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DRAFT PAPER

Elaboration of livestock R&D scenarios and assessment of the impact of alternative investment scenarios on employment generation: a methodological framework

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Introduction

As agriculture is the largest employment sector in Sub-Saharan Africa, and as the average contribution of agriculture to GDP is more than 17% (OECD/FAO, 2016; World Bank, 2017), the agricultural employment growth can be a driving force of eradicating extreme poverty in these marginalized areas. Agricultural employment growth in the extreme poverty stricken Sub-Saharan Africa is however limited by a number of factors. The world's population is expected to increase in between 8.71 billion to 10.8 billion by 2050 (UN, 2015), and 65% of the increase of population will take place in sub-Saharan Africa and Southern Asia. Due to the population pressure, the per capita arable land has been declining in Sub-Saharan Africa. In 1961, the per capita arable land in Sub-Saharan Africa was 0.57ha, which has declined to 0.22ha, in 2015 (World Bank, 2017). With further increase of population, the per capita arable land availability will also further decline in these regions. This ever-declining land-man ratio can, firstly push the people out of agriculture, and secondly may force people to stay in the agricultural sector out of necessity but not by choice. Also, the declining land-man ratio can push the marginal productivity of agricultural labor further down, and, hence can aggravate the poverty situation in Sub-Saharan Africa. In a recent study, Bezu and Holden (2014) demonstrate that young Ethiopians are pushed out of agricultural activities mainly due to the lack of access to the agricultural land, and only 9% of the young Ethiopians opted for agriculture as their future occupation also because of this land constraint.

An escape from this impasse can be adequate public and private investments in agricultural capital goods, such as on new machinery, infrastructure, and technology. Given the strong welfare impacts, agricultural investment can be instrumental in increasing employment and thus reducing poverty and hunger in the agriculture dependent extreme poverty-stricken regions. Particularly, government expenditure in highly positively associated with agricultural capital formation and growth exhibits the decisive role of the government expenditure in creating an enabling environment and thriving agricultural sector. Research has revealed that 10% increase in public expenditure on agriculture leads to 0.34 percent increase in a country's agricultural total factor productivity. In the same time, agricultural growth, particularly in Africa is considered as more pro-poor compared to industrial growth, primarily because it allows for greater participation of the poorest smallholders in the growth process (Diao et al., 2010a). This is more relevant for the poorest developing economies with high concentration of smallholder farmers, and where agriculture is the dominant sector in the poorest rural areas. This is also relevant for both, crops and livestock activities due to the respective importance of these activities in the different African countries.

Objectives of the study

Foresight analysis can provide useful insights for prioritizing agricultural R&D investments based on their long-term impacts. Such an assessment needs quantification of returns to these investments, including employment. In this study, we suppose that such investments will first have an impact on TFP of the livestock activities targeted by these investments, which will result into higher GDP growth and employment generation, depending on how important the livestock GDP in the overall agricultural GDP would be. Employment became one of the most important challenges in rural areas of most developing countries and will remain so in the next decades. Waves of rural and international migration are annually increasing because of high unemployment rates in these areas. The objective of the study is thus to consider a set of R&D investments for livestock productivity enhancement and assess their respective effects on employment generation. The study will also focus on comparing the respective impact of the same scenarios, in terms of employment generation, among countries, regions, and gender. This will result in clear recommendation of investments prioritization based on this employment criteria in the considered countries. Both medium (2030) and long terms (2050) perspectives will be considered. It is also important to note that this document is only intending to present and discus the methodology which will be used to simulate the effect of Livestock R&D scenarios on employment generation. An overall presentation of the scenarios and the targeted African countries would also be provided. A short application of the developed methodology on simplistic (generic) scenarios in Tanzania and Burkina Faso will be provided to illustrate the implementation of the developed methodology.

Methodological Approach

The present document includes the methodological approach used to translate overall GDP growth resulting from livestock Research and development investments into employment figures. This section also presents few investment scenarios (not necessarily specific to Livestock by rather to the overall agricultural sector), specifies sources of data, as well as an overall macro-economic description of a set of African countries.

The elasticity-based approach followed in this study to calculate employment figures from future GDP growth rates is based on Arega et al., (2009). For each country and scenario, the GLOBE model provides GDP growth rates which we translate into employment growth rates using the set of equations as follows.

Based on Arega et al., (2009), for each country (region), the employed population can be presented using the concept of elasticity of employment with respect to overall GDP growth (also called employment intensity of growth), as follows:

$$\Delta N = \left(\frac{\Delta GDP_t}{GDP_{BAU,ref}} \times 100\%\right) \times \left(\frac{\partial \ln(N)}{\partial \ln(GDP)}\right) \times N \qquad \text{(eq.1)}$$

$\frac{\Delta GDP_t}{GDP_{BAU,ref}}$ is calculated as:

$$\frac{\Delta GDP_t}{GDP_{BAU,ref}} = \left(\frac{GDP_{sc,t} - GDP_{BAU,ref}}{GDP_{BAU,ref}}\right) - \left(\frac{GDP_{BAU,t} - GDP_{BAU,ref}}{GDP_{BAU,ref}}\right)$$

Which makes,

$$\frac{\Delta GDP_t}{GDP_{BAU,ref}} = \left(\frac{GDP_{sc,t} - GDP_{BAU,t}}{GDP_{BAU,ref}}\right) \qquad \text{(eq.2)}$$

Where ΔN is the change in the employed population, N is the total economically active population in the reference year (ref) (considered as being 2015), GDP is the projected Gross Domestic Product (of the whole economy) under “business as usual” (BAU), and respective scenario (SC) in the year t. The term $\left(\frac{\partial \ln(N)}{\partial \ln(GDP)}\right)$ is expressing the employment elasticity to overall GDP growth.

The net benefits of the respective livestock investment scenarios are estimated in the present study by the difference between GDP with and without livestock investment scenarios. Figure A.1 illustrates the time frame and the approach used to quantify the net benefits of the livestock investments, which is simplified as differences between BAU and investment scenarios in different time points.

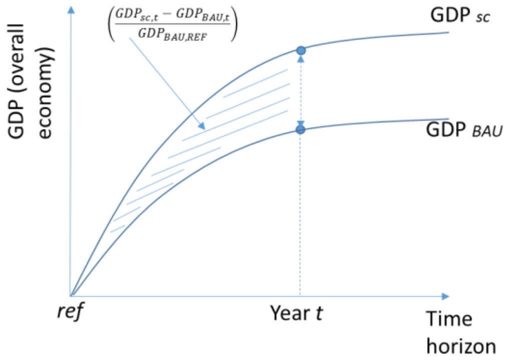

Figure 1. Quantifying net benefits from livestock R&D investment.

Employment elasticity to growth is defined as a numerical measure of how employment varies with the economic output (e.g. percentage change in employment due to 1% growth in GDP) (Kapsos, 2005). This macroeconomic elasticity concept can refer to the growth of the economy as a whole (all sectors included) or to an individual sector, such as livestock.

Kapsos (2005) performed a series of estimates of overall employment elasticities for the period 1991-2003, disaggregated by gender, age, sector and region. The estimates of Kapsos (2005) is used in the present study as the primary source of elasticities data, which are further complemented with most recent estimates from literature (table 3).

Examples of investment scenarios in agricultural research and development

For illustration matter, this section presents few investment scenarios developed and considered by Rosegrant et al (2017). Each of these investment scenarios considers increases of investments in one specific area of agricultural research and development (see Rosegrant, 2017). The reference scenario (REF_HGEM), which could be used for comparison of alternative investment portfolios, assumes "middle-of-the-road" changes in population and income and rapid climate change. These assumptions are based on the IPCC's (Intergovernmental Panel on Climate Change) Shared Socioeconomic Pathway 2 (SSP2). Under the SSP2 scenario, the global population is expected to reach 9.2 billion by 2050 with an average income of USD 25,000 per person. Rosegrant et al (2017) also consider the Representative Concentration Pathway 8.5 (RCP8.5), as modeled by the HadGEM general circulation model (GCM) for climate-related scenarios simulations. More details about both SSP and RCP scenarios can be found in Van Vuuren et al. 2006, van Vuuren et al. 2007; Jones et al. 2011; and IIASA. 2013; with a comprehensive summary in Rosegrant et al., 2017). Key areas of investment considered in the reference scenarios are related to agricultural research and infrastructure development where livestock, as a subsector of agriculture, is also supposed to benefit from these investments. Like crop production, it is assumed that Livestock productivity would be enhanced through increased and targeted research and infrastructure investments. (See Rosegrant et al., 2017 for more details).

Table1. Examples of policy and investment scenarios which could benefit the Livestock sector in Africa

Scenario Grouping	Scenario	Scenario Description
Reference	REF_HGEM	Reference scenario with RCP 8.5 future climate using HadGEM GCM. This scenario is considered as the BAU one.
	REF_NoCC	Alternate reference with no climate change (constant 2005 climate).
Productivity Enhancement	MED	Medium increase in investment across the CGIAR portfolio. This scenario provides an indication of the sensitivity of outcomes to levels of investment, specified to have an intermediate level of investment between the BAU and the HIGH scenario (below).
	HIGH	High increase in investment across the CGIAR portfolio. The HIGH scenario costs approximately 70 percent more than MED.
	HIGH+NARS	This scenario simulates high increase in investment across the CGIAR portfolio in addition to complementary NARS investments.
	HIGH+RE	High increase in investment across the CGIAR portfolio plus increased research efficiency. This scenario simulates higher CGIAR research efficiency so that the yield impact of investments is 30 percent higher and the maximum improvement is achieved by 2040, (five years earlier than in the HIGH scenario).
Improved Infrastructure	RMM	Infrastructure improvements to improve market efficiency through the reduction of transportation costs and marketing margins. This scenario assumes a mix of infrastructure improvements throughout the economies of developing countries, focusing primarily on improvements to transportation infrastructure (road building, road maintenance, and railroads) and increased rural electrification.

Note: The monetary value of each of these investments in the considered regions/countries can be found in Rosegrant et al 2017.

Two reference scenarios are presented in Table 1: REF_HGEM and REF-NoCC. As alternative investment scenarios, one can consider productivity enhancement, and infrastructural improvement investments (RMM). Specifically, in the productivity enhancement scenarios, Rosegrant et al (2017) considers medium (MED) and high (HIGH) international research investments, high investment combined with national governments complementary investments (HIGH+ NARS), and also a high level of investment combined with investment on increased research efficiency (HIGH+ RE). Productivity enhancement scenarios presented in Table 1 are research oriented and consider enhanced productivity through higher CGIAR agricultural research investments with and without a significant contribution from the NARS. The last scenario considers improved marketing efficiency through increased investment in

infrastructure. Description of the considered scenarios is further presented in Table 1. Each of these scenarios is associated with a given assumption of investment amounts in the sampled countries (See Rosegrant et al., 2017 for more details).
For further applying our methodological framework in this report, we opted for a sub-set of simple scenarios only assuming different economic growth and climate change trends. Accordingly, the three scenarios were developed according to the demand level, either it is optimal, base or pessimist (see Table 2 below). These scenarios will be used to simulate their effect on key livestock indicators in Tanzania and Burkina Faso.

Table 2. description of simplistic scenarios used for the application of the methodology

Scenario name	Description
Scenario 1: The optimal demand	Shared Socioeconomic Pathway 1; Representative Concentration Pathway 6.0; Institut Pierre Simon Laplace's Earth System Model (IPSL-CM5A-LR or IPSL; Dufresne et al. 2013)
Scenario 2: The base demand	Shared Socioeconomic Pathway 2; Representative Concentration Pathway 6.0; Institut Pierre Simon Laplace's Earth System Model (IPSL-CM5A-LR or IPSL; Dufresne et al. 2013)
Scenario 3: The pessimist demand	Shared Socioeconomic Pathway 4; Representative Concentration Pathway 6.0; Institut Pierre Simon Laplace's Earth System Model (IPSL-CM5A-LR or IPSL; Dufresne et al. 2013)

Selection and background information on a set of SSA countries

Western and Eastern Africa regions are the countries which are the mostly relevant for investigating the impact of R&D investments on Livestock sector. This section presents macro-economic characteristics of these countries. The western African countries we considered for this description include Nigeria, Ghana, Niger, Mali, and Senegal; and the Eastern African countries includes Ethiopia, Kenya, Sudan, Uganda, and Tanzania. Note that economies of the western and eastern African countries are dominated by agriculture, with high contribution of this sector to national GDPs: (between 22% and 50%) (FAO, 2017). Accordingly, it is expected that livestock investments as strongly related to agricultural investments would have high implications on employment in these regions (Diao et al., 2010a, 2010b, 2007; Hazell et al., 2010). More background information about the considered countries can be found in Tables 3 and 4.

Table3. General characteristics of agricultural sectors in a set of African countries.

		Aggregated crop yield (2010 values)*	% of agricultural land (2009)**	% of permanent crops (2009)**	Share of agricultural GDP (2009)**	Food availability per capita (2010)**
Western Africa	Nigeria	4.01	81.8	3.3	32.7	580
	Ghana	4.06	68.1	12.3	31.7	718
	Niger	0.51	34.6	0	39.6	401
	Mali	1.25	33.7	0.1	36.7	378
	Senegal	1.72	49.4	0.3	16.6	345
Eastern Africa	Ethiopia	2.07	35	1	50.7	307
	Kenya	3.7	48.1	1.1	22.6	411
	Sudan	1.69	57.5	0.1	29.7	516
	Uganda	3.9	69.9	11.3	24.7	555
	Tanzania	2.2	40.1	1.7	28.8	481
	Burkina Faso	Na	48.43	0.59	Na	Na

**Rosegrant et al., 2017; ** FAO data.*

Table 4. Infrastructure, research, and labor productivity indicators of a set of African countries.

Country Name	Electric power consumption (kWh per capita)- 2014 data	Access to electricity (% of population) – 2016 data	Labor force, female (% of total labor force)- 2017 data	Research and development expenditure (% of GDP) -	GDP per person employed (constant 2011 PPP $) – 2017 data
Ethiopia	69.7	42.9	47.3	0.604[b]	3647.1
Ghana	354.7	79.3	49.5	0.376[c]	9113.0
Kenya	166.7	56	48.4	0.785[c]	8651.9
Mali	na	35.0	43.0	0.583[c]	6045.3
Niger	51.4	16.2	43.4	na	2350.1
Nigeria	144.4	59.3	45.4	0.219[d]	18612.2
Sudan	190.2	38.5	25.7	0.298[e]	18416.4
Senegal	223.4	64.5	41.3	0.541[c]	7920.7
Tanzania	99.1	32.8	48.8	0.528[b]	5777.6
Uganda	na	26.7	47.9	0.475[c]	4871.0
Burkina Faso	na	19,16	44,6	0,111 [d]	4871,8

Source: The World Bank Open Data (https://data.worldbank.org/indicator); a: 2015 value; b: 2013 value; c: 2010 value; d: 2007 value; e: 2005 value.

Table 5. A selection of employment elasticity values for a set of African Countries.

		Elasticity values from literature					Average elasticities (from literature)	Standard Deviation	Coefficient of variation	Elasticity values for sensitivity analysis			
		Kapsos (2005) (1991-2003)	Ben Slimane (2015) (2000-2011)	World Bank (2011) (2000-2008)	UNCTAD (2013) (2000-2008)	Bhorat (2015) (2000-2008)				Mean + 10%	Mean + 30%	Mean - 10%	Mean - 30%
Western Africa	Nigeria	1.11	0.38	n.a	n.a	0.37	0.62	0.43	0.69	0.68	0.81	0.56	0.43
	Ghana	0.73	0.55	n.a	n.a	0.5	0.59	0.12	0.20	0.65	0.77	0.53	0.41
	Niger	0.67	1.14	n.a	0.56	1.11	0.87	0.30	0.34	0.96	1.13	0.78	0.61
	Mali	0.49	0.78	n.a	0.41	0.38	0.52	0.18	0.35	0.57	0.67	0.46	0.36
	Senegal	0.80	n.a	n.a	0.75	0.49	0.68	0.17	0.24	0.75	0.88	0.61	0.48
Eastern Africa	Ethiopia	0.82	0.55	n.a	0.58	n.a	0.65	0.15	0.23	0.72	0.85	0.59	0.46
	Kenya	1.96	0.84	n.a	n.a	0.8	1.20	0.66	0.55	1.32	1.56	1.08	0.84
	Sudan	0.68	0.54	n.a	0.35	n.a	0.52	0.16	0.31	0.57	0.68	0.47	0.37
	Uganda	0.34	0.41	n.a	0.46	n.a	0.40	0.06	0.15	0.44	0.52	0.36	0.28
	Tanzania	0.96	0.54	n.a	0.25	n.a	0.58	0.36	0.61	0.64	0.76	0.53	0.41

Average CV value is about 30%. Maximum variation of 30% for the sensitivity analysis is chosen on this basis.

Source of “employment elasticities”

The GDP-employment elasticities for the 10 sampled countries were collected from different literature references and sources (Table 5). While the approaches used for the estimation of these elasticities are mixed, their estimation period ranges between 2003 and 2011 (Table 5). Average elasticities for each country are calculated as the mean of a minimum of three values available from three different sources. It is found that the average coefficient of variation (CV) of elasticities we used in the present study for the set of 10 sampled countries was about 33%. Taking this into account we performed a sensitivity analysis on the elasticities by reviewing results at ± 10% and ± 30% intervals (Table 5).

Application of the methodological approach

In the present section we have chosen two countries as case studies, the first, Burkina Faso, located in West Africa; and the second, Tanzania, located in East Africa. GDP, GDP per capita and production value (calculated under two commodities: 1- all animal (AllA), and 2- crop and animal (All)) have been calculated based on the three selected scenarios (see table 2) for the years 2020, 2030, 2040 and 2050. The data on GDP, GDP per capita and production value for the years 2020, 2030, 2040 and 2050, under the different scenarios are shown in table 6, 7 and Figures 1 & 2.

Table 6: Total GDP and GDP per capita according to the three scenarios in Burkina Faso and Tanzania

		Burkina Faso		Tanzania	
		Total (billion 2005 USD)	Per capita (thousand 2005 USD per person)	Total (billion 2005 USD)	Per capita (thousand 2005 USD per person)
Base demand	2010	18.709	1.1360	56.273	1.2549
	2020	34.931	1.6197	106.837	1.8306
	2030	66.267	2.4282	213.831	2.9281
	2040	121.424	3.6646	397.54	4.5122
	2050	220.999	5.7251	702.113	6.8664
optimal demand	2010	18.709	1.1360	56.273	1.2549
	2020	34.144	1.6367	103.978	1.8467
	2030	71.961	2.8576	227.49	3.3774
	2040	155.782	5.3288	496.912	6.4232
	2050	312.921	9.62	975.595	11.475
pessimist demand	2010	18.709	1.1360	56.273	1.2549
	2020	35.362	1.5956	107.876	1.8058
	2030	59.462	2.0326	190.579	2.4466
	2040	86.54	2.3192	289.508	2.9563
	2050	121.9	2.6565	418.349	3.5141

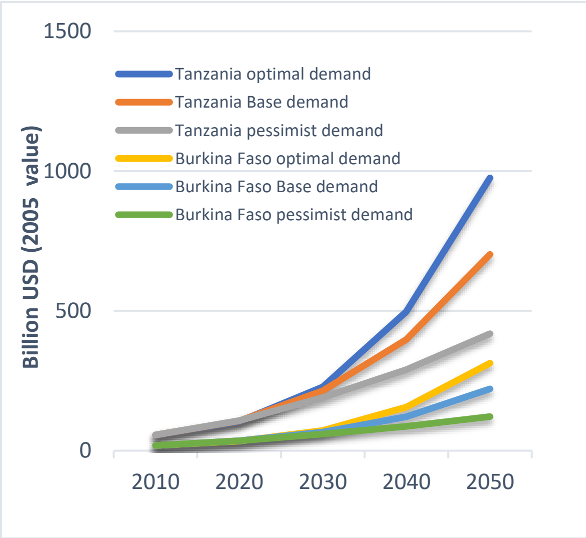

Figure1: Total GDP according to the three scenarios in Burkina Faso and Tanzania

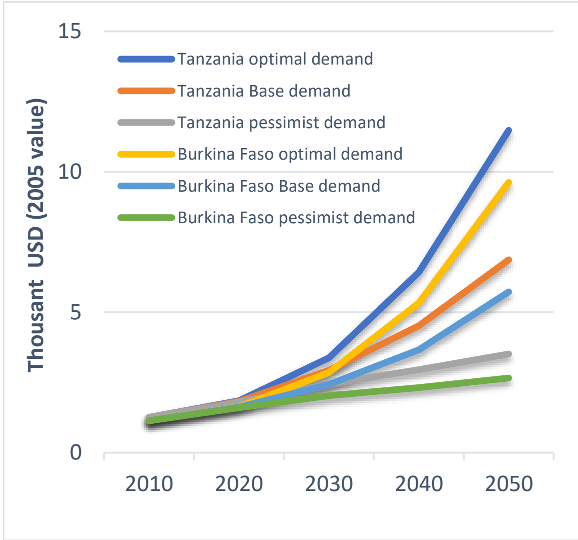

Figure2: GDP per capita according to the three scenarios in Burkina Faso and Tanzania

Table 7: Production value according to the three scenarios in Burkina Faso and Tanzania

Scenario name	Time Horizon	Burkina Faso		Tanzania	
		AIIA (Million)	AII (Million)	AIIA (Million)	AII (Million)
Base demand	2020	1.953	4.980	4.513	20.098
	2030	2.796	6.742	6.534	27.264
	2040	3.680	8.608	8.564	34.105
	2050	4.500	10.440	10.238	40.305
optimal demand	2030	1.928	4.894	4.461	19.704
	2020	2.917	6.826	6.796	27.295
	2040	4.167	9.204	9.658	35.565
	2050	5.254	11.424	11.963	42.362
pessimist demand	2020	1.930	4.951	4.462	19.950
	2030	2.657	6.552	6.214	26.403
	2040	3.250	7.999	7.560	31.669
	2050	3.573	9.084	8.103	35.471

Source: calculations from the IMPACT model.

To calculate the change in the employed population, one effective way would be to use five elasticity values: based on the confirmed one which is the average of elasticities from literature, we developed for example four others with different variations (-30%, -10%, +10% and +30%) as expressed in the table 5. In the current application, we are planning to use the elasticity values of Tanzania for both countries (Burkina Faso and Tanzania). We have chosen 2010 as the year of refence and the base demand scenario as BAU. More information about different variable used to calculate the change in the employed population are summarized in table 7 below.

Table 8: values of variables used to calculate the change in the employed population

	Burkina Faso	**Tanzania**
Average elasticities (from literature)	0.58	0.58
Elasticity (mean +30%)	0.64	0.64
Elasticity (mean+10%)	0.76	0.76
Elasticity (mean -10%)	0.53	0.53
Elasticity (mean -30%)	0.41	0.41
Active population in reference year (thousand)	5 906.179	20 977.917

The change in the employed population for Burkina Faso and Tanzania, under the considered scenarios (table 2), and as suggested by equation 1, is expressed in table 9 and 10 consecutively.

Table 9: Average percentage annual growth of employment in Burkina Faso under the different considered scenarios

	Elasticity used for the calculation (average + sensitivity analysis)	2020	2030	2040	2050
Pessimist demand	Average elasticities	0.13	-1.05	-3.60	-7.68
	Elasticity (mean+30%)	0.18	-1.38	-4.72	-10.06
	Elasticity (mean +10%)	0.15	-1.16	-3.98	-8.47
	Elasticity (mean -10%)	0.12	-0.96	-3.29	-7.02
	Elasticity (mean -30%)	0.09	-0.75	-2.55	-5.43
Optimal demand	Average elasticities	-0.24	0.88	3.55	7.12
	Elasticity (mean+30%)	-0.32	1.16	4.65	9.34
	Elasticity (mean +10%)	-0.27	0.97	3.92	7.86
	Elasticity (mean -10%)	-0.22	0.81	3.24	6.51
	Elasticity (mean -30%)	-0.17	0.62	2.51	5.04

Table 10: Average of percentage annual growth of employment in Tanzania under the different considered scenarios

		2020	2030	2040	2050
Pessimist demand	Average elasticities	0.11	-1.20	-3.71	-7.31
	Elasticity (mean+30%)	0.14	-1.57	-4.86	-9.58
	Elasticity (mean +10%)	0.12	-1.32	-4.10	-8.07
	Elasticity (mean -10%)	0.10	-1.09	-3.39	-6.68
	Elasticity (mean -30%)	0.08	-0.85	-2.62	-5.17
Optimal demand	Average elasticities	-0.29	0.70	3.41	7.05
	Elasticity (mean+30%)	-0.39	0.92	4.47	9.23
	Elasticity (mean +10%)	-0.33	0.78	3.77	7.78
	Elasticity (mean -10%)	-0.27	0.64	3.12	6.44
	Elasticity (mean -30%)	-0.21	0.50	2.41	4.98

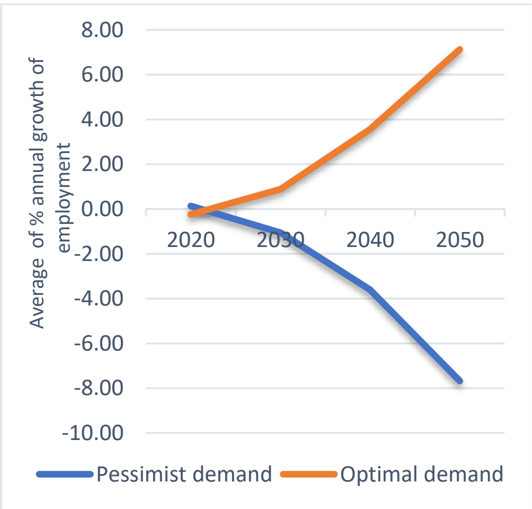

Figure 3: Average percentage annual growth of employment in Burkina Faso under the different considered scenarios

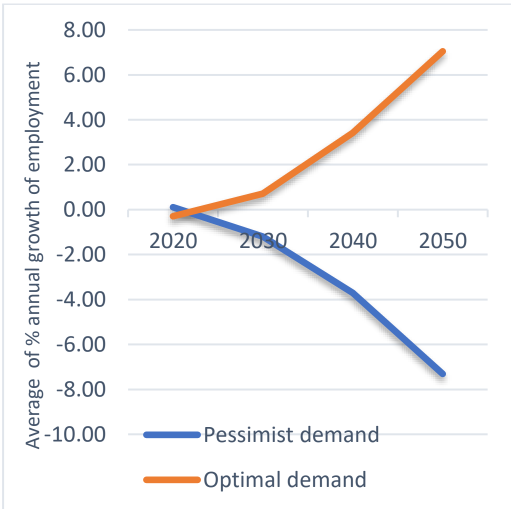

Figure 4: Average percentage annual growth of employment in Tanzania under the different considered scenarios

Both countries revealed the same curve progression, in the case of pessimist demand scenario, the values of change in the employed population are negative and the curve is decreasing in Burkina Faso as in Tanzania, results are explained by the fact that base demand scenario has been chosen as BAU so, in the situation of pessimist demand scenario we are going to lose some of that employments that were supposed to be created.

Conclusion

This report provides an overview of a methodological framework which can help assessing the impact of agricultural research and development investment scenarios on generating employment in the agricultural sector and beyond. The framework was tested for simplistic climate change and economic growth scenarios in the case of Tanzania and Burkina Faso. In terms of perspectives, it would be more interesting to further elaborate livestock-related investments scenarios, assess their respective impact on livestock productivity and agricultural GDP growth, and thus generate some related employment figures.

References

Arega D. Alene, Abebe Menkir, S. O. Ajala, B. Badu-Apraku, S. Olanrewaju, V. M. Manyong, Abdou Ndiaye. 2009. The economic and poverty impacts of maize research in West and Central Africa., Agricultural Economics 40 (2009) 535–550

Bezu, S and Holden S. 2014. Are youth in Ethiopia abandoning agriculture? World Development 64 : 259-272.

Diao, X., Hazell, P., Resnick, D., Thurlow, J., 2007. The role of agriculture in development – Implications for Sub-Saharan Africa. IFPRI, Washington, DC.

Diao, X., Hazell, P., Thurlow, J., 2010a. The Role of Agriculture in African Development. World Dev. 38, 1375–1383. https://doi.org/10.1016/j.worlddev.2009.06.011

Diao, X., Hazell, P., Thurlow, J., 2010b. The Role of Agriculture in African Development. World Dev. 38, 1375–1383. https://doi.org/10.1016/j.worlddev.2009.06.011

FAO (Food and Agriculture Organization of the United Nations). 2017. FAOSTAT: Government Expenditure. Rome: FAO. Available from URL: http://www.fao.org/faostat/en/#data/IG, [Accessed July 07, 2017]

Hazell, P., Poulton, C., Wiggins, S., Dorward, A., 2010. The Future of Small Farms: Trajectories and Policy Priorities. World Dev. 38, 1349–1361. https://doi.org/10.1016/j.worlddev.2009.06.012

IIASA. 2013. SSP Database version 1.0. Accessed at https://tntcat.iiasa.ac.at/SspDb on 2015-05-10 23:13:16.

Jones, C.D., J.K. Hughes, N. Bellouin, S.C. Hardiman, G.S. Jones, J. Knight, S. Liddicoat, F.M. O'Connor, R.J. Andres, C. Bell, K.O. Boo, A. Bozzo, N. Butchart, P. Cadule, K.D. Corbin, M. Doutriaux-Boucher, P. Friedlingstein, J. Gornall, L. Gray, P.R. Halloran, G. Hurtt, W.J. Ingram, J.F. Lamarque, R.M. Law, M. Meinshausen, S. Osprey, E.J. Palin, L.P. Chini, T. Raddatz, M.G. Sanderson, A.A. Sellar, A. Schurer, P. Valdes, N. Wood, S. Woodward, M. Yoshioka, and M. Zerroukat. 2011. "The HadGEM2-ES implementation of CMIP5 Centennial Simulations." Geoscientific Model Development 4 (3): 543–570.

Kapsos S. 2005. The employment intensity to growth: Trends and macroeconomic determinants. Employment Strategy Papers 12/2005. International Labor Office (ILO). Employment Trends Unit.

OECD-FAO (Organization for Economic Co-operation and Development –Food and Agriculture Organization of the United Nations). 2016. OECD-FAO Agricultural Outlook 2016-2025: Special focus: Sub-Saharan Africa. Paris: OECD Publishing. Available from the URL: http://www.fao.org/3/a-i5778e.pdf, [accessed on 07, July, 2017].

Rosegrant, Mark W.; Sulser, Timothy B.; Mason-D'Croz, Daniel; Cenacchi, Nicola; Nin-Pratt, Alejandro; Dunston, Shahnila; Zhu, Tingju; Ringler, Claudia; Wiebe, Keith D.; Robinson, Sherman; Willenbockel, Dirk; Xie, Hua; Kwon, Ho-Young; Johnson, Timothy; Thomas, Timothy S.; Wimmer, Florian; Schaldach, Rüdiger; Nelson, Gerald C.; and Willaarts, Barbara 2017. Quantitative foresight modeling to inform the CGIAR research portfolio. Project Report for USAID. Washington, D.C.: International Food Policy Research Institute (IFPRI). http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/131144

UN (The United Nations). 2015. World population prospects, the 2015 revision. New York: Department of Economics and Social Affairs. Available from URL: http://esa.un.org/unpd/wpp/Download/Standard/Population/, [Accessed 06, April 2016].

van Vuuren, D. P., B. Eickhout, P. L. Lucas, and M.G.J. den Elzen. 2006. "Long-term multi-gas scenarios to stabilise radiative forcing—Exploring costs and benefits within an integrated assessment framework." The Energy Journal, 27: 201-233. http://www.jstor.org/stable/23297082

van Vuuren, D., M.G.J. den Elzen, P.L. Lucas, B. Eickhout, B.J. Strengers, B. van Ruijven, S. Wonink, and R. van Houdt. 2007. "Stabilizing greenhouse gas concentrations at low levels: An assessment of reduction strategies and costs." Climatic Change 81(2): 119-159. doi: 10.1007/s10584-006-9172-9.

World Bank. 2017. World Development Indicators: Employment in Agriculture. Washington DC.: World Bank. Available from URL: http://data.worldbank.org/indicator/NY.GDP.PCAP.CD?view=chart, [Accessed 07, July 2017].