

## **Gross Economic Benefits from Tropical Legumes II (TL2-related) Modern Varieties in Project Countries**

The Tropical Legumes II (TLII) project aims to increase the productivity (yield per unit area) and production (total availability) of six major grain legumes – chickpea, common bean, cowpea, groundnut, pigeonpea and soybean in rural areas of SA and SSA. The project worked in a total of fourteen countries: twelve in SSA (Burkina Faso, Ghana, Mali, Niger, Nigeria, Ethiopia, Kenya, Malawi, Mozambique, Tanzania, Uganda and Zimbabwe) and two in SA (India and Bangladesh) during the 2<sup>nd</sup> phase. Burkina Faso, Ghana, Uganda are new anchor countries during phase 2.

The project focused on developing improved legume varieties and ensuring access for smallholder farmers to seed of these varieties, in the context of ongoing environmental constraints such as drought, pests and diseases. In particular, efforts were targeted on the informal and formal seed sector and the supply of quality seed, which is a major constraint in the adoption of legumes. The expected increase in added value of productivity gains in the rural areas of these regions will amount to about USD1.3 billion over the ten year period 2007 to 2017. It is expected that at least 50 new varieties, with yield advantages of at least 20% over the adapted checks, across the six crops will be released to farmers, with the seed sector (public and private) producing more than 96,000 metric tonnes (MT) of quality seed, enough to plant 1.6 million ha through the formal seed sector and considerably more when informal distribution systems are added.

During the first 2 phases (2007 to 2014), more than 100 varieties have been released, yielding more than 20% over the local checks. More than 127,000 metric tons of seed of modern legume varieties has been produced directly with project funds and more than 446,731 metric tons with project and partners' investment. In addition, the total amount of seed produced during the 2 phases covered more than 2,007,889 ha with the funds provided under TL2 and 6,524,027 ha with project and partners' investment. So far, the project has attained some of its major targets only after 7 years of implementation. The increase in productivity was computed using two approaches: (1) the total seed produced during the years of project implementation and (2) the adoption rate data from adoption surveys and/or expert opinions.

It is estimated that, since 2007, modern legume varieties (MVs) developed/disseminated under the TLII project implemented by ICRISAT, CIAT, and IITA with NARS partners have been adopted on at least 2,007,889 ha and have generated more than US\$513 million from project funding and nearly US\$2 billion from project and partners' investment. Even when using the adoption rates data from adoption and expert opinions surveys, the aggregate gross benefits from TLII related modern legume varieties is estimated at about US\$978 million, which is still far above the total TLII investment grossly compounded at US\$48 million<sup>1</sup> (phases 1 and 2). The returns on investment are high. In effect, for each TLII dollar invested, the project generates USD11 with direct project investment, USD39 with partnership's investment and USD20 when using adoption rate based estimation.

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<sup>1</sup> Uncompounded investment is US\$ 42 million. Compound rate is about 5% as in many projects in SSA with annual investment roughly estimated to US\$7 per year

## **Methods and Data**

In order to compute the gross benefits resulting from TLII intervention, two approaches were used. One approach was based on the quantity of seed produced during the 7 years of project implementation, and the second approach was based on adoption rates estimated from adoption surveys or expert opinions.

### *a/ Seed based estimation of total gross benefits*

The concept of cumulative adoption implied by the logistic function was applied. The area planted to MVs (or the number of adopters) in a given year includes the new area planted to MVs (or the new adopters) in that year as well as the areas planted to MVs in all previous years. The area planted was estimated based on the quantity of seed produced each year. It was assumed that the seed produced is recycled every 5-6 years and improved seed generates a stream of benefits with the yield gains accruing beyond the year of planting of fresh seed. Thus, the annual benefits were aggregated across the years to derive the total benefits for the whole 2008-2013 period. The gross benefit calculation per year was based on the cumulative quantity of seed produced over the years, the seeding rate, the yield with the local varieties, and the producer price of the crop from FAO. The parameters used in the calculation of gross benefits from TL2 investment since 2007 include:

1. The cumulative quantity of certified seed produced by year  $t$  [ $CQS_t$ ] (tons)
2. The quantity of seed produced in year  $t$  ( $QS_t$ )
3. The seeding rate [SR] (kg/ha)
4. The percent yield gain over the local check [PYGOL] (%)
5. The yields with local varieties [YLO] (tons/ha)
6. The FAO producer price of the crop [PPCROP] (US\$/ton)

The gross economic benefits (GEB) were estimated as the value of additional crop production per year ( $t$ ) and country as follows:

$$GEB_t = (1000 \times CQS_t) / SR \times YLO \times PYGOL \times PPCROP$$

$$\text{where } CQS_t = QS_{2008} + \dots + QS_t$$

The total value of additional production was aggregated over crop, country and year.

### *b/ Adoption rates based estimation*

Adoption is an outcome resulting from increased productivity. Farmers convinced with increased productivity from modern varieties are likely to use more and more of the varieties. Adoption rate expressed in terms of percentage of area adopted along with productivity gains provide gross measures of additional gross benefits from using modern varieties. The gross benefit calculation was based on the

adoption rates obtained from formal adoption surveys that are nationally representative or expert opinion surveys. The following parameters were used to compute the total gross economic benefits from TL2 intervention. These include the adoption rate (%area), the area under the crop (ha), the yield of the local varieties/local check (tons/ha), the yield gains over the local check (%), and FAO producer price of the crop from FAO statistics.

The parameters are measured as follows:

7. The adoption rate (% area) [ADOPAREA]
8. The area cultivated under the crop (ha) [AREACROP]
9. The yields of the local varieties/local check (tons/ha) [YLO]
10. The yield gains over the local check [YLDGAINS] (%)
11. The FAO producer price of the crop [PPCROP] (US\$/ton)

The total gross benefits were calculated as follows:

$$VACROPYEAR_{adoptionbased} = \frac{ADOPAREA \times AREACROP}{100} \times \frac{YLO \times YLDGAINS}{100} \times PPCROP$$

The adoption rate used was derived from adoption surveys that are representative of the major growing areas of the respective legumes. However, because adoption studies were not conducted for all crops and countries, expert opinions collected in other BMGF projects such as DIVA and TRIPSA were used.

## Results

Annexes 1 through 21 provide the individual calculations of gross benefits by crop, country<sup>2</sup> and scenarios. Table 1 presents a summary of gross economic benefits derived from TL2 related modern legume varieties from 2007 to 2013 under 2 scenarios on seed production and one on adoption rate by crop, region and scenario. Using seed production, the total gross benefits were calculated with seed produced using project funds and seed produced using both project and partners' investment. The latter provided measures on the effect of partnering in seed production. Using the total seed produced with project funds, the total gross benefits were estimated at US\$513,030,570 compared with US\$1,888,519,829 using both project and partners' funds, indicating the significant impact of partnering in seed production. In effect, the total gross benefits have more than tripled. Using the adoption rates, the gross benefits from project intervention were estimated at about US\$978,035,870.

Most of the direct gross benefits were derived from chickpea in South Asia accounting for about 52% of the total gross benefits of the project followed by common beans in ESA (17%) and chickpea in ESA (14%). Without accounting for chickpea in South Asia, most of the gross benefits are accounted for by the adoption of common beans in ESA (36%), chickpea in ESA (29%), pigeon pea in ESA (8%), etc. (Table 2). Though West and Central Africa has the largest area cultivated to groundnut and cowpea, it is noted that the quantity of seed produced is still very low. The search for alternative institutional arrangements

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<sup>2</sup> Annex 6 related to common beans in Southern highland of Tanzania did not use the quantity of seed for the estimation of aggregate gross-benefits but rather the adoption rate.

to increase seed production in countries and crops remain essential in increasing the gross benefits from TL2 investments and thus impacts of TL2 investments in WCA.

When including partners' investments, it is noted that more than 54% of the gross benefits is realized through chickpea in SA, followed by chickpea in ESA (19%), groundnut in ESA (7%), and common bean (5%) or chickpea in SA where the total gross benefits quintupled due to strong partnership.

**Table 1.** Total gross benefits derived from TL2 related modern legume varieties from 2007-2013 from direct funding from TL2; including partners' funding and with adoption data.

		Additional production					
		Direct TL2 funding (Seed)		Including partners' funding (Seed)		With adoption data	
Crop	Region	Value (USD)	Percent total (%)	Value (USD)	Percent total (%)	Value (USD)	Percent total (%)
Common bean	ESA	87,729,042	17.10%	93,218,739	4.94%	97,118,775	9.93%
Cowpea	WCA	18,106,550	3.53%	52,530,800	2.78%	171,848,588	17.57%
	ESA	2,013,900	0.39%	3,208,275	0.17%	877,500	0.09%
Groundnut	ESA	249,624	0.05%	140,938,849	7.46%	220,393,530	22.53%
	WCA	11,780,249	2.30%	15,667,599	0.83%	59,911,053	6.13%
	SA	2,826,623	0.55%	32,531,282	1.72%	108,710	0.01%
Pigeon pea	ESA	20,894,784	4.07%	49,634,696	2.63%	37,467,104	3.83%
	SA	6,210,978	1.21%	30,085,440	1.59%	65,097,080.00	6.66%
Chickpea	ESA	72,021,410	14.04%	366,636,430	19.41%	43,516,886	4.45%
	SA	266,330,610	51.91%	1,019,913,136	54.01%	248,146,829.00	25.37%
Soybean	WCA	10,605,000	2.07%	59,841,250	3.17%	33,173,095	3.39%
	ESA	14,261,800	2.78%	24,313,333	1.29%	376,720	0.04%
<b>Total gross-benefits (US\$)</b>		<b>513,030,570</b>	<b>100.00%</b>	<b>1,888,519,829</b>	<b>100.00%</b>	<b>978,035,870</b>	<b>100.00%</b>

**Table 2.** Total gross benefits derived from TL2 related modern varieties from 2007-2013 from direct funding from TL2; including partners' funding and with adoption data (excluding chickpea in SA).

Crop	Region	Additional production					
		Direct TL2 funding (Seed)		Including partners' funding (Seed)		With adoption data	
		Value (USD)	Percent total (%)	Value (USD)	Percent total (%)	Value (USD)	Percent total (%)
Common bean	ESA	87,729,042	35.56%	93,218,739	10.73%	97,118,775	13.31%
Cowpea	WCA	18,106,550	7.34%	52,530,800	6.05%	171,848,588	23.54%
	ESA	2,013,900	0.82%	3,208,275	0.37%	877,500	0.12%
Groundnut	ESA	249,624	0.10%	140,938,849	16.23%	220,393,530	30.20%
	WCA	11,780,249	4.78%	15,667,599	1.80%	59,911,053	8.21%
	SA	2,826,623	1.15%	32,531,282	3.75%	108,710	0.01%
Pigeon pea	ESA	20,894,784	8.47%	49,634,696	5.71%	37,467,104	5.13%
	SA	6,210,978	2.52%	30,085,440	3.46%	65,097,080.00	8.92%
Chickpea	ESA	72,021,410	29.19%	366,636,430	42.21%	43,516,886	5.96%
	SA		0.00%		0.00%		0.00%
Soybean	WCA	10,605,000	4.30%	59,841,250	6.89%	33,173,095	4.54%
	ESA	14,261,800	5.78%	24,313,333	2.80%	376,720	0.05%
<b>Total gross-benefits (US\$)</b>		<b>246,699,960</b>	<b>100.00%</b>	<b>868,606,693</b>	<b>100.00%</b>	<b>729,889,041</b>	<b>100.00%</b>

**Table 3.** Total gross benefits derived from TL2 related modern varieties from 2007-2013 from direct funding from TL2 and direct and indirect funding from TL2 by region and country.

Region	Country	Additional production			
		Direct funding (seed)		Including partners' funding (seed)	
		Value (USD)	Percent (%)	Value (USD)	Percent (%)
ESA	Kenya	18844033.36	3.67%	22272886.36	1.18%
	Tanzania	12890618.67	2.51%	103122340	5.46%
	Malawi	18265441.9	3.56%	98439363.9	5.21%
	Uganda	32874159.22	6.41%	33811252.22	1.79%
	Zimbabwe	257775.45	0.05%	3858316.43	0.20%
	Ethiopia	100483132.6	19.58%	394694930.6	20.90%
	Mozambique	13592324	2.65%	21751232.33	1.15%
WCA	Mali	4830688	0.94%	10201088	0.54%
	Niger	4038504	0.79%	9349404	0.50%
	Nigeria	31098426	6.06%	107963705	5.72%
	Burkina Faso	267294	0.05%	267294	0.01%
	Ghana	254768	0.05%	254768	0.01%
	Senegal	2119	0.00%	3391	0.00%
SA	India	275210205	53.64%	1081977988	57.29%
	Bangladesh	158007	0.03%	551870	0.03%
Total gross-benefits (US\$)		513067496.2	100.00%	1888519830	100.00%

The significant drop in the share of common beans in ESA in total gross benefits may be explained by the weak partnership in seed production when compared to groundnut or chickpea in ESA.

When using the adoption rate estimates, the share of the gross benefits significantly changes. In fact, chickpea accounts for about 25% of total gross benefits followed by groundnut in ESA (23%), cowpea in WCA (18%), and 10% for common beans. If one excludes chickpea in SA, groundnut accounts for 30% of the total gross benefits followed by cowpea in WCA (24%), common bean in ESA (13%), pigeon pea in SA (9%), groundnut in WCA (8%), etc.

Country-wise, with direct project funding, the total gross benefits from TL2 related modern varieties is dominated by India accounting for 54%, followed by Ethiopia (20%), Uganda (6%), Nigeria (6%), etc.. Similar trends are observed with project and partners' investments. The lowest shares are recorded in West Africa countries except for Nigeria. With direct project investments, when examining the gross benefits per hectare of legume cropped area, it is noted that Ethiopia has the largest 211.74 USD/ha of legume cropped area, followed Mozambique (27 USD/ha), Uganda (23 USD/ha), Malawi (19 USD/ha), Kenya (155), India (14%). As for the case of total gross benefits, the lowest values of gross benefits per cropped area are recorded in West African countries. Region-wise, SA accounts for 54%, followed by ESA (38%) and lastly WCA with 8%.

#### **Conclusions and caveats:**

The results showed that the gross benefits from TLII intervention are very high under different scenarios. Using direct project funding, the total gross benefits are estimated at a little more than \$US513 million. With partnership investment, the gross benefits increase by more than threefold. These results follow the same trend when using adoption data. The returns on investment are high. In effect, for each TL2 dollar invested, the project generates USD11 with direct project investment, USD39 with partnership's investment, and USD20 when using adoption rate based estimation.

There are however severe disparities between regions where SA and ESA accounts for about 90% of the total gross benefits. This calls for more research investments in appropriate institutional arrangements to enhance seed production and uptake in WCA. Investments in irrigation facilities for off-season cropping and breeder seed production may be highly necessary.

This analysis relies heavily on the total quantity of seed produced and assumes that the seed produced is recycled every 5-6 years and improved seed generates a stream of benefits with the yield gains accruing beyond the year of planting of fresh seed. Thus, the annual benefits were aggregated across the years to derive the total benefits for the whole 2008-2013 period. This analysis may suffer from attribution issues when using both the total quantity of seed production or adoption rates. This is likely to be refined as more adoption studies with nationally representative samples are undertaken.



**Annex 1.** Total direct gross economic benefits from modern common bean varieties and from TL2 direct intervention from 2007 to 2013.

Country	Certified/QDS seed (tons) (seed data for 2009-2013)	Seeding rate (kg/ha)	Yield gains over local checks (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)*	Area under bean in 2011 (ha)	Area under TL2 varieties (ha)	Adoption rate of TL2 varieties (%)	Additional production (tons)	Producer Price of bean US\$/ton at farm gate	Value of additional bean production 2009-2013 (US\$)
Kenya	4,573.90	70	42	0.79	0.3318	1078685	65,341.43	6.06	21,680.29	760	16,477,017.36
Tanzania	1,279.84	70	49.5	0.883	0.437085	817303	18,283.43	2.24	7,991.41	320.5	2,561,247.67
Malawi	227.00	70	42	0.527	0.22134	306509	3,242.86	12.71	8,573.71	550	4,715,542.90
Uganda*	8,817.70	70	56.4	0.964	0.543696	1005091	125,967.14	12.53	68,487.83	480	32,874,159.22
Zimbabwe	62.00	70	41.2	0.883	0.363796	37000	885.71	885.71	322.22	800	257,775.45
Ethiopia	20,908.56	70	35.5	0.895	0.317725	331708	298,693.71	90.05	94,902.46	325	30,843,299.62
											<b>87,729,042.22</b>
<p>* yield gain is based on average actual yield gains obtained by farmers derived from survey data and expert opinion  * quantity of seed for 2011-2013</p>											

**Annex 2.** Total direct and indirect gross economic benefits from modern common bean varieties and from TL2 intervention from 2007 to 2013

Country	Certified/QDS seed (tons) (seed data for 2009-2013)	Seeding rate (kg/ha)	Yield gains over local checks (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)*	Area under bean in 2011 (ha)	Area under TL2 varieties (ha)	Adoption rate of TL2 varieties (%)	Additional production (tons)	Producer Price of bean US\$/ton at farm gate	Value of additional bean production 2009-2013 (US\$)
Kenya	4,573.90	70	42	0.79	0.3318	1078685	65,341.43	6.06	21,680.29	760	16,477,017.36
Tanzania	2,223.84	70	49.5	0.883	0.437085	817303	31,769.14	2.24	13,885.82	320.5	4,450,403.97
Malawi	2,728.00	70	42	0.527	0.22134	306509	38,971.43	12.71	8,573.71	550	4,715,542.90
Uganda*	8,817.70	70	56.4	0.964	0.543696	1005091	125,967.14	12.53	68,487.83	480	32,874,159.22
Zimbabwe	928.00	70	41.2	0.883	0.363796	37000	13,257.14	13257.14	4,822.90	800	3,858,316.43
Ethiopia	20,908.56	70	35.5	0.895	0.317725	331708	298,693.71	90.05	94,902.46	325	30,843,299.62
											<b>93,218,739.50</b>
<p>* yield gain is based on average actual yield gains obtained by farmers derived from survey data and expert opinion  * quantity of seed for 2011-2013</p>											

**Annex 3.** Total gross economic benefits derived from modern common beans varieties and from TL2 intervention from 2007 to 2013 using adoption rate data from several sources.

Variety	Year released	Adoption (% area) under variety 2013	Average Yield of local varieties (tons)	Yield gain of new varieties over local checks (%)	average yield gains over local (t/ha)	Area (Ha) under beans 2012**	Area (Ha) under variety 2012/2013	additional production (ton)	Bean price/ton*	Value of additional output (\$) in 2012	Total gross benefits (USD)
<b>ETHIOPIA</b>											
Meher season	2003-2011	38.7	0.905	35.5	0.321	331708	128370.996	41,207	325	13,378,641	
Belg season	2003-2011	25.5	0.895	66.1	0.591	112461	28677.555	16,948	325	5,508,241	
	Total Ethiopia										<b>18,886,882.71</b>
<b>UGANDA</b>											
	1998-2011	13.2	0.964	56.4	0.544	1060000	139920	76,116	480		<b>36,535,910.40</b>
<b>KENYA</b>											
Western region	1998-2011	24	0.85	10	0.085	110025.9	26406.2	2244.53	837.5	1879792.0	
eastern province	1998-2011	30	0.675	9	0.061	275064.7	82519.4	5013.05	837.5	4198432.5	
Rift valley	1998-2011	16	0.9	10	0.090	275064.7	44010.3	3960.93	837.5	3317280.0	
central province	1998-2011	21	0.75	10	0.075	137640.2	28904.4	2167.83	837.5	1815560.3	
	Total Kenya										<b>11,211,064.79</b>
<b>ZIMBABWE</b>											
Highveld	2007 – 2013	34.2	0.92	29.4	0.8	15000	5130	4104	800	3283200	
Midlevel	2007 – 2013	24.4	0.75	36.7	0.6	10000	2440	1464	800	1171200	
Lowveld	2007 – 2013	16.1	0.98	58.9	0.8	12000	1932	1545.6	800	1236480	
	Total Zimbabwe										<b>5,690,880.00</b>
<b>MALAWI</b>											

Variety	Year released	Adoption (% area) under variety 2013	Average Yield of local varieties (tons)	Yield gain of new varieties over local checks (%)	average yield gains over local (t/ha)	Area (Ha) under beans 2012**	Area (Ha) under variety 2012/2013	additional production (ton)	Bean price/ton*	Value of additional output (\$) in 2012	Total gross benefits (USD)
High altitude	(2002-2011)	30	0.5	50	0.25	124971	37491.3	9372.825	550	5,155,053.75	
Mid-altitude	(2002-2011)	25	0.5	42	0.21	114198	28549.5	5995.395	550	3,297,467.25	
Low altitude	(2002-2011)	0									
	Total Malawi										<b>8,452,521.00</b>
<b>TANZANIA</b>											
Southern Tanzania	(2002-2011)	18.3	0.883	49.5	0.437	365661	66916.0	29242.3	320	9,357,528.27	
Northern Tanzania	jesca1997, Selian98,selian94	18.6	0.883	35.9	0.317	370153	68848.5	21825.0	320	6,983,987.58	
	Total Tanzania						690,116.17	221,207			<b>16,341,515.85</b>
											<b>97,118,774.74</b>

**Annex 4.** Total gross direct economic benefits derived from modern cowpea and soybean varieties from 2007 to 2013 using seed produced directly by the TL2 project

<b>Cowpea</b>												
Country	Certified/QDS seed (tons) 2007-2013	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under cowpea in 2011 (ha)	Area under TL2 varieties (ha)	Adoption rate of TL2 varieties (%)	Additional production (tons)	Producer Price of cowpea (US\$/ton)	Value of additional cowpea production 2013 (US\$)	Value of additional cowpea production 2007-2013 (US\$)
Mali	174	25	80	0.5	0.40	250,000	6,960	2.8	2,784	350	974,400	3,410,400
Mozambique	548	25	100	0.3	0.30	300,000	5,480	5.5	1,644	350	575,400	2,013,900
Niger	339	25	100	0.3	0.30	4,700,000	3,390	0.07	1,017	150	152,550	533,925
Nigeria	1051	25	60	0.7	0.42	3,200,000	17,517	0.5	7,357	550	4,046,350	14,162,225
											<b>5,748,700</b>	<b>20,120,450</b>
<b>Soybean</b>												
Country	Certified/QDS seed (tons) 2007-2013	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under soybean in 2011 (ha)	Area under TL2 varieties (ha)	Adoption rate of TL2 varieties (%)	Additional production (tons)	Producer Price of soybean (US\$/ton)	Value of additional soybean production 2013 (US\$)	Value of additional soybean production 2007-2013 (US\$)
Malawi	150	60	38	0.8	0.30	75,000	2,500	3.3	760	600	456,000	1,596,000
Mozambique	1734	60	28	0.8	0.22	13,000	28,900	222.3	6,474	500	3,236,800	11,328,800
Nigeria	1212	50	25	1.0	0.25	600,000	24,240	4.0	6,060	500	3,030,000	10,605,000
Kenya	382	60	10	1.0	0.10	2,000	6,367	318.3	637	600	382,000	1,337,000
											<b>7,104,800</b>	<b>24,866,800</b>

**Annex 5.** Total gross direct and indirect economic benefits derived from modern cowpea and soybean varieties from 2007 to 2013 using seed produced directly and indirectly by the TL2 project.

<b>Cowpea</b>												
Country	Certified/QDS seed (tons) 2007-2013	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under cowpea in 2011 (ha)	Area under TL2 varieties (ha)	Adoption rate of TL2 varieties (%)	Additional production (tons)	Producer Price of cowpea (US\$/ton)	Value of additional cowpea production 2013 (US\$)	Value of additional cowpea production 2007-2013
Mali	448	25	80	0.5	0.40	250,000	17,920	7.2	7,168	350	2,508,800	8,780,800
Mozambique	873	25	100	0.3	0.30	300,000	8,730	8.7	2,619	350	916,650	3,208,275
Niger	3711	25	100	0.3	0.30	4,700,000	37,110	0.79	11,133	150	1,669,950	5,844,825
Nigeria	2813	25	60	0.7	0.42	3,200,000	46,883	1.5	19,691	550	10,830,050	37,905,175
											<b>15,925,450</b>	<b>55,739,075</b>
<b>Soybean</b>												
Country	Certified/QDS seed (tons) *	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under soybean in 2011 (ha)	Area under TL2 varieties (ha)	Adoption rate of TL2 varieties (%)	Additional production (tons)	Producer Price of soybean (US\$/ton)	Value of additional soybean production 2013 (US\$)	Value of additional soybean production 2007-2013 (US\$)
Malawi	150	60	38	0.8	0.30	75,000	2,500	3.3	760	600	456,000	1,596,000
Mozambique	2800	60	28	0.8	0.22	13,000	46,667	359.0	10,453	500	5,226,667	18,293,333
Nigeria	6839	50	25	1.0	0.25	600,000	136,780	22.8	34,195	500	17,097,500	59,841,250
Kenya	1264	60	10	1.0	0.10	2,000	21,067	1053.3	2,107	600	1,264,000	4,424,000
											<b>24,044,167</b>	<b>84,154,583</b>

Annex 6. Total gross economic benefits derived from modern cowpea and soybean varieties from 2007 to 2013 using the adoption rate from several sources.

<b>Cowpea</b>										
<b>Country</b>	<b>Adoption of MVs (% area) *</b>	<b>Yield gains over local check (%)</b>	<b>Yield with local varieties (tons/ha)</b>	<b>Yield gain over local check (tons/ha)</b>	<b>Area under cowpea in 2009 (ha)</b>	<b>Area under TL2 varieties (ha)</b>	<b>Adoption rate of TL2 varieties (%)</b>	<b>Additional production (tons)</b>	<b>Producer Price of cowpea (US\$/ton)</b>	<b>Value of additional cowpea production per year (US\$)</b>
Mali	30	80	0.5	0.40	283,665	85,100	30.0	34,040	325	11,062,935
Mozambique	3	100	0.3	0.30	300,000	9,000	3.0	2,700	325	877,500
Niger	9	100	0.3	0.30	4,156,263	374,064	9.00	112,219	130	14,588,483
Nigeria	30	60	0.7	0.42	2,320,590	696,177	30.0	292,394	500	146,197,170
										<b>172,726,088</b>
<b>Soybean</b>										
<b>Country</b>	<b>Adoption of MVs (% area) *</b>	<b>Yield gains over local check (%)</b>	<b>Yield with local varieties (tons/ha)</b>	<b>Yield gain over local check (tons/ha)</b>	<b>Area under soybean in 2009 (ha)</b>	<b>Area under TL2 varieties (ha)</b>	<b>Adoption rate of TL2 varieties (%)</b>	<b>Additional production (tons)</b>	<b>Producer Price of soybean (US\$/ton)</b>	<b>Value of additional soybean production per year (US\$)</b>
Malawi	25	38	0.8	0.30	86,796	21,699	25.0	6,596	575	3,792,985
Mozambique	35	28	0.8	0.22	10,000	3,500	35.0	784	480	376,320
Nigeria	36	25	1.0	0.25	592,000	213,120	36.0	53,280	550	29,304,000
Kenya	43	10	1.0	0.10	2,950	1,269	43.0	127	600	76,110
										<b>33,549,415</b>
* Expert panel estimates excluding old improved varieties										

Annex 7. Total direct gross economic benefits derived from modern groundnut varieties from direct TL2 intervention in West Africa from 2007-2013.

<b>Groundnut</b>											
<b>Country</b>	<b>Certified/QDS seed (tons)</b>	<b>Seeding rate (kg/ha)</b>	<b>Yield gains over local check (%)</b>	<b>Yield with local varieties (tons/ha)</b>	<b>Yield gain over local check (tons/ha)</b>	<b>Area under groundnut in 2011 (ha)</b>	<b>Area under TL2 varieties (ha)</b>	<b>Adoption rate of TL2 varieties (%)</b>	<b>Additional production (tons)</b>	<b>Producer Price of groundnut (US\$/ton)</b>	<b>Value of additional groundnut production (US\$)</b>
Burkina Faso	466	80	15	0.683	0.10	388704	5,825	1.5	597	447.9	267,294
Ghana	71	80	15	1.304	0.20	356780	888	0.2	174	1467.6	254,768
Mali	1412	80	21	0.765	0.16	340,000	17,650	5.2	2,835	501	1,420,288
Niger	1175	80	35	0.334	0.12	690,853	33,571	4.86	3,925	893	3,504,579
Nigeria	1406	80	20	0.749	0.15	2,342,810	70,300	3.0	10,531	601	6,331,201
Senegal	5	80	15	0.609	0.09	865,770	63	0.0	6	371	2,119
											<b>11,780,249</b>



Annex 8. Total direct and indirect gross benefits derived from groundnut from direct and indirect TL2 intervention in West Africa from 2007-2013.

<b>Groundnut</b>											
<b>Country</b>	<b>Certified/ QDS seed (tons)</b>	<b>Seeding rate (kg/ha)</b>	<b>Yield gains over local check (%)</b>	<b>Yield with local varieties (tons/ha)</b>	<b>Yield gain over local check (tons/ha)</b>	<b>Area under groundnut in 2011 (ha)</b>	<b>Area under TL2 varieties (ha)</b>	<b>Adoption rate of TL2 varieties (%)</b>	<b>Additional production (tons)</b>	<b>Producer Price of groundnut (US\$/ton)</b>	<b>Value of additional groundnut production (US\$)</b>
Burkina Faso	466	80	15	0.683	0.10	388704	5,825	1.5	597	447.9	267,294
Ghana	71	80	15	1.304	0.20	356780	888	0.2	174	1467.6	254,768
Mali	1412	80	21	0.765	0.16	340,000	17,650	5.2	2,835	501	1,420,288
Niger	1175	80	35	0.334	0.12	690,853	33,571	4.86	3,925	893	3,504,579
Nigeria	2269	80	20	0.749	0.15	2,342,810	113,450	4.8	16,995	601	10,217,280
Senegal	8	80	15	0.609	0.09	865,770	100	0.0	9	371	3,391
											15,667,599

**Annex 9.** Total gross economic benefits derived from modern groundnut varieties from 2007 to 2013 using the adoption rate from several sources.

Variety	groundnut adoption (% area) (2007-2013)	Average Yield of local varieties (tons)	Yield gain of new varieties over local checks (%)	average yield gains over local/(ton/ha)	Area (Ha) under groundnut 2012**	Area (Ha) under variety 2012/2013	additional production (ton)	Groundnut price/ton*	<b>Total gross benefits (2007-2013)</b>
Burkina Faso	0.5	0.683	15	0.10245	388704	1943.52	199	447.9	89,183
Ghana	0.5	1.303	15	0.19545	356780	1783.9	349	1467.6	511,698
Mali*	17.64	0.765	21	0.16065	340000	59976	9,635	501	4,826,244
Niger*	10.98	0.334	35	0.1169	690853	75855.66	8,868	893	7,918,701
Nigeria**	22	0.749	20	0.1498	2342810	515418.2	77,210	601	46,418,439
Senegal	0.5	0.609	15	0.09135	865770	4328.85	395	371	146,787
						659306.1			59,911,053.14
<b>* estimated from expert opinion survey using a linear trend on adoption</b>									
<b>** national level survey estimates</b>									

**Annex 10.** Total direct gross economic benefits derived from modern groundnut varieties disseminated/developed under the TL2 project in ESA (2007-2013).

Country	Varieties released / supported	Certified/QDS seed (tons) *	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Groundnut in 2011 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	Producer Price of Groundnut (US\$/ton)	Value of additional Groundnut production per year (US\$)
Malawi	ALL / average	0			0.50	0.00	353,138	0	0	422	0
price of 2006	CG 7	0	80	150	0.50	0.75	353,138	0	0	422	0
	Nsinjiro	0	80	150	0.50	0.75	353,138	0	0	422	0
	Baka	0	60	120	0.50	0.60	353,138	0	0	422	0
	Chitala	0	80	100	0.50	0.50	353,138	0	0	422	0
	JL24	0	80	100	0.50	0.50	353,138	0	0	422	0
	Chalimbana 2005	0	80	100	0.50	0.50	353,138	0	0	422	0
	SC Mwenje	0	80	100	0.50	0.50	353,138	0	0	422	0
Tanzania	ALL / average				0.55	0.00	839,631	0	0	422	0
prices not available thus taken Malawi as proxy	Mnanje	0	80	150	0.55	0.83	839,631	0	0	422	0
	Pendo	0	80	150	0.55	0.83	839,631	0	0	422	0
	Nachingwea	0	80	130	0.55	0.72	839,631	0	0	422	0
	Mangaka	0	80	150	0.55	0.83	839,631	0	0	422	0
Uganda	ALL / average	0			0.9	0.00	421,000	0	0	422	0
prices not available thus taken Malawi as proxy	Serenut 1-14	0	80	70	0.90	0.63	421,000	0	0	422	0
yield advantage averages	Serenut 2	0	80	57	0.90	0.51	421,000	0	0	422	0
	Serenut 3R	0	80	57	0.90	0.51	421,000	0	0	422	0
	Serenut 4T	0	80	57	0.90	0.51	421,000	0	0	422	0
	Serenut 5R	0	80	57	0.90	0.51	421,000	0	0	422	0
	Serenut 6T	0	80	57	0.90	0.51	421,000	0	0	422	0
	Acholi White	0	80	60	0.90	0.54	421,000	0	0	422	0
	Igola	0	80	40	0.90	0.36	421,000	0	0	422	0

	Red beauty	0	80	0	0.90	0.00	421,000	0	0	422	0
Mozambique	ALL / average	66.5			0.50	0.00		831	0	429	249,624
price of 2008	Mamane	30	80	140	0.50	0.70	389,266	375	263	429	112,613
	Nametil	36.5	80	140	0.50	0.70	389,266	456	319	429	137,012
								<b>831</b>			<b>249,624</b>

**Annex 11.** Total direct gross economic benefits derived from modern pigeon pea varieties disseminated/developed under the TL2 project in ESA (2007-2013).

Country	Varieties released / supported	Certified/QDS seed (tons) *	Seeding rate (kg/ha)	Yield gain over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Pigeonpea in 2012 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	Producer Price of Pigeonpea (US\$/ton)	Value of additional Pigeonpea production per year (US\$)
Malawi	ALL / average	770.6						77,060			11,953,899
mean price 03-08	Sauma(ICP 9145)	266.2	10	23	0.99	0.23	203,400	26,620	6,061	526	3,188,283
	Kachangu(ICEAP 00040)	164.2	10	30	0.99	0.30	203,400	16,420	4,877	526	2,565,165
	Mwaiwathu Alimi(ICEAP 00557)	241.7	10	35	0.99	0.35	203,400	24,170	8,375	526	4,405,200
	Chitedze Pigeonpea 1(ICEAP 01514/15)	98.5	10	35	0.99	0.35	203,400	9,850	3,413	526	1,795,251
Tanzania	ALL / average	504.2						50,420			8,940,885
mean price Malawi and Kenya	Mali(ICEAP 00040)	354	10	40	0.945	0.38	290,000	35,400	13,381	486	6,503,263
	Tumia(ICEAP 00068)	28	10	35	0.945	0.33	290,000	2,800	926	486	450,085
	Kombo(ICPL 87091)	25	10	30	0.945	0.28	290,000	2,500	709	486	344,453
	ICEAP 00053	34.7	10	38	0.945	0.36	290,000	3,470	1,246	486	605,593
	ICEAP 00554	28.4	10	35	0.945	0.33	290,000	2,840	939	486	456,514
	ICEAP 00557	19.8	10	35	0.945	0.33	290,000	1,980	655	486	318,274
	ICEAP 00932	14.3	10	40	0.945	0.38	290,000	1,430	541	486	262,702
								<b>127,480</b>			<b>\$ 20,894,784</b>

**Annex 12.** Total direct gross economic benefits derived from modern chickpea varieties disseminated/developed under the TL2 project in ESA (2007-2013).

Country	Varieties released / supported	Certified/Q DS seed (tons) *	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Chickpea in 2012 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	Producer Price of Chickpea (US\$/ton)	Value of additional Chickpea production per year (US\$)
Ethiopia	ALL / average	19981						142,845			69,639,833
mean price 08-10	Arerti	16284	140	110	1.19	1.31	239,512	116,314	152,255	407	61,967,948
	Shasho	1998	140	68	1.19	0.81	239,512	14,271	11,548	407	4,700,215
	Marye	9	120	51	1.19	0.61	239,512	75	46	407	18,526
	Habru	999	140	51	1.19	0.61	239,512	7,136	4,331	407	1,762,581
	Ejere	199	140	26	1.19	0.31	239,512	1,421	440	407	178,995
	Natoli	27	120	68	1.19	0.81	239,512	225	182	407	74,102
	Kutaye	48	120	68	1.19	0.81	239,512	400	324	407	131,738
	Teji	199	140	51	1.19	0.61	239,512	1,421	863	407	351,105
	Chefe	120	140	68	1.19	0.81	239,512	857	694	407	282,295
	Acos Dube	78	140	51	1.19	0.61	239,512	557	338	407	137,619
	Minjar	20	120	43	1.19	0.51	239,512	167	85	407	34,710
Tanzania	ALL / average	315						3,282			1,388,486
Malawi price	Ukiriguru 1 (ICCV 97105)	125	90	46	1.12	0.52	120,000	1,389	716	822	588,187
	Mwanza 1 (ICCV 00108)	90	90	43	1.12	0.48	120,000	1,000	482	822	395,875
	Mwangaza (ICCV 92318)	50	120	54	1.12	0.60	120,000	417	252	822	207,144
	Mwanza 2 (ICCV 00305)	50	105	45	1.12	0.50	120,000	476	240	822	197,280
Kenya	ALL / average	372	97.14286					3,831			1,030,016
mean price Malawi and Ethiopia	Chania Desi1 (ICCV 97105)	131.9	90	50	1.00	0.50	190,000	1,466	733	615	450,658
	Saina K1 (ICCV 95423)	98.2	105	35	1.00	0.35	190,000	935	327	615	201,310
	ICCV 92944	41.8	90	50	1.00	0.50	190,000	464	232	615	142,817

	LTD068(ICCV 00305)	28	105	38	1.00	0.38	190,000	267	101	615	62,320
	ICCV 97126	15.7	90	50	1.00	0.50	190,000	174	87	615	53,642
	ICCV 97306	50.3	110	35	1.00	0.35	190,000	457	160	615	98,428
	LTD065(ICCV 00108)	6.1	90	50	1.00	0.50	190,000	68	34	615	20,842
								<b>149,958</b>			<b>\$72,058,335</b>

**Annex 13.** total direct and indirect gross economic benefits from modern chickpea varieties disseminated/developed under the TL2 project in ESA (2007-2013).

Chickpea										FAO	
Country	Varieties released / supported	Certified/QDS seed (tons) *	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Chickpea in 2012 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	Producer Price of Chickpea (US\$/ton)	Value of additional Chickpea production per year (US\$)
		Certified/QDS seed (tons)									
Ethiopia	ALL / average	104566.4						747,353		407	363,851,631
mean price 08-10	Arerti	84400	140	110	1.19	1.31	239,512	602,857	789,140	407	321,179,980
	Shasho	11784	140	68	1.19	0.81	239,512	84,171	68,112	407	27,721,389
	Marye	85.8	120	51	1.19	0.61	239,512	715	434	407	176,611
	Habru	7605	140	51	1.19	0.61	239,512	54,321	32,968	407	13,417,844
	Ejere	146.6	140	26	1.19	0.31	239,512	1,047	324	407	131,862
	Natoli	95.3	120	68	1.19	0.81	239,512	794	643	407	261,554
	Kutaye	155.6	120	68	1.19	0.81	239,512	1,297	1,049	407	427,050
	Teji	103.3	140	51	1.19	0.61	239,512	738	448	407	182,257
	Chefe	30	140	68	1.19	0.81	239,512	214	173	407	70,574
	Acos Dube	119.3	140	51	1.19	0.61	239,512	852	517	407	210,486
	Minjar	41.5	120	43	1.19	0.51	239,512	346	177	407	72,024
Tanzania	ALL / average	315.2						3,379		822	1,412,930
Malawi price	Ukiriguru 1(ICCV 97105)	150.4	90	46	1.12	0.52	120,000	1,671	861	822	707,706
	Mwanza 1(ICCV 00108)	108.8	90	43	1.12	0.48	120,000	1,209	582	822	478,569
	Mwangaza(ICCV 92318)	28.9	120	54	1.12	0.60	120,000	241	146	822	119,729
	Mwanza 2(ICCV 00305)	27.1	105	45	1.12	0.50	120,000	258	130	822	106,926
Kenya	ALL / average	491.96						5,078		615	1,371,869
mean price Malawi and ethiopia	Chania Desi1 (ICCV 97105)	161.86	90	50	1.00	0.50	190	1,798	899	615	553,022
	Saina K1(ICCV 95423)	121.606	105	35	1.00	0.35	190	1,158	405	615	249,292
	ICCV 92944	69.48	90	50	1.00	0.50	190	772	386	615	237,390
	LTD068(ICCV 00305)	41.674	105	38	1.00	0.38	190	397	151	615	92,754



	ICCV 97126	25.68	90	50	1.00	0.50	190	285	143	615	87,740
	ICCV 97306	63.82	110	35	1.00	0.35	190	580	203	615	124,884
	LTD065(ICCV 00108)	7.84	90	50	1.00	0.50	190	87	44	615	26,787
								<b>755,810</b>			<b>\$366,636,430</b>

**Annex 14.** Total direct and indirect gross economic benefits from modern pigeon pea varieties disseminated/developed under the TL2 project in ESA (2007-2013).

Country / variety	Certified/QDS seed (tons) *	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Pigeonpea in 2011 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	Producer Price of Pigeonpea (US\$/ton)	Value of additional Pigeonpea production per year (US\$)
<b>Malawi [ALL / average]</b>	<b>1824.6</b>						<b>182,460</b>			<b>28,606,904</b>
Sauma(ICP 9145)	527.2	10	23	0.99	0.23	203,400	52,720	12,004	526	6,314,285
Kachangu(ICEAP 00040)	519.9	10	30	0.99	0.30	203,400	51,990	15,441	526	8,121,982
Mwaiwathu Alimi(ICEAP 00557)	650.7	10	35	0.99	0.35	203,400	65,070	22,547	526	11,859,593
Chitedze Pigeonpea 1(ICEAP 01514/15)	126.8	10	35	0.99	0.35	203,400	12,680	4,394	526	2,311,044
<b>Tanzania [ALL / average]</b>	<b>498.5</b>						<b>117,468</b>			<b>21,027,792</b>
Mali(ICEAP 00040)	896.5	10	40	0.945	0.38	290,000	89,650	33,888	486	16,469,422
Tumia(ICEAP 00068)	58.1	10	35	0.945	0.33	290,000	5,810	1,922	486	933,926
Kombo(ICEAP 87091)	27.3	10	30	0.945	0.28	290,000	2,730	774	486	376,142
ICEAP 00053	65.6	10	38	0.945	0.36	290,000	6,560	2,356	486	1,144,868
ICEAP 00554	42.4	10	35	0.945	0.33	290,000	4,240	1,402	486	681,557
ICEAP 00557	59.05	10	35	0.945	0.33	290,000	5,905	1,953	486	949,196
ICEAP 00932	25.73	10	40	0.945	0.38	290,000	2,573	973	486	472,681
							<b>299,928</b>			<b>\$49,634,696</b>

**Annex 15.** Total direct and indirect gross economic benefits from modern groundnut varieties disseminated/developed under the TL2 project in ESA (2007-2013).

Country	Varieties released / supported	Certified /QDS seed (tons) *	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Groundnut in 2012 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	FAO Producer Price of Groundnut (US\$/ton)	Value of additional Groundnut production per year (US\$)
Malawi	ALL / average	16253.25						203,192		422	63,520,917
price of 2006	CG 7	13243.4	80	150	0.50	0.75	353,138	165,543	124,157	422	52,394,201
	Nsinjiro	2410.12	80	150	0.50	0.75	353,138	30,127	22,595	422	9,535,037
	Baka	6.25	60	120	0.50	0.60	353,138	104	63	422	26,375
	Chitala	473.44	80	100	0.50	0.50	353,138	5,918	2,959	422	1,248,698
	JL24	46.12	80	100	0.50	0.50	353,138	577	288	422	121,642
	Chalimbana 2005	49.92	80	100	0.50	0.50	353,138	624	312	422	131,664
	SC Mwenje	24	80	100	0.50	0.50	353,138	300	150	422	63,300
Tanzania	ALL / average	17542.2						219,278		422	76,231,214
prices not available thus taken Malawi as proxy	Mnanje	4850	80	150	0.55	0.83	839,631	60,625	50,016	422	21,106,594
	Pendo	11562.2	80	150	0.55	0.83	839,631	144,528	119,235	422	50,317,249
	Nachingwea	190	80	130	0.55	0.72	839,631	2,375	1,698	422	716,609
	Mangaka	940	80	150	0.55	0.83	839,631	11,750	9,694	422	4,090,763
Uganda	ALL / average	330.9						4,136		422	937,093
prices not available thus taken Malawi as proxy	Serenut 1-14	183.2	80	70	0.90	0.63	421,000	2,290	1,443	422	608,819
yield advantage	Serenut 2	40.33	80	57	0.90	0.51	421,000	504	257	422	108,498

averages	Serenut 3R	29.344	80	57	0.90	0.51	421,000	367	187	422	78,943
	Serenut 4T	37.326	80	57	0.90	0.51	421,000	467	238	422	100,416
	Serenut 5R	3.11	80	57	0.90	0.51	421,000	39	20	422	8,367
	Serenut 6T	3.09	80	57	0.90	0.51	421,000	39	20	422	8,313
	Acholi White	5	80	60	0.90	0.54	421,000	63	34	422	14,243
	Igola	5	80	40	0.90	0.36	421,000	63	23	422	9,495
	Red beauty	24.5	80	0	0.90	0.00	421,000	306	0	422	0
Mozambique	ALL / average	66.5						831		429	249,624
price of 2008	Mamane	30	80	140	0.50	0.70	389,266	375	263	429	112,613
	Nametil	36.5	80	140	0.50	0.70	389,266	456	319	429	137,012
								<b>427,437</b>			<b>\$140,938,849</b>

**Annex 16.** Total gross economic benefits derived from modern chickpea varieties disseminated/developed under the TL2 project in ESA (2007-2013) using adoption rates from several sources.

Chickpea									FAO	
Country	Varieties released / supported	Adoption rate	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Chickpea in 2012 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	Producer Price of Chickpea (US\$/ton)	Value of additional Chickpea production per year (US\$)
Ethiopia	ALL / average	0.63	59.54545	1.19	0.71	239,512	150,893	106,921	407	43,516,886
mean price 08-10	Arerti	n/a	110	1.19	1.31	239,512	n/a	n/a	407	n/a
	Shasho	n/a	68	1.19	0.81	239,512	n/a	n/a	407	n/a
adoption rate 2009 target areas	Marye	n/a	51	1.19	0.61	239,512	n/a	n/a	407	n/a
	Habru	n/a	51	1.19	0.61	239,512	n/a	n/a	407	n/a
	Ejere	n/a	26	1.19	0.31	239,512	n/a	n/a	407	n/a
	Natoli	n/a	68	1.19	0.81	239,512	n/a	n/a	407	n/a
	Kutaye	n/a	68	1.19	0.81	239,512	n/a	n/a	407	n/a
	Teji	n/a	51	1.19	0.61	239,512	n/a	n/a	407	n/a
	Chefe	n/a	68	1.19	0.81	239,512	n/a	n/a	407	n/a
	Acos Dube	n/a	51	1.19	0.61	239,512	n/a	n/a	407	n/a
	Minjar	n/a	43	1.19	0.51	239,512	n/a	n/a	407	n/a
Tanzania	ALL / average	n/a	47	1.12	0.53	120,000	n/a	n/a	822	n/a
Malawi price	Ukiriguru 1(ICCV 97105)	n/a	46	1.12	0.52	120,000	n/a	n/a	822	n/a
	Mwanza 1(ICCV 00108)	n/a	43	1.12	0.48	120,000	n/a	n/a	822	n/a
	Mwangaza(ICCV 92318)	n/a	54	1.12	0.60	120,000	n/a	n/a	823	n/a
	Mwanza 2(ICCV 00305)	n/a	45	1.12	0.50	120,000	n/a	n/a	822	n/a
kenya	ALL / average	n/a	44	1.00	0.44	190	n/a	n/a	615	n/a

mean price Malawi and ethiopia	Chania Desi1 (ICCV 97105)	n/a	50	1.00	0.50	190	n/a	n/a	615	n/a
	Saina K1(ICCV 95423)	n/a	35	1.00	0.35	190	n/a	n/a	615	n/a
	ICCV 92944	n/a	50	1.00	0.50	190	n/a	n/a	615	n/a
	LTD068(ICCV 00305)	n/a	38	1.00	0.38	190	n/a	n/a	615	n/a
	ICCV 97126	n/a	50	1.00	0.50	190	n/a	n/a	615	n/a
	ICCV 97306	n/a	35	1.00	0.35	190	n/a	n/a	615	n/a
	LTD065(ICCV 00108)	n/a	50	1.00	0.50	190	n/a	n/a	615	n/a
							<b>150,893</b>			<b>\$ 43,516,886</b>

Annex 17. Total gross economic benefits derived from modern pigeon pea varieties disseminated/developed under the TL2 project in ESA (2007-2013) using adoption rates from several sources.

Pigeonpea									FAO	
Country	Varieties released / supported	Adoption rate	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Pigeonpea in 2011 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	Producer Price of Pigeonpea (US\$/ton)	Value of additional Pigeonpea production per year (US\$)
Malawi	ALL / average	0.5	29.3333	0.99	0.29	203,400	101,700	29,534	526	14,299,000
mean price 03-08	Sauma(ICP 9145)	0.25	23	0.99	0.23	203,400	50,850	11,579	526	6,090,315
adoption based on expert panel 2012	Kachangu(ICEAP 00040)	0.2	30	0.99	0.30	203,400	40,680	12,082	526	6,355,111
	Mwaiwathu Alimi(ICEAP 00557)	0.05	35	0.99	0.35	203,400	10,170	3,524	526	1,853,574
Tanzania	ALL / average	0.497	35	0.945	0.33	290,000	144,130	47,671	486	23,168,105
mean price Malawi and Kenya	Mali(ICEAP 00040)	0.306	40	0.945	0.38	290,000	88,740	33,544	486	16,302,248
adoption based on nat. rep. survey 2012	Tumia(ICEAP 00068)	0.003	35	0.945	0.33	290,000	870	288	486	139,848
	Kombo(ICPL 87091)	0.016	30	0.945	0.28	290,000	4,640	1,315	486	639,304
Uganda	ALL / average	n/a		0.8	0.00	101,000	n/a	n/a	422	n/a
							<b>245,830</b>			<b>\$ 37,467,104</b>

**Annex 18.** Total direct gross economic benefits derived from groundnut varieties disseminated/developed under the TL2 project in ESA (2007-2013) using adoption rates from several sources.

Country	Varieties released / supported	adoption rate	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Groundnut in 2012 (ha)	Area under TL2 varieties (ha)	Additional production (tons)	Producer Price of Groundnut (US\$/ton)	Value of additional Groundnut production per year (US\$)
Malawi	ALL / average	0.81		117.1429	0.50	0.59	353,138	286,042	167,539	422	79,295,796
price of 2006	CG 7	0.367	80	150	0.50	0.75	353,138	129,602	97,201	422	41,018,921
adoption based on T-II survey in target areas 2013	Nsinjira	0.141	80	150	0.50	0.75	353,138	49,792	37,344	422	15,759,313
DIVA results are ....	Baka	0.001	60	120	0.50	0.60	353,138	353	212	422	89,415
	Chitala	0.013	80	100	0.50	0.50	353,138	4,591	2,295	422	968,658
	JL24	0.025	80	100	0.50	0.50	353,138	8,828	4,414	422	1,862,803
	Chalimbana 2005	0.263	80	100	0.50	0.50	353,138	92,875	46,438	422	19,596,687
	SC Mwenje	0	80	100	0.50	0.50	353,138	0	0	422	0
Tanzania	ALL / average	0.32		145	0.55	0.80	839,631	268,682	214,274	422	90,423,557
prices not available thus taken Malawi as proxy	Mnanje	0.001	80	150	0.55	0.83	839,631	840	693	422	292,318
adoption based on nat. rep. survey 2012	Pendo	0.184	80	150	0.55	0.83	839,631	154,492	127,456	422	53,786,426
	Nachingwea	0.001	80	130	0.55	0.72	839,631	840	600	422	253,342
	Mangaka	n/a	80	150	0.55	0.83	839,631	n/a	n/a	422	n/a
Uganda	ALL / average	0.556		57	0.90	0.51	421,000	234,076	120,081	422	50,674,177
prices not available thus taken Malawi as proxy	Serenut 1-14	n/a	80	70	0.90	0.63	421,000	n/a	n/a	422	n/a
adoption rates based on expert panel 2012	Serenut 2	n/a	80	57	0.90	0.51	421,000	n/a	n/a	422	n/a
	Serenut 3R	0.142	80	57	0.90	0.51	421,000	59,782	30,668	422	n/a
	Serenut 4T	0.119	80	57	0.90	0.51	421,000	50,099	25,701	422	n/a



	Serenut 5R	n/a	80	57	0.90	0.51	421,000	n/a	n/a	422	n/a
	Serenut 6T	n/a	80	57	0.90	0.51	421,000	n/a	n/a	422	n/a
	Acholi White	n/a	80	60	0.90	0.54	421,000	n/a	n/a	422	n/a
	Igola	n/a	80	40	0.90	0.36	421,000	n/a	n/a	422	n/a
	Red beauty	n/a	80	0	0.90	0.00	421,000	n/a	n/a	422	n/a
Mozambique	ALL / average	n/a			0.50	0.00		n/a	n/a	429	n/a
price of 2008	Mamane	n/a	80	140	0.50	0.70	389,266	n/a	n/a	429	n/a
	Nametil	n/a	80	140	0.50	0.70	389,266	n/a	n/a	429	n/a
								<b>788,800</b>			<b>\$220,393,530</b>

**Annex 19.** Total direct gross benefits from TL2 related modern varieties of groundnut, chickpea and pigeon pea from 2007 to 2013 in South Asia.

<b>Groundnut* (Direct benefits)</b>											
<b>Country</b>	<b>Certified/Q DS seed (tons) *</b>	<b>Seeding rate (kg/ha)</b>	<b>Yield gains over local check (%)</b>	<b>Yield with local varieties (tons/ha)</b>	<b>Yield gain over local check (tons/ha)</b>	<b>Area under Gnut in 2011 (ha)</b>	<b>Area under TL2 varieties (ha)</b>	<b>Adoption rate of TL2 varieties (%)</b>	<b>Additional production (tons)</b>	<b>Producer Price of Gnut (US\$/ton)</b>	<b>Value of additional groundnut production (US\$)</b>
India (2008-2013)	1821	125	40	1	0.40	5,856,145	14,568	0.2	5,827	483	2,814,538
Bangladesh (2011-13)	9	125	30	0.8	0.24	31,755	72	0.2	17	699	12,086
Note: 2008 Producer price for India was used											<b>2,826,623</b>
<b>Chickpea* (Direct benefits)</b>											
India (2008-2013)	56833	62	45	1.35	0.61	9,190,000	916,661	10.0	556,872	478	266,184,689
Bangladesh (2012-2013)	53	62	30	1	0.30	8,229	855	10.4	256	569	145,921
											<b>266,330,610</b>
Note: India (2006) and Bangladesh (2009) producer prices was used											
<b>Pigeonpea* (Direct benefits)</b>											
India (2008-2012)	307	5	22	0.95	0.21	4,420,000	61,400	1.4	12,833	484	6,210,978

**Annex 20.** Total direct and indirect gross benefits from TL2 related modern varieties of groundnut, chickpea and pigeon pea from 2007 to 2013 in South Asia.

<b>Groundnut</b>											
Country	Certified/QDS seed (tons) *	Seeding rate (kg/ha)	Yield gains over local check (%)	Yield with local varieties (tons/ha)	Yield gain over local check (tons/ha)	Area under Gnut in 2011 (ha)	Area under TL2 varieties (ha)	Adoption rate of TL2 varieties (%)	Additional production (tons)	Producer Price of Gnut (US\$/ton)	Value of additional groundnut production (US\$)
India (2008-2013)	20940	125	40	1	0.40	5,856,145	167520	2.9	67,008	483	32,364,864
Bangladesh (2011-13)	124	125	30	0.8	0.24	31,755	992	3.1	238	699	166,418
											<b>32,531,282</b>
<b>Chickpea</b>											
India (2008-2013)	217679	62	45	1.35	0.61	9,190,000	3510952	38.2	2132903	478	1,019,527,684
Bangladesh (2012-2013)	140	62	30	1	0.30	8,229	2258	27.4	677	569	385,452
											<b>1,019,913,136</b>
<b>Pigeon pea</b>											
India (2008-2012)	1480	5.0	22.0	1.0	0.2	4420000.0	296000.0	6.7	62160	484	<b>30,085,440</b>
<b>* Based on total seed distribution data, 2008-13 under TL-II Phase 1 &amp; 2</b>											

**Annex 21.** Total gross economic benefits derived from modern pigeon pea varieties, chickpea and groundnut varieties disseminated/developed under the TL2 project in ESA (2007-2013) using adoption rates from several sources.

	Year	Adoption rate (% area)	Avg. yield of local varieties (ton/ha)	Yield gain of new cultivars than check (%)	Avg. yield gain over local (ton/ha)	Area under crop (ha) in 2012	Area under TL-II varieties (ha)	Additional Production (tons)	Price/ton (\$/ton)	Value of additional production (\$)	Total benefits
<b>Chickpea</b>											
Andhra Pradesh	2013	85	1.35	45	0.6075	615000	522750	317571	478	151798759	
Karnataka	2013	65	1	35	0.35	886000	575900	201565	478	96348070	
											<b>248,146,829</b>
<b>Groundnut</b>											
Tamil Nadu	2013	8%	1.8	35	0.63	386000	308.8	195	483	93965	
Karnataka	2011	1%	1.2	30	0.36	848000	84.8	31	483	14745	
											<b>108,710</b>
<b>Pigeonpea</b>											
Andhra Pradesh	2011	31	1.1	25	0.275	498000	154380	42455	484	20547978	
Maharashtra	2011	40	0.95	22	0.209	1101000	440400	92044	484	44549102	
											<b>65,097,080</b>