016/315112/D1FE-2701.nsf>

⁶International Labour Organization (ILO) statistics database: <http://stats.ilo.org/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

BURUNDI



Burundi: Market Access

Project Description

- Market strengthening, capacity building and training of professional organizations
- Conducting strategic planning and market consultations for possible export crops
- Developing a more modern market information system for agricultural products
- Producer training in value chain development
- Paving provincial roads, rehabilitation of agricultural feeder roads, and repairing market infrastructure

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Cost to construct a provincial road (\$/km) ¹	\$ 40,000	\$40,000	\$40,000	
Length of paved provincial roads (km)	2500	147	0	Increasing from 11% to 32.6% (Botswana-level) of roads paved ³
Provincial road construction total	\$100,000,000	\$5,880,000	0	
Rehabilitate ag feeder roads (\$/km) ²	\$3,000	\$3,000	\$3,000	National Agriculture Investment Plan – Burundi (PNIA) ²
Length of rehabilitated ag feeder roads (km)	50000	2945	2	Target from Burundi's National Agriculture Investment Plan (PNIA) ²
Ag feeder road construction total	\$150,000,000	\$8,835,000	\$6,000	
Rehabilitate (wholesale) trading centers (300 units)	\$20,000	\$20,000	\$20,000	Cost of one wholesale market center in Malawi
Number of trading centers	300	18	0	Target from PNIA ²
Trading center rehabilitation cost	\$6,000,000	\$360,000	\$0	
Capacity building for professional organizations ²	\$60,000,000	\$3,534,191	\$-	Equivalent to 6,122 workshops (country-level) or 360 (district-level) over 5 years ⁴ to train members of organizations in business and production
Support strategic development and investment plans for crop sectors	\$500,000	\$29,452	\$18	Fund for subsidizing expanding the production area of priority crops ²
Develop fund for crop marketing consultation	\$250,000	\$14,726	\$-	Fund for consulting services ²
Development of market information system	\$430,000	\$430,000	\$430,000	Funds to build an electronic system to provide up-to-date pricing information for commodities for use by current staff ²
Promote formation of value-chain oriented producer organizations	\$500,000	\$29,452	\$18	Fund to induce farmers to form organizations by subsidizing start-up cost ²
Train producer organization in value-chain model	\$750,000	\$44,177	\$-	Equivalent to ~76 (country-level) and ~5 (district-level) workshops ⁴
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$318,000,000	\$19,135,882	\$436,036	
Total annual cost				
5-year cost	\$318,000,000	\$19,135,882	\$436,036	

BENEFIT

Headwind reduction	4.6%
Increased production (maize-eq. tonnes)	78,076
Cost/tonne of increased production	\$815

¹World Bank – Agro-Pastoral Productivity and Markets Development Project, Report No. 53219-B, April 2010; <http://documents.worldbank.org/curated/en/2010/04/12085777/burundi-agro-pastoral-productivity-markets-development-project>
²Plan National D'Investissement Agricole (PNIA) 2012-17; Ministère De L'Agriculture et de L'Elevage - République du Burundi; <http://www.burundi.gov/b/minagri>
³An Infrastructure Action Plan for Burundi – African Development Bank, Sep. 2009; <http://www.afdb.org/>
⁴Assuming \$9,800 per workshop; from Burundi – Institutional capacity building project, African Development Bank and Republic of Burundi, 2004; <http://reliefweb.int/sites/reliefweb.int/files/resources/F5960217A3949F0685256ED10072190D-afdb-bdi-31mar.pdf>
Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Burundi: Trade Barriers

Project Description

- Rehabilitate and improve the physical infrastructure at Burundi's border crossings
- Rehabilitate Bujumbura airport and add a refrigerated terminal to allow for the transport of fragile agricultural products
- Improvements to the merchant fleet and Lake Tanganyika port infrastructure
- Capacity building in the Ministry of Trade and Industry and the Bureau of Standards
- Equipment upgrades and communication improvements to facilitate faster border crossing and custom enforcement

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Modernize port-of-entry infrastructure (per border crossing)	\$3,200,000	NS ¹	NS ¹	Upgrade port-of-entry equipment and structures at 10 land crossings ²
Road & bridge rehabilitation (per border crossing)	\$30,000,000	NS ¹	NS ¹	Construction costs for road and bridge rehabilitation near overland border crossings ²
Number of primary overland border crossings	10			
Overland port of entry upgrades	\$332,000,000	NS¹	NS¹	
Modernize port infrastructure (Lake Tanganyika)	\$9,000,000	NS ¹	NS ¹	National Agriculture Investment Plan – Burundi (PNIA) ²
Increase merchant fleet capacity ²	\$75,000,000	NS ¹	NS ¹	Equivalent to as many as 75 ships with a combined capacity of 112,500 tons ³
Rehabilitate merchant fleet	\$10,000,000	NS ¹	NS ¹	Fund for repairs and upgrades to current transport ships operated by several private firms ²
Bujumbura airport improvements	\$5,000,000	NS ¹	NS ¹	General airport improvements (i.e. terminal, runway, and support structures rehabilitation) & construction of a new refrigerated terminal ²
Improvements and capacity building in the Burundi Bureau of Standards ²	\$6,000,000	NS ¹	NS ¹	Equivalent to 123 workshops (25 people each) and 277 out-of-country training courses over 5 years ⁴
Establish system of "Calibration/ Standards monitoring and evaluation"	\$15,000,000	NS ¹	NS ¹	Staff and consultation cost to develop import and export standards ¹
Capacity building in the Ministry of Trade and Industry	\$5,000,000	NS ¹	NS ¹	Increase capabilities and professionalism. Cost are equivalent to 102 workshops (25 people each) and 231 out-of-country training courses over 5 years ⁴
International policy development for Lake Tanganyika trade	\$600,000	NS ¹	NS ¹	Travel and staff costs for policy negotiations with neighboring countries in the lake region ²
Communication improvements	\$1,700,000	NS ¹	NS ¹	Multinational Project to Develop Roads and Facilitate transport on the north-south corridor – Phase III ⁵
Project support and contingency (entire trade Program)	\$1,500,000	NS ¹	NS ¹	Funds for additional staff and cost overruns ²
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$460,800,000	NS ¹	NS ¹	
Total annual cost	\$-	NS ¹	NS ¹	
5-year cost	\$460,800,000	NS¹	NS¹	
BENEFIT				
Headwind reduction	1.7%			
Increased production (maize-eq. tonnes)	28,596			
Cost/tonne of increased production	\$3,223			

¹Cannot be scaled to the village or district level

²Plan National D'Investissement Agricole (PNIA) 2012-17; Ministère De L'Agriculture et de L'Elevage - République du Burundi; <http://www.burundi.gov.bj/minagri>

³Lake Partners' Analysis. Based on the capacity of the MV Teza built by Bitalc (<http://www.bitalc.net/gba/teza>) at a cost of \$1M (<http://www.mongel.com/news/301/ark-ky-nyove-burundi-gemoshio>)

⁴Assuming \$9,800 per workshop and \$17,200 for travel, tuition & stipend for out-of-country trainings; costs and mix of workshops and international trainings: from Institutional capacity building project, African Development bank and

Republic of Burundi, 2004 <http://reliefweb.int/sites/reliefweb.int/files/resources/E990217A3999F68256FD10728DD4f4b43-31mar.pdf>

⁵Multinational (Burundi/Rwanda) Project to Develop Roads (Mugira-Mabanda-Lake Nyanza and Rubavu-Gisiza) and Facilitate transport on the north-south corridor – Phase III, African Development Fund, Mar 2012.

<http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/MULTINATIONAL%20BURUNDI-RWANDA%20-AR%20-%20Project%20to%20develop%20roads%20and%20facilitate%20transport%20on%20the%20North-South%20corridor%20-%20Phase%20III.pdf>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

GHANA



Ghana: Market Access

Project Description

- Construction & rehabilitation of rural markets and access roads
- Local capacity building to promote long-term infrastructure maintenance

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
One-time costs per market				
Road construction cost	\$26,078	\$26,078	\$26,078	Average: 2.16 km of road @ \$12,100/km
Village track & trail construction	\$8,968	\$8,968	\$8,968	Average: 1.08 km of road @ 8,300/km
Marketplace infrastructure	\$40,136	\$40,136	\$40,136	
Warehouse	\$1,001	\$1,001	\$1,001	5-ton capacity
Agro-processing facility	\$1,613	\$1,613	\$1,613	Average cost of corn mill (\$1,085) and cassava processing facility (\$2,140)
Total one-time cost per market	\$77,795	\$77,795	\$77,795	
Annual costs per market				
Road maintenance	\$216	\$216	\$216	Average: 2.16 km of road @ \$100/km
Track & trail maintenance	\$81	\$81	\$81	Average: 1.08 km of road @ \$81/km
Market improvements & cleaning materials	\$533	\$533	\$533	
Agro-processing maintenance	\$54	\$54	\$54	
Total annual cost per market	\$884	\$884	\$884	
Total one-time cost per market (from above)	\$77,795	\$77,795	\$77,795	
Number of new markets	611	61	1	Increasing rural market density to Senegal-level ^{2,3}
Total annual infrastructure costs	\$540,102	\$54,010	\$884	
Total one-time infrastructure costs	\$47,546,309	\$4,754,631	\$77,795	
Capacity building cost				
District assembly training	\$1,250,000	\$125,000	\$11,364	Training 110 district assemblies in administration, financial project management, planning & budgeting
Area council training	\$1,250,000	\$125,000	\$20,833	Training 60 area councils in administration & management
Community representative training	\$1,500,000	\$150,000	\$260	Training local community representatives on market operations management
NGO training	\$1,250,000	\$125,000	\$7,184	Involving local NGOs in assisting in market performance
Total one-time capacity building costs	\$5,250,000	\$525,000	\$39,641	
Annual area council training	\$208,333	\$20,833	\$20,833	Annual training of 10 area councils
TOTAL COSTS				
Total one-time cost	\$52,059,946	\$5,205,995	\$116,231	
Total annual cost	\$748,435	\$74,844	\$21,717	
5-year cost	\$55,802,121	\$5,580,215	\$224,816	
BENEFIT				
Headwind reduction	0.3%			
Increased production (maize-eq. tonnes)	36,670			
Cost/tonne of increased production	\$304			

¹World Bank – Village Infrastructure Project: http://www.worldbank.org/external/afsa/AMDS/Screen/Screen/MSB/8/2015/02/18/00000103_2015021813222/Bookbox/315/31016.pdf

²USAID/Hieffer Project Info: <http://www.wfp.org/usaid/hieffer-project-info>

³Trading Economics: <http://www.tradingeconomics.com/ghana/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

MALAWI



Malawi: Soil Erosion

Project Description

- Reduce soil erosion by increasing extension to farmer groups, teaching conservation agricultural techniques, and community-based dambo (wetland) management
- Also builds agroforestry and river-bank management to prevent increased runoff/degradation
- This intervention targets a reduction of soil loss from 20 tonnes/ha/year to 6 tonnes/ha/year (low-mid European country average)

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Number of farmer's groups for outreach ²	6,400	114	NS ¹	
Cost per group of increased outreach ²	\$500	\$500		Cost of hiring and training short-term extension staff for farmer outreach ³
Outreach costs	\$3,200,000	\$114,286	NS¹	
Land targeted to switch to conservation ag	260,000	9,285	NS ¹	
Cost/Ha to switch to conservation ag ³	\$150	\$150	NS ¹	Cost of training sessions to promote conservation ag techniques (e.g., water harvesting) ³
Total conservation ag costs	\$39,000,000	\$1,392,857	NS¹	
Land converted to agroforestry (Ha) ²	140,000	5,000	NS ¹	Purchase seeds/seedlings & inputs for farmers to switch to agroforestry on fragile/degraded land
Cost/Ha to move to agroforestry ²	\$500	\$500	NS ¹	Cost of seeds/seedlings & inputs ²
Increasing Ha under agroforestry	\$70,000,000	\$2,500,000	NS¹	
Number of 10 Ha dambos (wetlands) under protection	540	19	NS ¹	
Cost per dambo ²	\$400	\$400	NS ¹	Cost of extension services to enlist community involvement in dambo (wetland) management ²
Total cost of dambo management	\$216,000	\$7,714	NS¹	
Kilometers of river bank protected	2,800	100	NS ¹	
Cost/km of river bank ^{3,4}	\$580	\$580	NS ¹	Cost of extension services, building new policy guidelines, and monitoring activities to protect river banks ^{3,4}
Total cost of river bank degradation prevention	\$1,624,000	\$58,000	NS¹	
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$114,040,000	\$4,072,857	NS ¹	
Total annual cost	\$-	\$-	NS ¹	
5-year cost	\$114,040,000	\$4,072,857	NS¹	

BENEFIT

Headwind reduction	0.4%
Increased production (maize-eq. tonnes)	24,986
Cost/tonne of increased production	\$ 913

¹Not scalable to the village level

²Malawi's Agriculture Sector-Wide Approach (ASWA) p: <http://www.coadh.net/inf/investments/000/000000/Malawi.pdf>

FAO - Plan of Action for Malawi: <http://www.fao.org/filestore/land/2014/1400002/Malawi.pdf>

³World Bank - Shire River Basin Management Program: <http://www.worldbank.org/projects/P117617/malawi-shire-river-basin-management-project?lang=en>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Malawi: Resilience to Drought

Project Description

- Teach drylands farming techniques such as soil moisture and drought crop management or no-till farming
- Provide training to villagers and local government officials in water conservation, community organizing, and drought monitoring
- This intervention is similar to Botswana's "Water Resource Management" program

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Local government drylands training (per extension section) ¹	\$7,900	\$7,900	\$7,900	<i>Instruct government officials in water management and conservation and drought monitoring</i>
Village volunteer drylands training (per extension section) ¹	\$2,000	\$2,000	\$2,000	<i>Instruct local townspeople in water conservation and drought monitoring</i>
Cost of local training sessions per extension section	\$9,900	\$9,900	\$9,900	
Number of extension sections in Malawi ^{2,3}	2,554	91	<1	<i>Extension section = range of 1 extension officer</i>
Total cost of local training sessions	\$25,284,500	\$900,900	\$9,900	
Dryland farming field school instruction (one year) ⁴	\$36,948,087	\$6,597,972	\$5,564	<i>Cost of travel, stipend, and curriculum materials to give one class per year to all farmers⁴</i>
Years of intervention	5	5	5	
Total farmer field school costs	\$184,740,433	\$32,989,860	\$27,820	
Dryland farming field school setup & training (one-time cost) ⁴	\$22,926,158	\$818,791	\$8,977	<i>Cost of instructor training & curriculum development⁴</i>
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$ 232,951,191	\$8,319,685	\$46,697	
Total annual cost	\$-	\$-	\$-	<i>5 seasons of farmer field schools are counted as one-time costs</i>
5-year cost	\$ 232,951,191	\$8,319,685	\$46,697	
BENEFIT				
Headwind reduction	1.0%			
Increased production (maize-eq. tonnes)	59,518			
Cost/tonne of production	\$783			

¹South Eastern Dry Areas Project—Republic of Zimbabwe Loan Proposal; IFAD, September 1995: <http://ocw.mit.edu/doc/ocw/mit/06/315112/D1/E/201.pdf>

²Modernizing Extension and Advisory Services (MEAS): Strengthening Ruralist Agricultural Extension in Malawi: http://www.afes.africa.org/media/ro/crops/publications/mess_country_report_malawi_-_jan_2012.pdf

³Digby, P.W., Measuring the size of the rural population in Malawi, Statistical Services Centre (SSC) of the University of Reading, UK: 2000; <http://www.rdg.ac.uk/~ssm045.pdf>

⁴Cost structure from extension component of optimal crop choice intervention

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Malawi: Women Farmers

Project Description

- Promotes equitable involvement of women in all sectors of ag-based economy: value chains, extension services, microfinance, farmer's groups, equitable land tenure, ag leadership, and use of advanced farming techniques and inputs
- Based on Malawi's Ag Sector Gender, HIV and AIDS Strategy Plan, 2012

	Country-Level	District-Level	Village-Level	Notes (descriptions from Malawi ASWAp ²)
Promote optimal high nutrition crops	\$1,400,000	\$50,000	NS ¹	Provide high-nutritive crops & nutrition education
Ensure fairness in input distribution programs	\$1,200,000	\$42,857	NS ¹	Policy development for enforcing guidelines on transparency & participatory fairness
Encourage improved technologies & techniques	\$500,000	\$17,857	NS ¹	Improve extension to promote improved technology/technique use
Improved targeting of women in extension services	\$300,000	\$10,714	NS ¹	Build enforceable guidelines for equitable extension delivery
Promote women's participation in value chain	\$120,000	\$4,286		Increase outreach to encourage women to become commercially oriented
Extension officer capacity building	\$350,000	\$12,500		Train extension officers on group and enterprise management to help women grow commercially
Formation of women's groups	\$250,000	\$8,929	NS ¹	Outreach to women to build groups and provide links to service providers
Gender awareness campaigns	\$300,000		NS ¹	Conduct awareness campaigns on the importance of women's participation in decision-making
Integrate gender awareness into ag policies & programs	\$180,000	\$180,000	NS ¹	Build gender issues into current training programs
Stakeholder gender-focused programing	\$1,400,000	\$50,000		Train local women in leadership, assertiveness, and decision-making
Facilitate linkages between women & microfinance	\$175,000	\$175,000	NS ¹	Outreach campaign to improve vulnerable women's access to financial services & lobby lenders to become gender-responsive
Improve women's land tenure	\$300,000	\$300,000	NS ¹	Write new policies to make legal framework of land tenure more equitable
Encourage women in leadership roles	\$550,000	\$550,000	NS ¹	Implement interventions to increase women in policy & decision-making roles
Establish an information sharing platform	\$175,000	\$175,000	NS ¹	Website construction costs
Staff costs	\$100,000	\$100,000	NS ¹	Hire 3 staff members (1 coordinator and 2 technical assistants) for 5 years
TOTAL COSTS				
	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$7,700,000	\$2,087,857	NS ¹	
Total annual cost	\$-	\$-	NS ¹	
5-year cost	\$7,700,000	\$2,087,857	NS¹	

BENEFIT

Headwind reduction	0.7
Increased production (maize-eq. tonnes)	41,828
Cost/tonne of increased production	\$37

¹Malawi's Ag Sector Gender, HIV, and AIDS Strategy, 2012: <http://www.mogf.mw.gov.mz/ceconf/docs/ficconf%20Home/Gender%20HIV%20and%20AIDS%20Strategy%20Final.pdf>
²Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

RWANDA



Rwanda: Commodity Reserves

Project Description

- Develop a Strategic Grain Reserve (SGR) consisting of both a physical (60K tonnes of grain) and cash (\$6.7M) component
- Build and maintain ~ 60,000 tonnes of storage in multiple locations throughout the country
- Hire staff to oversee the program including stock maintenance through “purchase, recycling, and release” of stocks

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Metal silo construction (per site)	\$ 2,295,082	\$2,295,082	NS ¹	10,000 MT capacity; \$1,147,541 x 2 silos per site ²
Warehouse construction (per site) ²	\$901,639	\$901,639	NS ¹	
Grain dryer (per site) ³	\$135,000	\$135,000	NS ¹	Drying rate of 50 MT/Hr
Number of sites	3	1	NS ¹	
Storage sites construction cost	\$9,995,164	\$3,331,721		
Amount of grain needed (tonnes)	60,478	12,096	NS ¹	Amount of grain required to feed the food insecure (26% of the population) for three months ⁵
Average grain price (per tonne) ²	\$333	\$333	NS ¹	
Grain reserve purchase	\$20,126,380	\$4,025,276		
Cash reserves	\$6,708,793	\$1,341,759	NS ¹	Cash reserves are equivalent to the food supply (20K tonnes) required to feed the food insecure (26% of the population) for one month
Total reserve cost	\$26,835,173	\$5,367,035		
Annual maintenance contract (per site) ²	\$114,754	\$114,754	NS ¹	
Number of sites	3	1	NS ¹	
Annual maintenance cost	\$344,262	\$114,754		
Stock inspection officer (per year)	\$2,164	\$2,164		Staff paid at average government wage rates ⁴
Number of officers	6	2		
Annual stock inspection officer cost	\$12,984	\$4,328		
Market analyst position (per year)	\$4,918	\$4,918		Staff paid at average government wage rates ⁴
Number of analysts	2	1		
Annual market analysts cost	\$9,836	\$4,918		
Admin/Accounting position (per year)	\$3,934	\$3,934		Staff paid at average government wage rates ⁴
Number of Admin/Accounting positions	3	1		
Annual Admin/Accounting cost	\$11,803	\$3,934		
Program Manager (per year)	\$10,584	\$10,584		Staff paid at average government wage rates ⁴
Annual staffing/program support	\$45,207	\$23,764	NS¹	
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$36,830,337	\$8,698,756	NS ¹	
Total annual cost	\$389,469	\$138,518	NS ¹	
5-year cost	\$38,777,682	\$9,391,346	NS¹	

BENEFIT

Headwind reduction	0.1%
Increased production (maize-eq. tonnes)	3,063
Cost/tonne of increased production	\$2,532

¹Does not scale to the village level

²National Post-Harvest Staple Crop Strategy—Ministry of Agriculture and Animal Resources, Rwanda, Mar 2011: <http://amis.mimnet.gov.rw/content/national-crosthaveststaple-crosthawey>

³Retail price of one Brak SQ series horizontal dryer: <http://www.brocksgain.com/>

⁴Rwanda Public Sector pay and Retention Policy and Implementation Strategy, Ministry of Public Service and Labour, Rwanda, June 2012: <http://www.milista.gov.rw/fileadmin/templates/downloads/IMPLEMENTATION.pdf>

⁵Lake Partners Analysis

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Rwanda: Water Resources Management

Project Description

- Taken from the Rwandan government's 5-year *Water Resources Management Sub-Sector Strategic Plan*¹
- The most relevant interventions from the strategic plan are priced below
- Plan utilizes an Integrated Water Resources Management (IWRM) approach to overhauling Rwanda's water management regime
- As defined, the program is not scalable below the country-level

OUTCOMES	Costs	Key Activities ¹
1. Effective Water Governance framework that reflects the principles of Integrated Water Resource Management (IWRM) developed and operationalized	\$7,578,550¹	
1.1: Adequately-resourced and effective national WRM Directorate	\$965,800 ¹	Ministry of Natural Resources (MINIRENA) will: (1) Conduct institutional reform of the water Sub-sector and review the functional structure of water resource management (WRM) and other Public Agencies & (2) Review WRM functions in decentralized government structures (district-level) and assess their appropriateness
1.2: A Water Resources Development and Management Master plan in place and being implemented	\$1,117,000 ¹	MINIRENA will (1) Develop the National Water Resources Development Master plan; (2) Organize stakeholders' workshops on master plan implementation; (3) Organize roundtable meetings to mobilize resources for implementation of the Master plan
1.3: Operational Water Catchment and Sub-catchment management plans;	\$1,270,000 ¹	MINIRENA will (1) Delimit sub-basins and key catchments for purposes of water resources protection/conservation and management; (2) Mobilize and sensitize local communities, leaders and stakeholders on catchment and sub-basin management approaches, roles and responsibilities; (3) Facilitate the establishment of catchment & sub-catchment committees; (4) Facilitate the catchment & sub-catchment planning processes
1.4: Inclusive and effective WRM sub-sector coordination and monitoring mechanism	\$1,194,750 ¹	MINIRENA & the Ministry of Finance (MINECOFIN) will (1) establish & operationalize the Inter-Ministerial Committee on IWRM; MINIRENA will also (2) Procure Technical Assistance in water sector planning and coordination; (3) Carry out training/skills development workshops for technical, planning and finance units of water related Ministries and Agencies
1.5: Harmonized sectorial and cross-sectorial policies and plans	\$869,000 ¹	MINIRENA will (1) Review and harmonize water-related policies and plans; (2) Organize policy and legislation harmonization workshops for policy makers in water-related ministries, agencies and other relevant institutions; (3)
1.6: Legal and regulatory framework supportive to IWRM	\$389,000 ¹	MINIRENA will (1) Review and harmonize water-related laws and regulations; (2) Support districts to develop regulations and bylaws for IWRM
1.7: Operational public – private partnership arrangements for WRM	\$812,000 ¹	Ministry of Trade and Industry (MINICOM) will (1) Organize mobilization, sensitization and partnership development workshops for private sector stakeholders in WRM & (2) Develop and implement PPP strategy and implementation plan. MINIRENA will (3) Provide advocacy and skills training workshops for private sector representatives in corporate social and environmental responsibility issues related to water resources & (4) Organize study visits, exhibitions and other events to promote private sector participation and responsibility in sustainable WRM
1.8: Community and civil society effectively participate in WRM activities;	\$195,000 ¹	MINIRENA will (1) Review and map organization and operations of existing water user groups/associations in all sectors
1.9: Effective mechanism for adequate and sustainable financing for WRM;	\$320,000 ¹	MINECOFIN & MINIRENA will (1) Develop and discuss a water sub-sector investment plan; (2) Organize round table meetings for WRM financing; (3) Organize budget advocacy and awareness raising workshops for WRM financing; (4) Establish a National Water Fund and develop innovative mechanisms for generating and managing non-budget water revenue
1.10: An effective communication strategy in place and implemented	\$355,000 ¹	MINIRENA will (1) Develop a public education and awareness plan for WRM; (2) Publish a biannual newsletter; (3) Prepare and publish biennial National Water Resources status report
1.11: An effective strategy to promote ICTs applications in WRM in place and implemented	\$91,000 ¹	Ministry of Infrastructure (MININFRA) will ensure that ICT solutions are promoted in WRM activities

¹Water Resources Management sub-sector Strategic Plan (2011-2015), Ministry of Natural Resources, Dec 2011: http://mna.gov.rw/index.php?option=com_content&view=article&id=27&Itemid=27&lang=fr or http://mna.gov.rw/index.php?option=com_content&view=article&id=27&Itemid=27&lang=fr&Itemid=27&lang=fr

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Rwanda: Water Resources Management

Project Description

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OUTCOMES	Costs	Key Activities ¹
2. Cost-effective Water Resources Assessment and Monitoring System in place and operational	\$4,967,000	
2.1: Updated hydrological database and Water Resources Information System	\$2,719,000 ¹	MINIRENA will (1) Inventory existing hydrological infrastructure and assess their appropriateness and functionality; (2) Review existing water resources data and information system; (3) Conduct national water resources assessment (quality and quantity); (4) Develop capacity of local and national IWRM institutions in water resources data collection, reporting and monitoring;
2.2: Water quantity and quality status reports regularly published	\$560,000 ¹	MINIRENA will (1) Determine water balance in all watersheds & catchments; (2) Prepare & publish annual water quality and quantity reports
2.3: Water quality standards established, communicated and enforced	\$260,000 ¹	MINIRENA will (1) Develop and publish national water quality standards and sensitize WRM stakeholders; (2) Establish at least two nationally accredited water quality laboratories
2.4: Strategy for assessment, exploitation and monitoring of geothermal water resources developed and implemented;	\$300,000 ¹	MININFRA will (1) Conduct mapping of hot springs and other geo-thermal water sites; (2) Develop a thermal exploration, development and conservation strategies that include social and environmental safeguards; (3) Develop a regulation and monitoring plan for geothermal development activities
2.5: Point-source pollution of all major water resources controlled	\$1,128,000 ¹	Ministry of Agriculture and Animal Resources (MINAGRI) and MINIRENA will (1) Formulate and enforce pollution control guidelines for pesticides and fertilizer applications; the Rwandan Environmental Management Authority (REMA) & Ministry of Education will (2) Formulate and enforce guidelines for waste management for educational, health and other institutions; MINIRENA & MININFRA will (3) Ensure that municipal and other solid waste management plans avoid pollution of surface and ground water sources; MININFRA will (4) Put in place mechanisms to ensure all waste are treated before disposal; REMA will (5) see to the enforcement of polluter pays principle & (6) Ensure regular environmental audits and follow-up of Environmental Management
3. Efficient and Equitable Water Allocation and Utilization framework	\$ 7,758,750	
3.1: Sectoral plans for water demand and utilization in place and integral part of sectoral planning;	\$420,000 ¹	MINIRENA will (1) Clarify water use rights and obligations for different users including upstream-downstream relations; the Rwandan natural resources authority (RNRA) will (2) Organize national sensitization and awareness raising programs on raw water allocation and water use regulations; all water related Ministries will (3) Prepare & submit sectoral water requirement and utilization plans
3.2: Catchment-based Water Allocation Master plan reflecting rights and obligations of water users developed, disseminated and in use;	\$1,245,000 ¹	MINIRENA will (1) Develop expertise in the potential and limitations of water resources; (2) Develop and implement a Water Allocation Master Plan; RNRA & the Energy, Water and Sanitation Authority (EWASA) will (3) Prepare and publish annual water allocation and utilization reports
3.3: An incentive structure to Promote water use efficiency and conservation in place and operational;	\$4,195,000 ¹	MINIRENA will (1) Establish baselines and standards for water use efficiency in various sectors; (2) Develop and implement a package of incentives for promoting water utilization efficiency; MININFRA will (3) Ensure proper operation and maintenance procedures/plans during inspections of water supply systems to reduce water losses; (3) Review water pricing mechanisms to increase incentives for efficient service water Delivery
3.4 Rainwater harvesting promoted and adopted	\$1,898,750 ¹	MINIRENA & MININFRA will (1) Undertake rain water harvesting promotion activities for all households, institutions and production activities; MININFRA will (2) Develop guidelines and regulations for rainwater harvesting, including recommendations on appropriate technologies, and provide demonstrations and training for local artisans to build adequate infrastructure for harvesting rainwater

¹Water Resources Management sub-sector Strategic Plan (2011-2015), Ministry of Natural Resources, Dec 2011: http://mna.gov.rw/index.php?doc=27&tx_armfiledownload_file%5Barmfiles%5D=Rwanda-Waterstrategy-04062011-final-1006-corrected1406.pdf&tx_armfiledownload_file%5Baction%5D=download&tx_armfiledownload_file%5Bcontroller%5D=Armfiles&cHash=3da47a2e0a8a8767fab56260a5255d6

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Rwanda: Water Resources Management

Project Description

- Taken from the Rwandan government's 5-year *Water Resources Management Sub-Sector Strategic Plan*¹
- The most relevant interventions from the strategic plan are priced below
- Plan utilizes an Integrated Water Resources Management (IWRM) approach to overhauling Rwanda's water management regime
- As defined, the program is not scalable below the country-level

OUTCOMES	Costs	Key Activities
4. Effective framework for management of shared waters	\$2,657,750	
4.1: Trans-boundary Water Cooperation framework in place and integrated into the Country's international relations and regional integration strategies;	\$279,750 ¹	MINIRENA will (1) Prepare and discuss position papers and policy briefs on Rwanda's position and programs on shared waters; (2) Develop a National Water Cooperation Framework; (3) Publish and disseminate simplified versions of the International Fresh Water Agreements and Protocols to which Rwanda is signatory; the Ministry of Foreign Affairs and Cooperation (MINAFFET) will (4) Organize training and sensitization workshops for Rwanda diplomats and staff of regional cooperation and foreign affairs ministries; (5) Develop a national guide on shared waters for Rwandan Diplomatic offices, Foreign and Regional Cooperation Ministries/ Agencies
4.2: National policies, legislation and institutional arrangements harmonized with those of other riparian countries	\$447,500 ¹	MINIRENA will (1) Commission studies to review legislation and policy instruments for Rwanda and other countries in the NBI, LVBC and CPEGL zones; (2) Organize stakeholder dialogue sessions on harmonization process; (3) Study visits for technical staff and political leaders to other countries to study best practices on trans-boundary WRM; (4) Consolidate and simplify policy and legislative instruments for National Trans-boundary Water Governance
4.3: Rwanda effectively participates in the Nile, Congo, Kagera and Victoria Basin cooperation and management frameworks	\$1,930,500 ¹	MINIRENA will (1) Organize training and skills development programs in international water law, international negotiations and communication; (2) Organize and participate in regional WRM meetings and activities; (3) Organize regular dialogue engagements with regional basin-wide cooperation bodies, especially those hosted in Rwanda; (4) Training and sensitization of relevant border district and community leaders in International water cooperation and joint monitoring; (5) Develop pilot collaborative community micro-projects for Trans-boundary WRM (Akanyaru, Muvumba, Ruzizi and Kagera); (6) Consolidate and scale up national programs for protection of international waters in line with International Law
5. Basic capacities developed and Effective framework for WRM Capacity Development and Knowledge Management in place	\$5,503,500	
5.1: Plan and budget for continuous WRM skills improvement and institutional capacity development;	\$487,500 ¹	MINIRENA will (1) Strengthen the analytical and modelling capacity of WRM agencies and ministries
5.2: Universities and training institutions have adequate capacity to train WRM experts, technicians and researchers;	\$3,040,000 ¹	MINEDUC will (1) Provide technical assistance to selected national universities and institutions to review curriculum and develop relevant educational programs for WRM researchers, technical experts and technicians; MINEDUC and MINIRENA will (2) create partnership arrangements in WRM training, policy analysis and other services
5.3: Adequate WRM expertise among local service providers	\$135,000 ¹	MINIRENA will develop and implement a capacity building plan for local WRM service providers
5.4: Applied Research Fund in place and includes mechanisms to promote WRM research	\$825,000 ¹	MINIRENA & MINEDUC will create a strategy for promoting research, learning and knowledge management
5.5: Documentation and sharing of lessons and good practices from WRM program and related activities	\$516,000 ¹	REMA & MINIRENA will (1) Document and share lessons from the ecosystems rehabilitation and water quality improvement programs; MINIRENA will (2) Document and disseminate lessons on adoption and impact of innovative water efficiency technologies (rainwater harvesting, waste water recycling and reuse) & develop plan for cost-effective scale-up
5.6: WRM Information exchange program;	\$500,000 ¹	MINIRENA will develop a regional and International Knowledge and Information exchange program for WRM institutions
TOTAL COSTS		
5-year cost (all cost are one-time)	\$28,465,550	
BENEFIT		
Headwind reduction	1.5%	
Increased production (maize-eq. tonnes)	39,305	
Cost/tonne of increased production	\$145	

¹ Ministry of Natural Resources, Dec 2011: http://mna.gov.rw/index.php?id=27&tx_armfiledownload_file%5Barmfiles%5D=Rwanda-Waterstrategy_04062011-final_1006-corrected1406.pdf&tx_armfiledownload_file%5Baction%5D=download&tx_armfiledownload_file%5Bcontroller%5D=Armfiles&cHash=3da47a2e0a8a8767fca56260a5255d6

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

SOUTH AFRICA



South Africa: Road Condition

Project Description

- Paving gravel roads & annual maintenance

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Cost to pave a road (\$/km) ¹	\$149,226	\$149,226	\$149,226	Includes purchasing of equipment and labor costs
Annual maintenance cost of new road (\$/km) ¹	\$4,251	\$4,251	\$4,251	
Length of roads to pave (km) ²	28,277	3,142	10	Increasing from 17.3% to 32.6% of provincial roads paved (Botswana-level ³)

TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$4,219,632,011	\$474,814,733	\$1,427,914	
Total annual cost	\$120,194,720	\$13,354,969	\$40,677	
5-year cost	\$4,820,605,611	\$541,589,577	\$1,631,299	

BENEFIT

Headwind reduction	2.6%
Increased production (maize-eq. tonnes)	328,880
Cost/tonne of increased production	\$2,932

¹African Development Bank - Rural Roads II Project: <http://reporting.africadevbank.org/finance/updates/fin/Document/Policy/Reports/05242014/05242014-ROADS-PROJECT.PDF>

²Development Bank of Southern Africa: <http://www.dbsa.org/Research/Documents/DPSA%20State%20of%20Asias%20Economic%20Infrastructure%20Report%20012.pdf>

³International Road Federation: <http://data.worldbank.org/indicator/IS.RD.PAVE.ZS>

⁴The Africa Report: <http://www.theafricareport.com/EachItem/Africa/infrastructure-wards-against-chinese-expectations.html>

⁵FAO: <http://www.fao.org/dataset/0524/052405.htm>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

South Africa: Cultural Heterogeneity

Project Description

- Empowering cultural minorities by helping them organize into groups and strengthening their collective power
- Through organization, minorities have a stronger voice to become commercially oriented and demand extension services¹
- Original Ugandan program was very successful and had high penetration²
 - 55,000 new organizations were formed, and in nearly every subcounty
 - Farmers who were members of new organizations were 40% more likely to access training and advisory services and 20% more likely to access credit or subsidies
 - Poor smallholders saw the largest gains wealth generation – a 45% increase in wealth per capita compared with nonmembers

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Total number of SAF farmers ³	1,154,000	128,222	100	
Number of farmers per organization	17	17	17	Ugandan number of farmers per organization (172) scaled to smallholder farm sizes of Uganda vs. South Africa (10:1)
Number of organizations	67,882	7,542	6	
Cost per farmer organization ^{1,2}	\$875	\$875	\$875	Cost of hiring "group promoters" (each monitoring 5 groups) to help groups organize and become self-sufficient; topics include: governance, group enterprise & marketing, financial planning, & gender/poverty issues
Total cost of building farmer organizations	\$59,396,750	\$6,635,523	\$20,211	

TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$59,396,750	\$6,635,523	\$20,211	
Total annual cost	\$ -	\$ -	\$ -	
5-year cost	\$59,396,750	\$6,635,523	\$20,211	

BENEFIT	
Headwind reduction	0.7%
Increased production (maize-eq. tonnes)	80,277
Cost/tonne of increased production	\$148

¹WorldBank—NAADS PhaseII: http://www.worldbank.org/external/default/MDSCenterServer/MDSP/0/2010/08/17/000333138_2100811010210/Revised/E0F/0R42/031/521/0/Headwind18191101.pdf

²WorldBank—NAADS PhaseII: http://www.worldbank.org/external/default/MDSCenterServer/MDSP/0/2010/05/03/000333255_2100848322218/Revised/E0F/545/0128A/031031010/Headwind021101.pdf

³FAO STAT: <http://faostat3.fao.org/>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

South Africa: Water Resources

Project Description

- Switches farmers to in-field rainwater harvesting, using no-till farming and runoff control¹ to conserve water
- Funds demonstration plots, extension officers, and grants to farmers to cover additional labor
- Increases extension and outreach services to drive adoption

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Number of farmers targeted	885,170	98,352	100	Only targeting farmers in semi-arid regions
Grants per farmer to cover new labor costs	\$16	\$16	\$16	Difference in labor cost between water harvesting & traditional methods ²
Total labor-cost grants	\$14,328,164	\$1,592,018	\$1,619	
Number of new technical assistants	2,571	286	3	3 per farmer group, consisting of 1,033 farmers ³
Cost of training & salary per technical assistant	\$92,149	\$92,149	\$92,149	Hired for 5 years (salary level 5 ⁴ : hands-on assistance to farmers with new techniques
Training and salary for new technical assistants	\$236,886,256	\$26,320,695	\$276,448	
Focus groups	\$260,512	\$28,946	\$304	\$51/group; meet with farmers pre- & post-harvest to discuss technique implementation ³
Information days	\$1,397,747	\$155,305	\$1,631	\$181/info day; local outreach event to sell farmers on new techniques on research plot ³
Extension officer training workshops	\$2,795,495	\$310,611	\$3,262	\$1,631/workshop; 3-day workshop to train extension officers on how to teach new technique ³
Community water festivals	\$1,863,663	\$207,074	\$2,175	\$2,175/festival; local 4-day event to drive adoption ²
Regional outreach events	\$48,935	\$5,437	\$5,437	\$604/regional event; 1-day outreach event ³
National outreach event	\$3,625	\$3,625	\$3,625	2-day outreach event ³
Total cost of outreach & training events	\$6,369,977	\$721,872	\$12,810	
Cost of national level administrative staff	\$780,629	\$780,629	\$780,629	8 staff @ \$19,516/year (salary level 7) ⁴ : hired for 5 years
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$258,332,403	\$29,404,340	\$887,721	
Total annual cost	\$-	\$-	\$-	
5-year cost	\$258,332,403	\$29,404,340	\$887,721	
BENEFIT				
Headwind reduction	0.7			
Increased production (maize-eq. tonnes)	77,107			
Cost/tonne of increased production	\$670			

¹Denotes any earthen (eg, grade control structure) or vegetal (eg, buffer strip) construct to control runoff and erosion that are compatible with the physical conditions, crop(s) and equipment utilized by farmers
 Baha et al. (2003): <http://www.waters.org.za/Knowledge%20Hub%20Documents/Research%20Reports/1176103.pdf>
 Baha et al. (2007): <http://www.waters.org.za/Knowledge%20Hub%20Documents/Research%20Reports/119201313/Website.pdf>
⁴South African public service employee pay scale: <http://www.westerncape.gov.za/ewf/2013/May/salariescales2013.pdf>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

TANZANIA



Tanzania: Access to Capital

Project Description

- Improves access to credit for rural farmers in Tanzania
- Based on a Tanzania-based World Bank program that includes:
 - Training bank officials on better risk assessment & rural outreach
 - Helping banks offer better financial products (e.g., warehouse receipts & weather insurance)
 - Transforming microfinance NGOs into licensed lending organizations
 - Supporting growth of new microfinance institutions
 - Linking formal urban finance institutions to semi-formal rural microfinance institutions
- This intervention targets an increase in rural Tanzanians with access to credit from 12% to 50%

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Size of rural ag population (15-64) ³	16,114,637	619,794	NS ¹	
% of rural ag population farming full time ³	48.9%	48.9%	NS ¹	
Targeted increase in rural farmers with access to credit ^{4,5}	38%	38%	NS ¹	Increase of rural Tanzanians with access to credit from 12% to 50% (S. American/SE Asian average)
Loans required to reach target	2,994,420	115,170	NS ¹	
Cost per loan issued ²	\$88.38	\$88.38	NS ¹	Includes bank official training on risk assessment & rural outreach, helping banks offer better financial products, transforming microfinance NGOs to licensed institutions, building new institutions, and linking formal urban banks to microfinance lenders
Total cost of program	\$264,646,637	\$10,178,717	NS¹	

TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$264,646,637	\$10,178,717	NS ¹	
Total annual cost	\$-	\$-	NS ¹	
5-year cost	\$264,646,637	\$10,178,717	NS¹	

BENEFIT	
Headwind reduction	0.7%
Increased production (maize-eq. tonnes)	88,214
Cost/tonne of increased production	\$600

¹Not scalable to the village level

²Cost of program = \$42M / (# of loans issued 423K) – World Bank – Tanzania Private Sector Competitiveness Project: <http://documents.worldbank.org/curator/en/2015/11/64491811400014810001/tanzania-private-sector-competitiveness-project>

³Tanzania 2007/8 Ag Census Gap Report: http://www.rpbs.gov.tz/ris/ris/Ag200708/Gaps_National_Report21a

⁴MF Transparency: <http://www.mftransparency.org/wp-content/uploads/2012/05/MFTRP3108EN-Country-Survey-Tanzania.pdf>

⁵Handbook of Development Economics: <http://eprints.oxfordjournals.org/doi/pdf/10.1017/S0950080403000001>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Tanzania: Rural Electrification

Project Description

- Installs power plants, transmission lines, and distribution systems to increase total electrification rate from 18% to 75% (rural: 4% to 59%)
- Uses estimates from Tanzania's national power system master plan¹

ASSUMPTIONS	Country-Level	District-Level ²	Village-Level	Notes
Power plants	\$17,518,000,000	\$250,000,000	NS ³	29 new plants nationally, 2 plants at district level ¹
Distribution	\$6,460,000,000	\$87,912,730	NS ³	
Transmission	\$3,708,000,000	\$288,860,000	NS ³	43 systems [lines/transformers/substations] nationally, 4 transmission lines/1 transformer/1 substation at district level ¹
Inflation	\$11,329,000,000	\$256,472,884	NS ³	2012-2035 implementation schedule ¹
Interest during construction	\$1,903,000,000	\$43,081,287	NS ³	

TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$40,918,000,000	\$926,326,900	NS ³	
Total annual cost	\$-	\$-	NS ³	
5-year cost	\$40,918,000,000	\$926,326,900	NS³	

BENEFIT	
Headwind reduction	1.4%
Increased production (maize-eq. tonnes)	181,579
Cost/tonne of increased production	\$45,069

¹Tanzanian Power System Master Plan 2012: http://www.psm.gov.tz/Pdfs/0/Fess/DNNNewsDocuments/1039/1057_10072013/Power_System_Master_Plan_2012.pdf

²Scaled to the least-expensive Tanzanian province to electrify (Singida)

³Not scalable to the village level

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Tanzania: Research & Education

Project Description

- Improves undergraduate and graduate education by providing scholarships and builds capacity at major institutions
- Trains faculty, improves curriculum, purchases better equipment, rehabilitates facilities, improves coordination between major universities and small vocational schools, and provides scholarships to new students
- Targets 3 major universities with agriculture programs: Sokoine University of Agriculture, University of Dar es Salaam, and University of Bukoba

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Costs per university^{1,2,3}				
Facility rehabilitation & construction per university	12,900,000	NS ³	NS ³	Rehabilitation and construction of ~10,000 m ² of lab, teaching, and office space ²
Training of professors and staff	\$1,400,000	NS ³	NS ³	Provides scholarships for ~10 professors to attain higher-level degrees, 3 scholarships for staff ²
Improving quality & relevance of curriculum	\$1,100,000	NS ³	NS ³	Funds tailoring of curriculum to industry needs and construction of an enterprise incubation center to increase outreach to private industry ²
Project management and coordination	\$400,000	NS ³	NS ³	
Laboratory improvements & outreach to partner institutions	\$2,500,000	NS ³	NS ³	Upgrade existing lab space & outreach costs to government ag ministry and other ag institutions in-county and internationally
Grad student research funding	\$8,900,000	NS ³	NS ³	Funding for 120 graduate students (100 MSc, 20 PhD) to pursue research
Additional faculty & staff costs per university	\$363,778	NS ³	NS ³	8 professors (\$38,400 per professor ⁶), outreach coordinator (\$22,775) and program facilitator (\$33,803) at each university; 1 st year only -- subsequent annual costs are supported by tuition
Total one-time cost per university	\$27,563,778			
Number of universities targeted	3	NS ³	NS ³	Sokoine University of Agriculture, University of Dar es Salaam, and University of Bukoba
Total one-time costs	\$82,691,334			
Targeted number of new ag undergrads & grads	8,346	NS ³	NS ³	Improving ag grads to 1 st -world average
Average annual school fees/student ⁷	\$971	NS ³	NS ³	
Total annual scholarship costs	\$8,148,341	NS¹	NS¹	
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$82,691,334	NS ³	NS ³	
Total annual cost	\$8,148,341	NS ³	NS ³	
5-year cost	\$123,433,039	NS³	NS³	

BENEFIT

Headwind reduction	1.9%
Increased production (maize-eq. tonnes)	257,500
Cost/tonne of increased production	\$96

¹Total per-university costs taken from Footnotes #4 & #5

²Breakdown of subcomponent costs for African Centers of Excellence project estimated from similar Ugandan AFDB project:

[http://www.afrib.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Uganda%20-%20Support%20to%20Higher%20Education%20Science%20and%20Technology%20\(HESI\)%20Project%20-%20%20Amraisa%20Report.pdf](http://www.afrib.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Uganda%20-%20Support%20to%20Higher%20Education%20Science%20and%20Technology%20(HESI)%20Project%20-%20%20Amraisa%20Report.pdf)

³Not scalable to the village or district level

⁴World Bank – African Centers of Excellence: http://www.worldbank.org/external/dfs/h/WDCGreenSever/ANDSP/AFR/2012/03/07/5893CA0725DAB5257A/61003E25/1_0/Revised/BEF/PIDOPrintOP12697400802201201343915734039.pdf

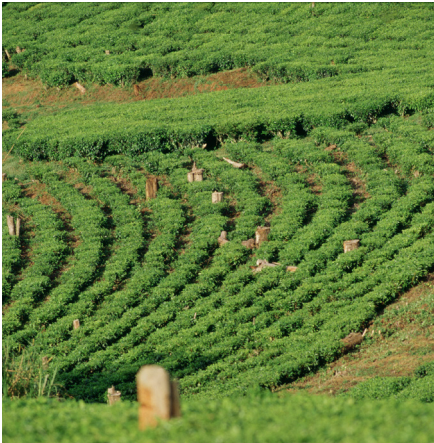
⁵AGRI Progress Report: <https://docs.google.com/file/d/0BDrzVGSBy5ZuWSR/HtQkNvTDe/edit>

⁶The East African: <http://www.theeastafrican.co.ke/news/BeyondTanzania%20at%20highest%20level%20-%202558/1521079-4-af5657z/inbcl.html>

⁷Average of Tanzanian school fees – AET-Africa: http://www.aet-africa.org/aet_handbook.pdf

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

UGANDA



Uganda: Market Access

Project Description

- Construction & rehabilitation of rural markets and access roads
- Local capacity building to promote long-term infrastructure maintenance

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Cost to build a market (\$/mkt) ²	\$73,217	\$73,217	NS ¹	
Cost to electrify a market (\$/mkt) ²	\$15,019	\$15,019	NS ¹	
Number of new markets ³	927	12	NS ¹	Increasing rural market density to Senegal-level ⁴
Market building total	\$81,815,980	\$1,058,841		
Cost to pave a road (\$/km) ²	\$6,422	\$6,422	NS ¹	
Length of paved roads (km) ³	41,725	540	NS ¹	45 km of road built per market ²
Road paving total	\$267,957,950	\$3,467,880		
Consultative workshop (per mkt)	\$3,836 ²	\$3,836 ²	NS ¹	Trains local officials in infrastructure maintenance & market operations ⁵
Number of new markets ³	927	12	NS ¹	
Capacity building total	\$3,555,972	\$46,032	NS¹	
Annual maintenance costs (\$/mkt) ^{2,3}	\$808	\$808	NS ¹	
Number of new markets ³	927	12	NS ¹	Increasing rural market density to Senegal-level ⁴
Annual market maintenance cost	\$749,016	\$9,696		
Road maintenance cost (\$/km)	\$100	\$100	NS ¹	
Length of paved roads (km) ³	41,725	540	NS ¹	45 km of road built per market ²
Annual road maintenance cost	\$4,172,500	\$54,000		
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$353,329,902	\$4,572,753	NS ¹	
Total annual cost	\$4,921,516	\$63,696	NS ¹	
5-year cost	\$377,937,482	\$4,891,233	NS¹	
BENEFIT				
Headwind reduction	0.6%			
Increased production (maize-eq. tonnes)	45,135			
Cost/tonne of increased production	\$1,675			

¹Program does not scale to village level due to large number of incremental markets (527)

²AFDB/IFAD Community Agricultural Infrastructure Improvement Program:

[http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project_and_Operations/Uganda%20-%20The%20Community%20Agricultural%20Infrastructure%20Improvement%20Programme%20\(CAIP-3\).pdf](http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project_and_Operations/Uganda%20-%20The%20Community%20Agricultural%20Infrastructure%20Improvement%20Programme%20(CAIP-3).pdf)

³World Bank – Village Infrastructure Project, Ghana: http://www.worldbank.org/externaldocs/default.aspx/WDS/Content/Sector/WDS/IB/2015/07/18/11111019_2015071813224/Revised/IB/13016.pdf

⁴USAID/Hieffer Project Infr., Senegal: <http://www.hieffer.com/usaid/hiefferprojectinfr.htm>

⁵Commonwealth Local Government Forum, Uganda: <http://www.clgf.org.uk/us-offices/files/Uploads/2014/02/20140215-2.pdf>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Uganda: Farmers Co-ops

Project Description

- Promote increased farm size by constructing farmers' cooperative infrastructure
- Build capacity through collective marketing advisory and information services

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Annual production of major crops ¹	8,330,932	108,259	72	
Total number of farmers ²	11,610,000	150,779	100	
Major crops produced per farmers (tonnes)	0.72	0.72	0.72	
Number of farmers per cooperative	20	20	20	Number of farmers served (1.1 million) in the National Agricultural Advisory Service Project divided by the number of farmer's groups in the program (5500) ³
Storage requirement per cooperative (tonnes)	14.4	14.4	14.4	
Total number of farmers ²	11,610,000	150,779	100	
Percentage of farmers to target	56.1%	56.1%	56.1%	Average percentage of farmers not involved in a cooperative ³
Number of farmers in need of cooperative membership	6,513,210	84,587	56	
Number of farmers per cooperative	20	20	20	
Number of new farmer cooperatives	361,845	4,699	3	
Cost to build a metal silo (\$/tonne) ⁴	\$50	\$50	\$50	
Cost to build a cement silo (\$/tonne) ⁴	\$350	\$350	\$350	
Average cost of one ton of storage	\$200	\$200	\$200	
Storage requirement per cooperative (tonnes)	14.4	14.4	14.4	
Storage cost per cooperative	\$2,800	\$2,800	\$2,800	
Number of new farmer cooperatives	325,660	4,229	3	
Cost of new farmer cooperatives	\$911,849,400	\$11,842,183	\$7,854	
Institutional development cost per cooperative ³	\$521	\$521	\$521	Training in the areas of community organizing, participatory planning, farming techniques, information and communications & on-farm adaptation of agricultural technologies; \$521 is the average amount spent on these programs per farmer's group ³
Agribusiness development cost per cooperative ³	\$273	\$273	\$273	Trains local leaders in agribusiness development to promote collective marketing; \$273 is the average amount spent on these programs per farmer's group ³
Number of new farmer cooperatives	325,660	4,229	3	
Total Capacity Building Costs	\$258,574,437	\$3,358,105	\$2,227	
TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$1,170,423,837	\$15,200,287	\$10,081	
Total annual cost	\$-	\$-	\$-	Assumes any annual costs are covered by member dues
5-year cost	\$1,170,423,837	\$15,200,287	\$10,081	
BENEFIT				
Headwind reduction	0.6%			
Increased production (maize-eq. tonnes)	44,949			
Cost/tonne of increased production	\$5,208			

¹Maize eq. tonnes; Lake Paranaq Analysis with data from FAO: <http://faostat3.fao.org/>

²UN FAO stat: <http://faostat3.fao.org/>

³NAADS Program: <http://www.wfp.org/countries/uganda/naads-program/naads-program-overview>

⁴Malawi an Extension Services: <http://www.fao.org/4/005/x0530/x0530051m>

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

Uganda: Cell Phones

Project Description

- Provide ~5M cell phones to improve access to market, crop & disease information

ASSUMPTIONS	Country-Level	District-Level	Village-Level	Notes
Cost of mobile phone (\$)¹	\$7.92	\$7.92	\$7.92	
Cost of annual basic plan (\$)¹	\$69	\$69	\$69	<i>Paid for one year to help adoption</i>
Bulk purchasing discount	18%	18%	18%	
Total cost per phone	\$63.07	\$63.07	\$63.07	
Target number of Ugandan farmers	5,328,044	69,622	47	<i>Increasing to rural penetration of 93% (Cote d'Ivoire levels)³ of currently phoneless farmers</i>
Total phone & one-year of plan costs	\$338,112,319	\$4,391,069	\$2,983	
Cost of providing one text per month per farmer	\$0.48	\$0.48	\$0.48	<i>One text per month allows farmers to maintain in minimal contact with extension officers or markets</i>
Target number of Ugandan farmers	5,328,044	69,622	47	
Annual cost of providing one text a month	\$2,557,461	\$33,214	\$23	

TOTAL COSTS	Country-Level	District-Level	Village-Level	Notes
Total one-time cost	\$338,112,319	\$4,391,069	\$2,983	
Total annual cost	\$2,557,461	\$33,214	\$23	
5-year cost	\$350,899,623	\$4,557,138	\$3,095	

BENEFIT

Headwind reduction	0.2%
Increased production (maize-eq. tonnes)	16,078
Cost/tonne of increased production	\$4,365

¹MTN Uganda: <http://www.mtn.co.ug/>

²Trading Economics: <http://www.tradingeconomics.com/uganda/cell-phones>

³Kantar – African phone use: <http://i.kantar.com/tech/mobile/mobile-usage-in-africa/>

⁴Assumes 18% volume discount

Special Cost Note: When multiple interventions are selected concurrently we remove any overlapping extension and personnel costs

APPENDIX



Appendix | Headwinds to Production: Initial Scores

Country Scores

- **Initial Country Scores:** Weighted averages of min-max adjusted individual metrics for each major category. A LOW score translates to a HIGH headwind (e.g. score of 21 = 79% headwind)
- **Highlighted Score:** The score below which zero progress is likely without structural change

Country	Initial Scores				
	Governance & Socioeconomics	Government Support for Agriculture	Farming Catalysts	Infrastructure	Overall
Algeria	58.1	36.2	26.6	54.1	43.8
Angola	34.6	30.5	21.5	25.0	27.9
Benin	44.8	34.8	29.0	22.5	32.8
Botswana	70.1	41.7	28.5	40.5	45.2
Burkina Faso	34.1	43.6	28.7	24.5	32.7
Burundi	31.2	36.7	21.6	27.6	29.3
Cameroon	37.0	37.6	26.0	28.1	32.2
Central African Rep.	23.4	32.1	17.5	31.2	26.0
Chad	20.5	32.0	19.5	21.0	23.2
Congo	39.5	39.5	19.8	26.0	31.2
Cote d'Ivoire	40.1	39.5	20.8	24.8	31.3
Dem. Rep. Congo	18.9	33.6	20.0	13.8	21.6
Djibouti	44.7	44.4	24.5	25.8	34.8
Egypt	58.5	40.6	32.1	63.5	48.7
Eq. Guinea	41.6	43.9	20.6	32.2	34.6
Eritrea	35.3	31.9	21.5	33.3	30.5
Ethiopia	34.5	44.4	27.6	38.8	36.3
Gabon	57.2	43.3	22.9	13.2	34.1
Gambia	43.1	44.0	31.8	36.3	38.8
Ghana	55.0	47.1	33.8	31.7	41.9
Guinea	30.6	45.2	23.7	21.5	30.2
Guinea-Bissau	28.5	41.1	24.8	24.1	29.6
Kenya	44.4	43.8	27.6	32.2	37.0
Lesotho	55.7	36.7	23.7	36.7	38.2
Liberia	40.1	38.1	22.9	16.6	29.4
Libya	55.0	52.0	11.5	37.3	39.0
Madagascar	45.9	40.9	22.4	22.1	32.8
Malawi	42.5	51.8	23.2	37.3	38.7
Mali	31.0	46.3	28.9	39.3	36.4
Mauritania	48.6	47.3	19.4	29.8	36.3
Morocco	56.9	39.9	30.8	56.8	46.1
Mozambique	40.2	36.0	26.1	29.4	32.9
Namibia	61.2	37.2	29.1	43.5	42.8
Niger	35.9	40.0	22.7	26.6	31.3
Nigeria	31.8	36.9	30.3	25.6	31.1
Rwanda	48.5	38.2	29.2	28.7	36.1
S. Sudan	23.8	12.6	0.9	0.0	9.3
Senegal	51.9	52.4	30.6	30.0	41.2
Sierra Leone	29.6	33.3	25.1	25.8	28.5
Somalia	13.3	32.1	18.3	12.2	19.0
South Africa	62.2	50.1	33.3	42.1	46.9
Sudan	34.0	23.7	26.5	42.4	31.6
Swaziland	47.2	41.7	26.0	36.4	37.8
Tanzania	45.2	42.4	26.6	30.0	36.0
Togo	39.2	42.1	20.7	22.8	31.2
Tunisia	68.9	47.2	34.0	63.3	53.4
Uganda	40.9	36.2	26.9	27.3	32.8
Zambia	45.5	31.1	28.6	34.1	34.8
Zimbabwe	49.1	44.2	14.2	32.8	35.1

Appendix | Headwinds to Production: Scaled Scores

Scaled Scores and Headwinds to Improved Production

- **Scaled Scores:** Scores are scaled from 0 (no progress in country without addressing barriers) to 100 (ideal country with no practical or political headwind)
- **Headwind Score:** 100 minus a scaled score. Represents the amount of theoretical improvement lost due to practical and political barriers to production (e.g. a country with a score of '90' will likely only actualize 10% of potential production improvements without relief)

Country	Scaled Scores					Headwind Score
	Governance & Socioeconomics	Government Support for Agriculture	Farming Catalysts	Infrastructure	Overall	
Algeria	45.0	2.2	6.4	38.0	22.7	77.3
Angola	14.1	0.0	0.0	0.0	3.5	96.5
Benin	27.6	0.0	9.5	0.0	9.1	90.9
Botswana	60.7	10.7	8.9	19.6	24.7	75.3
Burkina Faso	13.5	13.5	9.2	0.0	9.1	90.9
Burundi	9.7	3.0	0.0	2.1	3.7	96.3
Cameroon	17.3	4.3	5.7	2.8	7.5	92.5
Central African Rep.	0.0	0.0	0.0	7.0	1.8	98.3
Chad	0.0	0.0	0.0	0.0	0.0	100.0
Congo	20.6	7.3	0.0	0.0	6.9	93.1
Cote d'Ivoire	21.4	7.2	0.0	0.0	7.1	92.9
Dem. Rep. Congo	0.0	0.0	0.0	0.0	0.0	100.0
Djibouti	27.4	14.8	3.8	0.0	11.5	88.5
Egypt	45.5	9.0	13.5	50.6	29.5	70.6
Eq. Guinea	23.4	14.0	0.0	8.4	11.5	88.5
Eritrea	15.0	0.0	0.0	9.8	6.1	93.9
Ethiopia	14.0	14.8	7.7	17.2	13.5	86.5
Gabon	43.8	13.0	1.7	0.0	14.6	85.5
Gambia	25.3	14.1	13.0	13.9	16.5	83.5
Ghana	40.9	19.0	15.7	7.7	20.7	79.3
Guinea	8.8	16.1	2.7	0.0	7.0	93.0
Guinea-Bissau	6.1	9.7	4.2	0.0	5.0	95.0
Kenya	26.9	13.9	7.8	8.3	14.2	85.8
Lesotho	41.9	3.0	2.7	14.4	15.3	84.7
Liberia	21.4	5.2	1.7	0.0	7.0	93.0
Libya	40.9	26.5	0.0	15.3	20.7	79.3
Madagascar	29.0	9.4	1.1	0.0	9.8	90.2
Malawi	24.6	26.1	2.1	15.2	17.1	82.9
Mali	9.4	17.7	9.4	18.0	13.7	86.3
Mauritania	32.6	19.2	0.0	5.0	14.2	85.8
Morocco	43.5	7.9	11.8	41.6	26.0	74.0
Mozambique	21.5	1.8	5.8	4.6	8.3	91.7
Namibia	49.1	3.8	9.6	23.7	21.3	78.7
Niger	15.9	8.0	1.5	0.8	6.5	93.5
Nigeria	10.4	3.3	11.1	0.0	6.2	93.9
Rwanda	32.4	5.2	9.7	3.6	12.6	87.4
S. Sudan	0.0	0.0	0.0	0.0	0.0	100.0
Senegal	36.8	27.0	11.6	5.4	20.2	79.8
Sierra Leone	7.5	0.0	4.5	0.0	3.0	97.1
Somalia	0.0	0.0	0.0	0.0	0.0	100.0
South Africa	50.4	23.5	14.9	21.8	27.6	72.4
Sudan	13.3	0.0	6.3	22.1	10.3	89.7
Swaziland	30.7	10.6	5.7	14.0	15.2	84.8
Tanzania	28.0	11.6	6.5	5.3	12.8	87.2
Togo	20.2	11.2	0.0	0.0	7.9	92.1
Tunisia	59.2	19.1	15.8	50.4	36.0	64.0
Uganda	22.5	2.2	6.8	1.7	8.2	91.8
Zambia	28.4	0.0	9.0	10.9	11.9	88.1
Zimbabwe	33.1	14.4	0.0	9.1	14.2	85.9



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