InfoBrief 2

Capacity Strengthening of SGCs to Measure Economic Sub-Sector Innovation Performance in Sub-Saharan Africa

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SUMMARY

In many African economies, the link between STI and economic growth (and competitiveness and wellbeing) has not been clearly demonstrated. For innovation to work for society, R&D and innovation activities-wherever they are performed-must be properly managed, well-documented and the results disseminated as part of national statistics. There is an urgent need for government entities such as Science Granting Councils (SGCs) to understand African economies which are remarkably diverse in terms of markets, research and innovation systems, education systems, the institutional environment, and political conditions. Strong R&D and innovation systems are required to drive economic growth, competitiveness and wellbeing. Building strong R&D and innovation systems is not possible without an in-depth understanding of the attributes related to the performance of such systems, particularly the investments in research and innovation activities, the personnel that perform the activities, the supporting infrastructure, and institutional settings. The extent to which R&D activities performed in African countries are funded from abroad (or Rest of the World) is an important policy issue that has elicited debates in different fora on the African continent. The granularity of data collected for each attribute from the smallest unit of analysis, where the economic activity of interest takes place, should address the robustness of the STI indicators required for policymaking and the decision-making processes at different levels of institutional operations.

1. BACKGROUND AND CONTEXT OF PERFORMANCE MEASUREMENT

Innovation and research are key drivers for economic growth, competitiveness, and they provide solutions to societal grand challenges (e.g. health, food security, water, energy and many more). If national developments are clear in pursuing both, improved economic conditions would impact positively on living standards and human well-being. For innovation to work for society, R&D and innovation activities-wherever they are performed-must be properly managed, well-documented and the results disseminated as part of national statistics. In many African economies, the link between STI and economic growth (and competitiveness and wellbeing) has not been clearly demonstrated. There is an urgent need for government entities such as Science Granting Councils (SGCs) to understand African economies which are remarkably diverse in terms of markets, research and innovation systems, education systems, the institutional environment, and political conditions[1]. Strong R&D and innovation systems are required to drive economic growth, competitiveness and wellbeing. Building strong R&D and innovation systems is not possible without an in-depth understanding of the attributes related the performance of such systems, particularly the investments in research and innovation activities, the personnel that perform the activities, the supporting infrastructure, and institutional settings (i.e. leadership, structure, networks, norms, rules, and policies). The granularity of data collected for each attribute should address the robustness of the indicators. These indicators in turn should help SGCs to create operational solutions and solve societal challenges in line with their National Development Plans.

The level of understanding required should be anchored on extraordinary knowledge[2] of the national innovation and R&D systems. The analysis of innovation in the economic sub-sectors and their contribution to economic growth or the potential of such innovation to create jobs and wealth is a must. To understand how national innovation systems can deliver on jobs and prosperity, SGCs need to; *collect relevant data, analyze and use high quality microdata for insights, and report on the insights to decision makers*. SGCs must be able to fulfill this function in collaboration with other government agencies. Throughout the African continent, many organizations (government and non-governmental) talk about the good work that they are doing on R&D and innovation but the results of their work are not reflected in the national statistics in a way or manner that renders *actionable information available to the policymaker or decision*

[1]Sara Grobbelaar and Sylvia Schwaag Serger (2016). STIAS-Wallenberg Roundtable on Innovation for Prosperity: realising innovation opportunities in Sub-Saharan Africa (SSA), 2nd Edition

[2]Knowledge is the awareness of information, and its interpretation, organization, synthesis and prioritization, to provide insights and understanding (Financial Times Guides. INVESTING, THE DEFINITIVE COMPANION TO INVESTMENT AND THE FINANCIAL MARKETS. 3rd Edition (2014), Glen Arnold

maker. There is an urgent need for SGCs to collect microdata and analyze such data to provide detailed micro-level information on the *characteristics of the smallest unit of enquiry within R&D and innovation systems*. How could R&D and innovation systems be mapped to inform policymakers or decision makers? How could the R&D and innovation systems be informed by the work in other policy domains such as education and skills training, health, trade, financing, sanitation, energy, transportation, agriculture, or regulation? There is a need for robust indicators, but the robustness depends on how well SGCs know their operational context at the smallest unit of analysis level.

To start *measuring R&D and/ or innovation at the smallest unit of inquiry*, there is need for a better map that is different from the one that takes the entire country as the unit of analysis. The new map should also identify *new sources of data* (e.g. web, open, big data, face-to-face and more) and analytics (e.g. Machine Learning, data mining, etc.). Each of the SGCs should continuously check for the attributes of an R&D or innovation systems they are good at measuring, the value of data and the aspects that must be improved. Any measurement system should rely on a continuous feedback from a broad range of stakeholders to get information on whether; the right indicators are being used to evaluate the efforts, what would be the right indicators, how could data on these indicators be collected, and what would be the best way to support and communicate the results of work to decision makers at different levels of government or private business.

The African Innovation Outlook 3 (AIO3) results (*published and unpublished*) provide a first level of understanding of R&D and innovation performance at the national level. However, the results also show that more work needs to be done to improve the collection of quality and high-coverage data on R&D and innovation[3]. The African Union Development Agency (AUDA-NEPAD) is working together with AU Member States (Burkina Faso, Senegal, Ethiopia and Mozambique who are part of the Science Granting Council Initiative (SGCI)) to strengthen their capabilities to collect and use high-quality data on R&D and innovation to design socio-economic interventions. This *InfoBrief* is based on R&D data submitted by 23 countries for AIO3 and current work on measurement of economic sub-sector innovation performance. Among the countries that submitted data for AIO 3, there are 10 countries whose SGCs[4] directly participated in the surveys (Tables 1 and 2). Table 1 shows the important attributes (as national aggregates) that SGCs need to consider when *contextualizing the R&D and innovation data*.

[3] Thompson, Kristi Anne. "Data in development: An overview of microdata on developing countries." IASSIST Quarterly 33.4 (2009): 25.
[4]Eleven out of 15 SGCs participating in the Science Granting Council Initiative

The population size, GDP per capita and the contribution of the manufacturing, services, industry and agriculture sectors to national GDP. The attributes are different for the 11 countries, providing the context within which each SGCs operates from. Data should be collected at smallest unit of analysis where the specific economic activity is performed. Data collected from such a unit of analysis level contributes to the required robustness of the indicators for R&D and innovation performance in both policymaking and decision-making processes.

Country	Population, total (millions)	GDP PPP$ (billions)	GDP per capita PPP$	Manufacturing, value added (% of GDP)	Services, value added (% of GDP)	Industry, value added (% of GDP)	Agriculture, value added (% of GDP)
Angola	27.86	184.85	6635.24	7.06	30.37	53.13	9.44
Botswana	2.21	36.13	16352.55	6.41	64.44	26.71	2.44
Burkina Faso	18.11	30.78	1699.88	7.38	45.08	13.79	33.75
Cape Verde	0.53	3.36	6302.49	5.44	69.83	14.53	10.20
DRC	76.20	60.86	798.74	18.53	35.01	26.59	19.87
Egypt	93.78	1008	10750.46	16.50	52.54	19.7	11.26
Ethiopia	99.87	163.04	1632.55	4.79	43.03	12.95	39.23
Gabon	1.93	34.6	17928.70	3.13	44.50	47.69	4.68
Ghana	27.58	115.42	4184.58	5.33	51.42	22.26	20.99
Kenya	47.24	142.63	3019.58	10.33	47.61	8.76	33.30
Lesotho	2.17	6.27	2883.81	16.32	57.81	20.32	5.55
Mali	17.47	35.69	2043.72	3.11	38.27	16.64	41.98
Mozambique	28.01	33.35	1190.75	10.01	53.23	11.56	25.20
Namibia	2.43	25.77	10610.55	10.74	62.47	20.29	6.50
Niger	19.90	19.16	963.25	6.23	41.38	12.97	39.42
Rwanda	11.63	21.24	1827.19	6.35	51.55	11.93	30.17
Senegal	14.98	36.58	2442.64	13.50	59.26	10.32	16.92
Seychelles	0.09	2.54	27180.62	8.45	69.78	19.13	2.64
South Africa	55.29	727.88	13164.48	13.39	68.52	15.77	2.32
Eswatini	1.32	10.89	8261.75	33.92	51.63	4.21	10.24
Tanzania	53.88	138.75	2652.53	5.69	42.16	20.69	31.46
Togo	7.42	10.65	1436.90	4.93	40.67	13.74	40.66
Uganda	40.14	71.21	1774.01	9.47	52.14	12.3	26.09

Table1. The economic structure of all countries that submitted data on R&D and innovation for AIO3[5]

Out of the 11 SGC countries, there are no SGCs from the Small Island Developing States (SIDS), there are six SGCs from coastal nations (Kenya, Ghana, Mozambique, Namibia, Senegal, and Tanzania) while five (Botswana, Burkina Faso, Ethiopia, Rwanda and Uganda) are

[5]*The Table shows the contribution of economic sectors to country GDP for 2015 (Source: World Development Indicators database accessed April 2018*

from landlocked nations. The geographical location could affect the choice of economic sector to perform more R&D activities. The economies of the 11 countries are dominated by the services sectors whose contribution to GDP ranges from 42-64% (Table 1). An important question for SGCs when they are designing interventions should be whether to have more projects in the services sector or the other three sectors. *What (and where) are the business entities responsible for which economic activity?* The need for micro-level data to inform such choices as part of the decision-making process cannot be overemphasized. The distribution of the Gross Domestic Expenditure on Research and Development (GERD) at different levels of the national R&D and innovation systems is critical as *a planning input and an advocacy tool for SGCs*. This InfoBrief would focus more on GERD for the SGC countries that submitted complete datasets. The SGCs from Botswana, Ethiopia, Mozambique, Namibia and Uganda submitted complete datasets (Table 2) and their GERD could be calculated. Later, some examples of detailed financial flows depicting interactions across sectors are shown.

No	Country	Business		Government		Higher Education		PNP	
		R&D Expenditure	R&D Personnel	R&D Expenditure	R&D Personnel	R&D Expenditure	R&D Personnel	R&D Expenditure	R&D Personnel
1	Angola	–	–	✓	✓	✓	✓	–	–
2	Botswana	✓	✓	✓	✓	✓	✓	✓	✓
3	Burkina Faso	–	–	✓	✓	✓	✓	✓	✓
4	Cape Verde	–	–	–	✓	–	✓	–	–
5	DRC	–	–	✓	✓	–	–	–	–
6	Egypt	✓	✓	✓	✓	✓	✓	✓	✓
7	Ethiopia	✓	✓	✓	✓	✓	✓	✓	✓
8	Gabon	–	✓	–	✓	–	✓	–	✓
9	Ghana	–	–	✓	✓	✓	✓	–	–
10	Kenya	–	–	–	–	–	✓	–	–
11	Lesotho	–	–	✓	✓	✓	✓	–	–
12	Mali	–	–	✓	✓	✓	✓	✓	✓
13	Mozambique	✓	✓	✓	✓	✓	✓	✓	✓
14	Namibia	✓	✓	✓	✓	✓	✓	✓	✓
15	Niger	–	–	✓	✓	✓	✓	✓	✓
16	Rwanda	–	–	✓	✓	✓	✓	✓	✓
17	Senegal	–	–	✓	✓	✓	✓	✓	✓
18	Seychelles	–	✓	✓	✓	✓	✓	–	✓
19	South Africa	✓	✓	✓	✓	✓	✓	✓	✓
20	Eswatini	✓	✓	✓	✓	✓	✓	✓	✓
21	Tanzania	–	–	✓	✓	✓	✓	–	–
22	Togo	–	–	✓	✓	✓	✓	–	–
23	Uganda	✓	✓	✓	✓	✓	✓	✓	✓
	TOTAL	8	10	20	22	19	22	13	15

AU-8: Countries that submitted full dataset for both R&D expenditure and personnel, –: Unavailable data, NOTE: The SGCs for Botswana, Ethiopia, Namibia, Rwanda, Senegal and Uganda were directly involved in collecting data for R&D

Table 2. Twenty-three countries that submitted data from R&D surveys for AIO-3 and the characteristics of the datasets. The brown shade is for SGCs that submitted complete datasets and yellow shade is for incomplete datasets (based on R&D expenditures by sources of funding and sectors of R&D performance and characteristics of R&D personnel) across the four institutional sectors namely; Business enterprise, Government, Higher education institutions, and Private non-profit

2. CONTEXT: Distribution of Gross Domestic Expenditure on R&D Among SGCs Countries

GERD is an essential measure for R&D activity performance (Box 1 and Table 3) and it helps SGCs to understand the following attributes:

- How much money is allocated to perform national R&D activities;
- Who performed R&D activities;
- Where the R&D activities were performed;
- Who funded the R&D activities;
- What types of R&D activities were performed;
- What was the purpose of performing the R&D activities;
- What are the characteristics of the personnel that performed the R&D activities; and
- What were the levels of interactions and collaborations across and among the sectors and fields of R&D.?

Box 1: Why Knowing GERD[6] is Important for SGCs

GERD is the total intramural expenditure on R&D performed in the national territory during a specific reference period

Intramural R&D expenditures are all current expenditures plus gross fixed capital expenditures for R&D performed within a statistical unit during a specific reference period, whatever the source of funds

R&D Intensity is a ratio of GERD divided by gross domestic product

BERD is the measure of expenditures on intramural R&D within the Business enterprise sector during a specific reference period**. BERD Intensity** is a ratio of BERD divided by GDP, as %.

GOVERD is the measure of expenditures on intramural R&D within the Government sector during a specific reference period. **GOVERD Intensity** is a ratio of GOVERD divided by GDP, as %.

HERD is the measure of intramural R&D expenditures in the Higher education sector during a specific reference period**. HERD Intensity** is a ratio of HERD divided by GDP, as %**.**

PNPERD is the measure of intramural R&D expenditures within the Private non-profit sector during a specific reference period**. PNPERD Intensity** is a ratio of PNPERD divided by GDP, as %**.**

The collection of data on these attributes provide useful information on resources (e.g. money, labour, R&D infrastructure (buildings, equipment, software), consumables, electricity, etc.) allocated by different actors for R&D activities performed in the four sectors of the economy (see Box 1). How the GERD is calculated and distributed by the sectors of R&D performance is shown in Table 3. Among the SGC countries, the higher education sector had the highest share of GERD ranging from $14.72 million for Rwanda to $577 million for Ethiopia. Further studies or collection of data (and analysis) on the actual projects that contributed to these R&D expenditures are critical for SGCs to gain a better understanding of what activities were being funded and why. A deeper understanding of the smallest units of analysis for sectors in which

[6]All the definitions in Box 1 are from the Frascati Manual 2015

R&D activities are performed could shade light on the maturity of the R&D systems and help to predict the impact of increased investments. Although the higher education sector in most African countries is heterogeneous, public expenditure is relatively higher than in other sectors. For all the SGCs, the proportion of GERD spent on R&D activities performed by the business sector was less than 20% of GERD compared to a high of 46% for South Africa (Table 3).

Country	Year	GDP in Million PPP$	GERD	Business (BERD)	Government (GOVERD)	Higher Education (HERD)	Private Non-Profit (PNPERD)
Angola*	2014	175 540	42.8	–	20.14	22.66	–
Botswana	2013/2014	31 689	171.54	30.33	22.53	86.75	31.93
Burkina Faso*	2013/2014	27 738	63.31	–	22.51	37.91	2.9
Cape Verde*	2014	3 286	†	–	†	†	–
DRC*	2015	61 579	10.16	–	10.16	–	–
Egypt	2015	996 551	7520.92	467.17	2 479.96	4 569.27	4.52
Ethiopia	2013/2014	126 748	780.1	10.02	190.84	577.42	1.81
Gabon	2014	34 280	†	†	†	†	†
Ghana*	2015	116 640	400.12	–	91.35	308.77	–
Kenya	2013/2014	125 770	†	–	–	†	–
Lesotho*	2015	5 959	3.4	–	0.44	2.96	–
Mali	2015	28 924	114.09	–	55.66	0.99	57.44
Mozambique	2014/2015	29 757	112.64	0.53	48.46	42.17	21.48
Namibia	2013/2014	22 245	88.76	10.14	40.76	31.07	6.79
Niger*	2013	16 341	14.13	–	4.62	8.57	0.94
Rwanda*	2013/2014	18 704	29.96	–	6.36	14.72	8.89
Senegal*	2015	35 893	264.59	–	81.69	170.97	11.93
Seychelles*	2015	2 435	5.55	†	4.69	0.49	†
South Africa	2014/2015	683 147	4803.55	2 205.70	1123.49	1365.19	109.17
Eswatini	2015/2016	9 011	29.05	0.21	11.71	9.04	8.08
Tanzania*	2013/2014	84 884	599.44	–	231.67	367.77	n/a
Togo*	2015	10 958	28.41	–	4.89	23.52	–
Uganda	2014	66 650	116.76	5.06	54.98	53.7	3.02
TOTALS		**2 714 729**	**15 199**	**2 729**	**4 507**	**7 694**	**269**

–Sector was not surveyed, † R&D Expenditure data for the sector was either not submitted or was incomplete, *Incomplete GERD

Table 3. Gross Domestic Expenditure on R&D (GERD) in Million PPP$. The brown shade is for SGCs that submitted complete datasets and the yellow is for incomplete datasets.

Can governments achieve the objectives of their National Development Plans while investing (at low levels) mostly in one sector? The SGCs should identify this observation as a basis for reaching out to the governments. The funds used to perform R&D activities comes from different sources (Table 4).

Country	R&D financed by the Business Enterprises as % of GERD	R&D financed by the Business Enterprises as % of GDP	R&D financed by Government as % of GERD	R&D financed by Government as % of GDP	R&D financed by Other Sources as % of GERD	R&D financed by Other Sources as % of GDP
Botswana	17.68	0.0957	59.71	0.3232	22.61	0.1223
Egypt	6.20	0.0468	93.74	0.7075	0.06	0.0004
Ethiopia	1.08	0.0067	96.77	0.5956	2.15	0.0132
Mozambique	0.49	0.0018	43.5	0.1646	56.02	0.2121
Namibia	56.92	0.2271	17.39	0.0694	25.68	0.1025
South Africa	41.37	0.2909	42.90	0.3016	15.73	0.1106
Eswatini	12.72	0.0443	34.78	0.1211	52.50	0.1828
Uganda	3.42	0.0060	38.24	0.0670	58.34	0.1022

Table 4. R&D financed by Business Enterprises, Government and Other Sources for countries with participating 5 SGCs (shaded in brown) that submitted complete datasets

The government sector was the major source of funding for R&D activities performed in the five SGC countries. More specifically, the government financed from as low as 38% of GERD for Uganda to a high of 97% for Ethiopia (Table 4). The R&D activities financed from other sources is relatively high for Uganda (58%) and Mozambique (56%), but the results require further disaggregation to pinpoint the specific sources. It is a fact that African countries have made a political commitment to invest 1% of GERD to GDP in order to advance STI on the continent. When GERD is expressed as a ratio of GDP, only SGC countries Ethiopia (0.62%) and Botswana (0.52%) reported an R&D intensity of more than 0.5% (Table 4). For SGCs to effectively advocate for the AU target of 1%, countries should: (1) Clearly break down the target into realistic percentage contributions by the government and the business sectors; (2) Focus more on financing mechanisms for R&D and the potential pathways for achieving results (e.g. funding instruments, national programmes and outputs); (3) Link the target to innovation and entrepreneurship (i.e. going beyond R&D); (4) Relate the target to the framework conditions (e.g. partnerships, collaborations, financing, regulatory, trade, competition, etc.) important for the national context within which R&D, innovation and entrepreneurship take place; and (5) Formulate country-specific programmes or projects that promote basic research, applied research and commercialization of research results. Some SGC countries such as Botswana (2%) and Kenya (2%) have R&D intensity targets that are more than the 1%. For SGCs *to*

effectively advocate for the achievement of this target an in-depth understanding of GERD components is a must. In this case, the detailed sources of funding is an urgent need for SGCs to familiarize themselves with.

3. Public Expenditure on R&D: What Is the Major Source of Funds for Research Activities Performed by SGC Countries?

Governments, world-wide, invest money in R&D activities performed by different sectors of the national economy to create societal benefits. Each dollar invested as part of the public gross domestic expenditure on R&D (PubERD; calculated as GOVERD+HERD financed by Government) should directly or indirectly result in economic payback. Therefore, it is important to know the levels of GOVERD, HERD and PubERD regardless of the source of funds for the SGC countries compared to the share that is financed by government.

As shown in Table 5, the PubERD intensity for Ghana, Kenya, Senegal and Tanzania increased for 2010 (AIO-2) while Uganda reported reduced levels. Uganda's PubERD intensity significantly dropped from 1.07% (AIO-1) to 0.32% (AIO-2) then 0.16% (AIO-3). The progressive sharp decrease was caused by a corresponding decrease in funding for GOVERD and HERD while the GDP increased from $32 709 million in 2007/2008 to $47 531 million in 2010 and $66 650 in 2014. For the period 2013-2016 (AIO-3), Ethiopia, Senegal, and Tanzania increased their PubERD intensity by investing more funds for GOVERD and HERD. In 2013/2014, Ethiopia significantly increased its PubERD intensity to 0.61% by investing in HERD and GOVERD from $88.3 million (2010) to $577.4 million and $88 million to $190.8 million, respectively (Table 5). The decrease in PubERD intensity for Ghana (2015) and Mozambique (2014/2015) may have been due to moderate increases in GDP. The disaggregated data for the SGC countries highlighted in Table 5 to determine GOVERD, HERD and PubERD are regardless of the source of funds and for Table 5 the GOVERD, HERD and PubERD are financed by the government.

GOVERD+HERD for AIO-1, AIO-2 and AIO-3																				
	AIO-1						AIO-2						AIO-3							
		GDP	GOVERD	HERD	GOVERD+HERD			GDP	GOVERD	HERD	GOVERD+HERD			GDP	GOVERD	HERD	GOVERD+HERD	
Country	Year	*Amount in Million PPP$*	*Amount in Million PPP$*	*Amount in Million PPP$*	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*	Year	*Amount in Million PPP$*	*Amount in Million PPP$*	*Amount in Million PPP$*	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*	Year	*Amount in Million PPP$*	*Amount in Million PPP$*	*Amount in Million PPP$*	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*
Angola	–	–	–	–	–	–	2011	113000	61.3	24.3	85.6	0.08	2014	175 540	20.1	22.7	42.8	0.02
Botswana	–	–	–	–	–	–	–	–	–	–	–	–	2013/14	31 689	22.5	86.8	109.3	0.34
Burkina Faso	–	–	–	–	–	–	2009/10	21763	†	†	†	†	2013/14	27 738	22.5	37.9	60.4	0.22
DRC	–	–	–	–	–	–	–	–	–	–	–	–	2015	61 579	10.2	–	†	†
Egypt	–	–	–	–	–	–	2011	843842	†	†	†	†	2015	996 551	2480.0	4569.3	7049.3	0.71
Ethiopia	–	–	–	–	–	–	2010	83952	88.0	88.3	176.3	0.21	2013/14	126 748	190.8	577.4	768.3	0.61
Ghana	2007/08	31605	111.4	2.8	114.2	0.36	2010	40368	144.2	5.7	149.9	0.37	2015	116 640	91.4	308.8	400.1	0.34
Kenya	2007/08	57875	193.3	41.9	235.2	0.41	2010	66615	265.0	254.6	519.6	0.78	2013/14	125 770	–	–	–	–
Lesotho	–	–	–	–	–	–	2011	5160	–	0.5	†	†	2015	5 959	0.4	3.0	3.4	0.06
Mali	2007	22998	–	36.3	†	†	2010	17030	92.8	19.6	112.4	0.66	2015	28 924	55.7	1.0	56.7	0.20
Mozambique	2007/08	18821	36.5	–	†	†	2010	21429	54.4	35.7	90.1	0.42	2014/15	29 757	48.5	42.2	90.6	0.30
Namibia	–	–	–	–	–	–	2010	18015	†	18.6	†	†	2013/14	22 245	40.8	31.1	71.8	0.32
Niger	–	–	–	–	–	–	–	–	–	–	–	–	2013	16 341	4.6	8.6	13.2	0.08
Rwanda	–	–	–	–	–	–	–	–	–	–	–	–	2013/14	18 704	6.4	14.7	21.1	0.11
Senegal	2008	20625	33.2	40.3	73.5	0.36	2010	24200	67.9	41.0	108.9	0.45	2015	35 893	81.7	171.0	252.7	0.70
Seychelles	–	–	–	–	–	–	–	–	–	–	–	–	2015	2 435	4.7	0.5	5.2	0.21
South Africa	2007	473962	1079.9	965.5	2045.4	0.43	2010	524158	914.8	1077.0	1991.8	0.38	2014/15	683 147	1123.5	1365.2	2488.7	0.36
Eswatini	–	–	–	–	–	–	–	–	–	–	–	–	2015/16	9 011	11.7	11.4	23.1	0.26
Tanzania	2007/08	48875	98.8	126.9	225.7	0.46	2010	62000	44.3	278.1	322.4	0.52	2013/14	84 884	231.7	367.8	599.4	0.71
Togo	–	–	–	–	–	–	2010	6120	8.9	6.4	15.3	0.25	2015	10 958	4.9	23.5	28.4	0.26
Uganda	2007/08	32709	165.5	179.5	345	1.05	2010	47531	91.7	60.4	152.1	0.32	2014	66 650	55.0	53.7	108.7	0.16

–Sector was not surveyed or Survey was not conducted

† R&D Expenditure data for the sector was either not submitted or was incomplete

Table 5. The Trends of GOVERD+HERD for AIO-1, AIO-2 and AIO-3 for the 11 SGC countries (shaded in brown)

As stated earlier the flow of funds, from the government and the rest of the world, into public research and higher education institutions is an important public policy issue. The results for GOVERD, HERD, and GOVERD+HERD and the corresponding intensities, regardless of source and financed by government respectively are shown in Table 6 and Figures 1 and 2. For SGC countries, the GOVERD+HERD intensity regardless of source of funds ranged from 0.11% for Rwanda to as high as 0.61% for Ethiopia, Senegal (0.7%) and Tanzania (0.71%) while the PubERD intensity (financed by government) ranged from 0.04% for Rwanda to a high of 0.59% for Ethiopia and Senegal (0.63%) (Figure 2). Varying significant amounts of GOVERD+HERD financed from sources other than government were reported by Tanzania ($311 million), Uganda ($64.1 million), Mozambique ($42 million), Senegal ($27 million), Ethiopia ($17.3 million), Namibia ($17.1 million), Rwanda ($13.7 million) and Botswana ($9.1 million) (Figure 1).

A clearer understanding of PubERD intensity shown when the share of GOVERD financed by government for the nineteen countries was presented separately as shown in Figure 3 where GOVERD ranged from $2.3 million for Rwanda to $176.5 million for Ethiopia. When expressed as a ratio of GOVERD financed by government to GDP (as %), the intensity ranged from 0.01% for Rwanda to 0.18% for Namibia (Figure 3; Panel: GOVERD financed by Government/GDP, as %). It is noteworthy that among the SGCs, although Ethiopia is has the highest GOVERD $176.5 million, it is in the fourth position for GOVERD intensity (Figure 3). The HERD financed by government for the SGC countries ranged from as low as $5.1 million for Rwanda to a high of $574.5 million for Ethiopia. The corresponding HERD intensity ranged from 0.006% for Ghana to 0.5% for Senegal (Figure 4; Panel: HERD financed by Government/GDP, as %). The highest GOVERD plus HERD intensity, among SGC countries, financed by government was that for Senegal (0.63%) followed by Ethiopia (0.59%). Therefore, among the SGC countries, the governments of Senegal and Ethiopia were the major funders of public ERD (PubGERD).

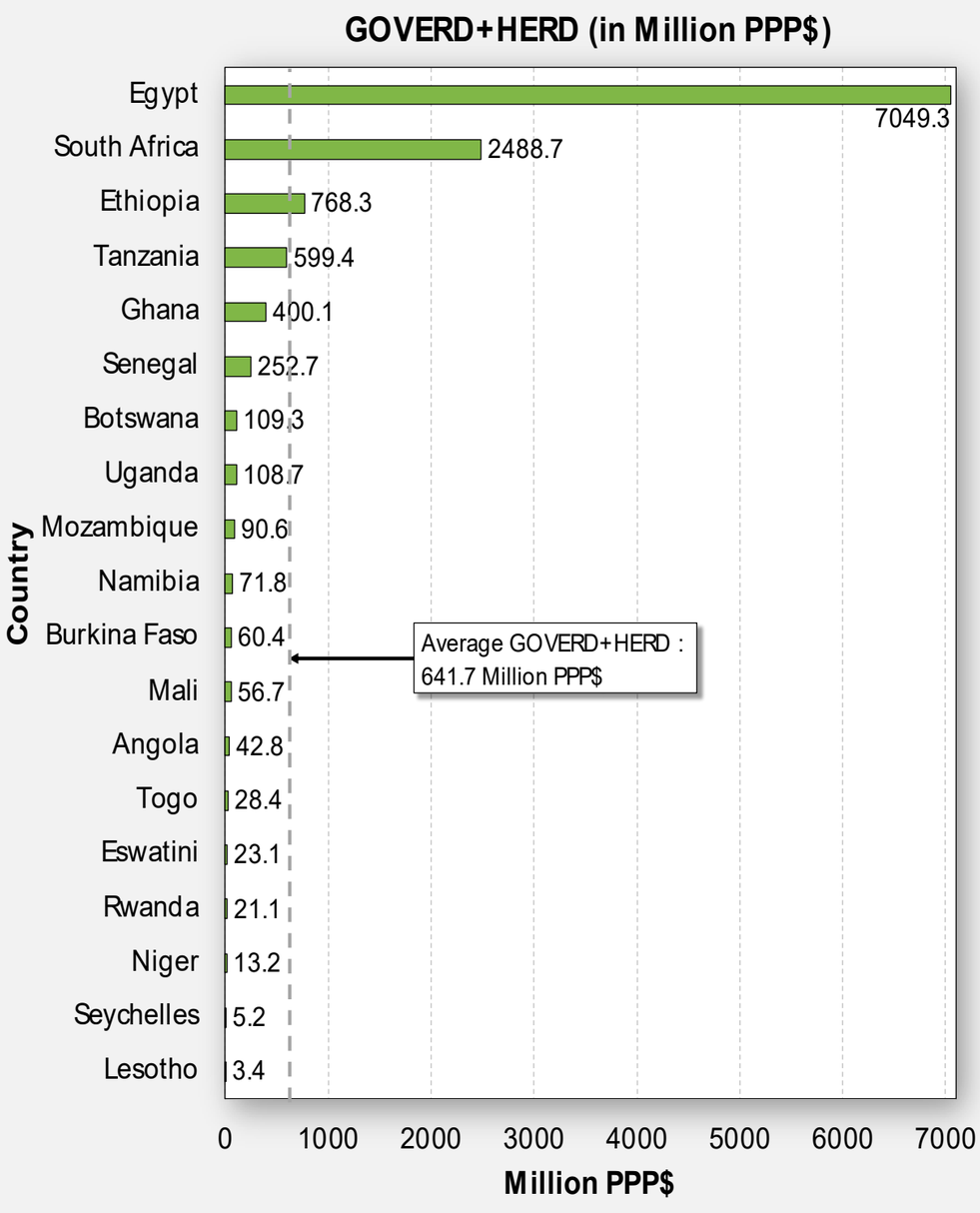
Public Expenditure on R&D (PubERD) for SGC Countries														
			GOVERD		HERD		GOVERD+HERD		GOVERD Financed by Government		HERD Financed by Government		GOVERD+HERD financed by Government (PubERD)	
Country	Survey Year	GDP (in Million PPP$)	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*	*Amount in Million PPP$*	*(Amount in Million PPP$.)/ GDP as %*
Angola	2014	175 540	20.1	0.01	22.7	0.01	42.8	0.02	20.14	0.01	22.66	0.01	42.80	0.02
Botswana	2013/14	31 689	22.5	0.07	86.8	0.27	109.3	0.34	17.19	0.05	83.01	0.26	100.20	0.31
Burkina Faso	2013/14	27 738	22.5	0.08	37.9	0.14	60.4	0.22	22.40	0.08	37.91	0.14	60.31	0.22
DRC	2015	61 579	10.2	0.02	–	–	†	†	7.14	0.01	–	–	†	†
Egypt	2015	996 551	2480.0	0.25	4569.3	0.46	7049.3	0.71	2480.00	0.25	4569.27	0.46	7049.27	0.71
Ethiopia	2013/14	126 748	190.8	0.15	577.4	0.46	768.3	0.61	176.54	0.14	574.46	0.45	751.00	0.59
Ghana	2015	116 640	91.4	0.08	308.8	0.26	400.1	0.34	†	†	6.87	0.01	†	†
Kenya	2013/14	125 770	–	–	–	–	–	–	–	–	–	–	–	–
Lesotho	2015	5 959	0.4	0.01	3.0	0.05	3.4	0.06	0.32	0.01	2.78	0.05	3.10	0.06
Mali	2015	28 924	55.7	0.19	1.0	0.01	56.7	0.20	50.90	0.18	0.16	0.00	51.06	0.18
Mozambique	2014/15	29 757	48.5	0.16	42.2	0.14	90.6	0.30	37.97	0.13	10.58	0.04	48.55	0.17
Namibia	2013/14	22 245	40.8	0.18	31.1	0.14	71.8	0.32	40.68	0.18	13.97	0.06	54.65	0.24
Niger	2013	16 341	4.6	0.03	8.6	0.05	13.2	0.08	3.45	0.02	7.74	0.05	11.19	0.07
Rwanda	2013/14	18 704	6.4	0.03	14.7	0.08	21.1	0.11	2.25	0.01	5.10	0.03	7.35	0.04
Senegal	2015	35 893	81.7	0.23	171.0	0.48	252.7	0.71	54.89	0.15	170.53	0.48	225.42	0.63
Seychelles	2015	2 435	4.7	0.19	0.5	0.02	5.2	0.21	1.36	0.06	0.28	0.01	1.64	0.07
South Africa	2014/15	683 147	1123.5	0.16	1365.2	0.20	2488.7	0.36	907.70	0.13	1005.11	0.15	1912.81	0.28
Eswatini	2015/16	9 011	11.7	0.13	11.4	0.13	23.1	0.26	8.59	0.10	2.37	0.03	10.96	0.13
Tanzania	2013/14	84 884	231.7	0.27	367.8	0.43	599.4	0.70	134.91	0.16	153.50	0.18	288.41	0.34
Togo	2015	10 958	4.9	0.04	23.5	0.21	28.4	0.25	4.14	0.04	20.68	0.19	24.82	0.23
Uganda	2014	66 650	55.0	0.08	53.7	0.08	108.7	0.16	29.48	0.04	15.09	0.02	44.57	0.06

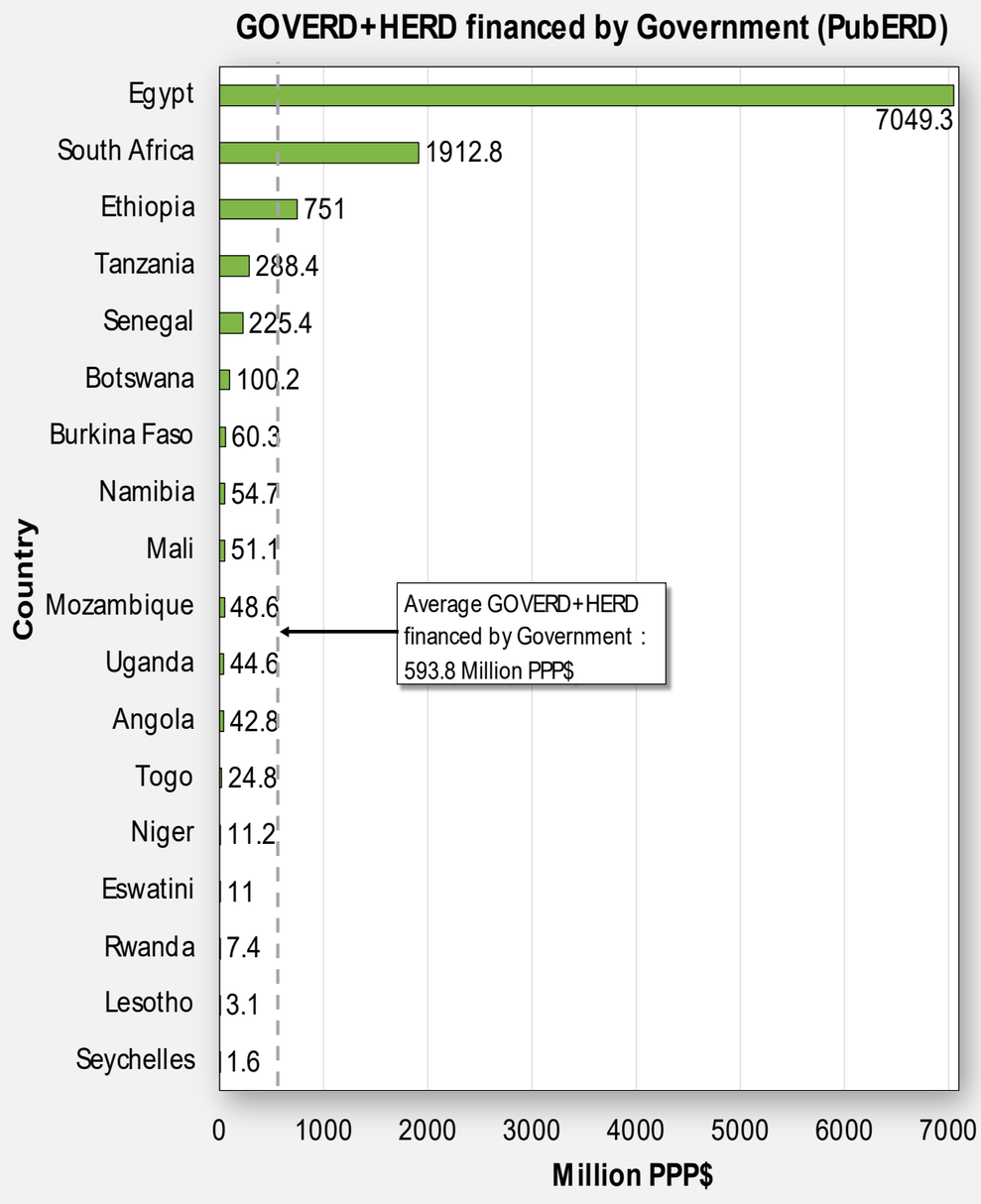
–Sector was not surveyed, or Survey was not conducted

† R&D Expenditure data for the sector was either not submitted or was incomplete

Table 6. The Share of Public Expenditure on R&D (PubERD) for 23 countries highlighting the 11 SGC countries that submitted datasets for AIO-3

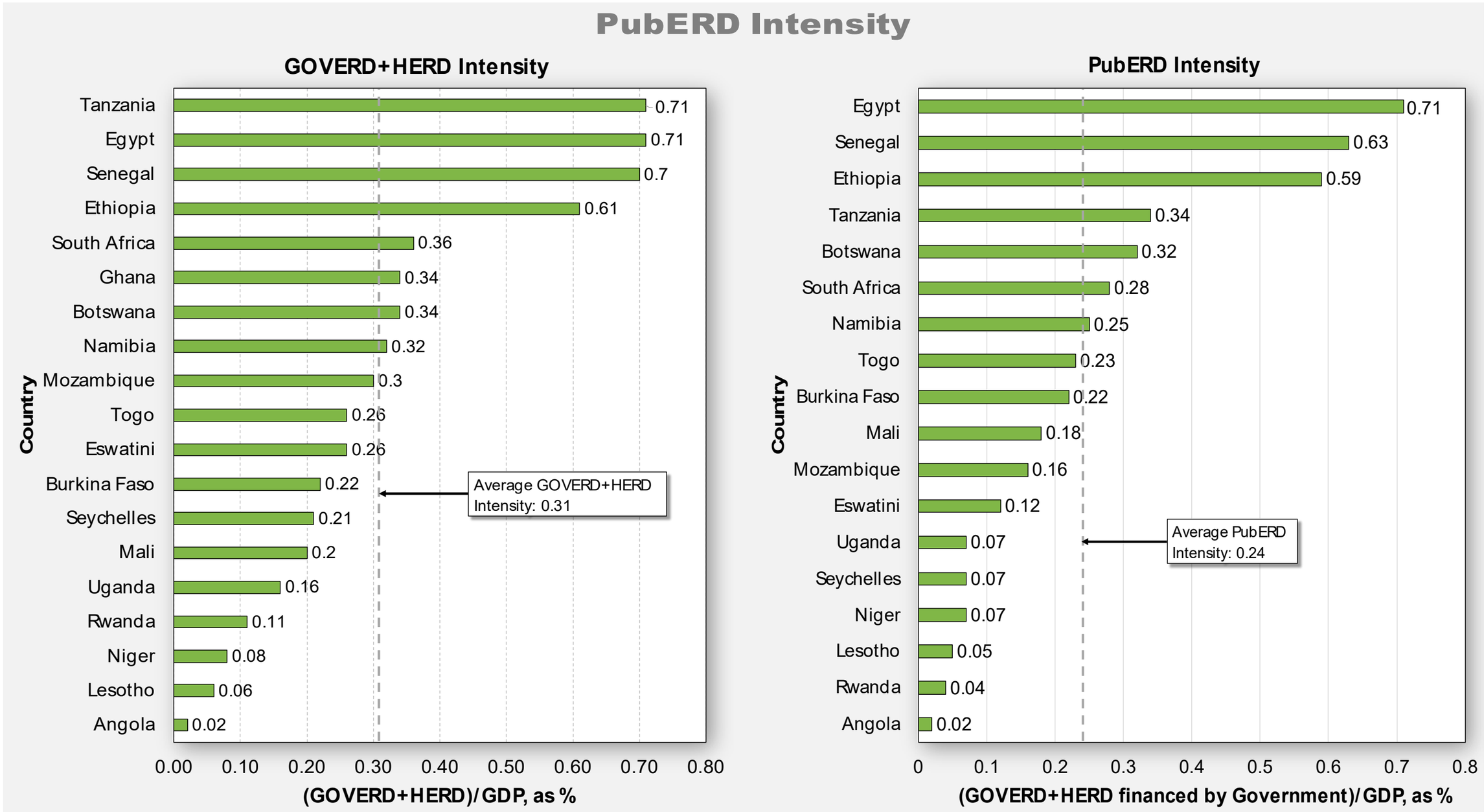
Public Expenditure on R&D (PubERD)





NOTE: Ghana did not provide disaggregated data on GOVERD financed by the Government

Figure 1. GOVERD+HERD regardless of source of funds versus GOVERD+HERD financed by Government (PubERD) for 10 SGC countries



NOTE: Ghana is not included in the graph for PubERD intensity because there was no disaggregated data for GOVERD financed by the Government

Figure 2. GOVERD+HERD Intensity versus PubERD Intensity focusing on 10 SGC countries

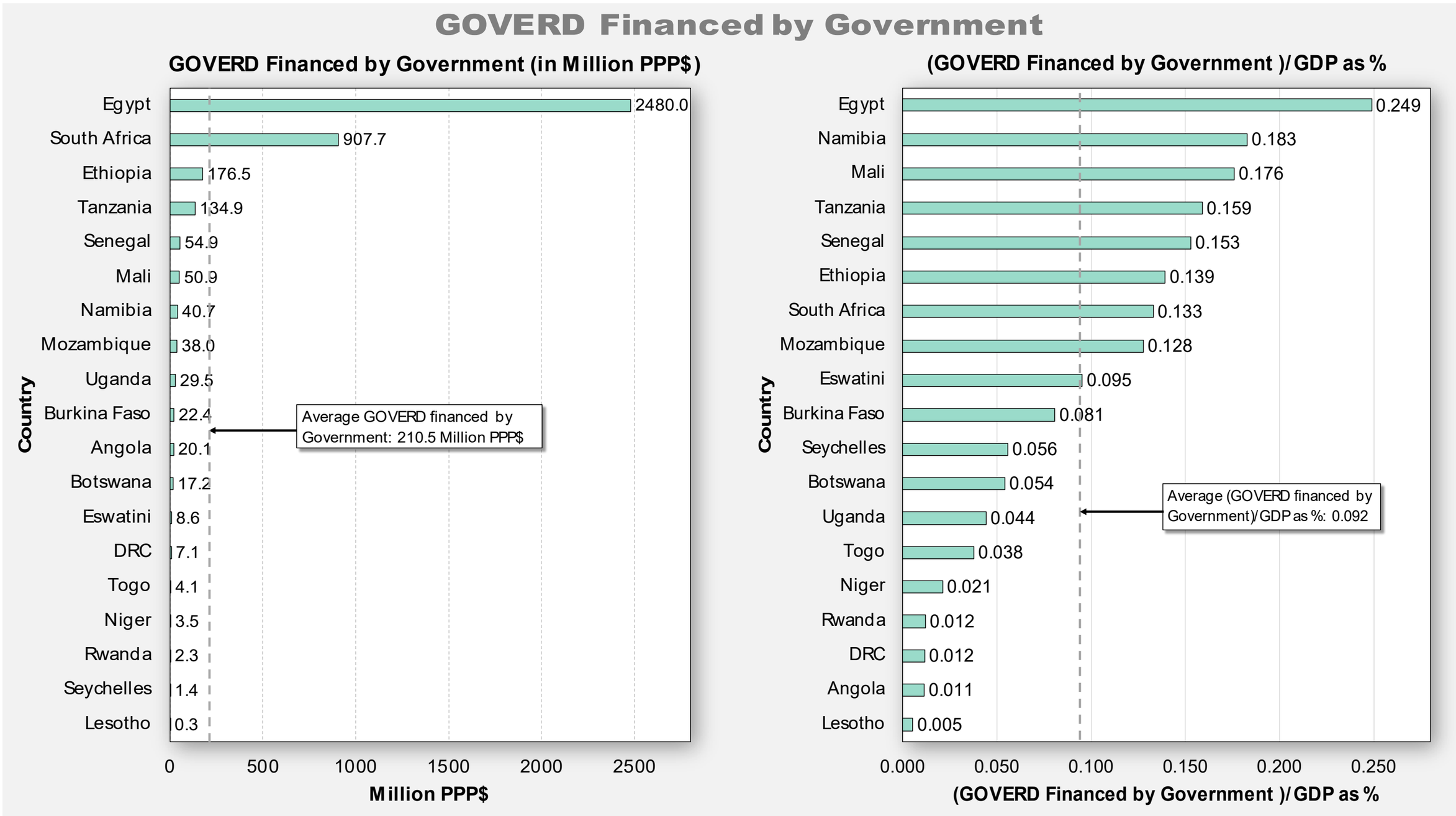


Figure 3. GOVERD Financed by Government and (GOVERD Financed by Government)/GDP as % for 19 out of 23 countries that submitted datasets, with a focus on 11 SGC countries

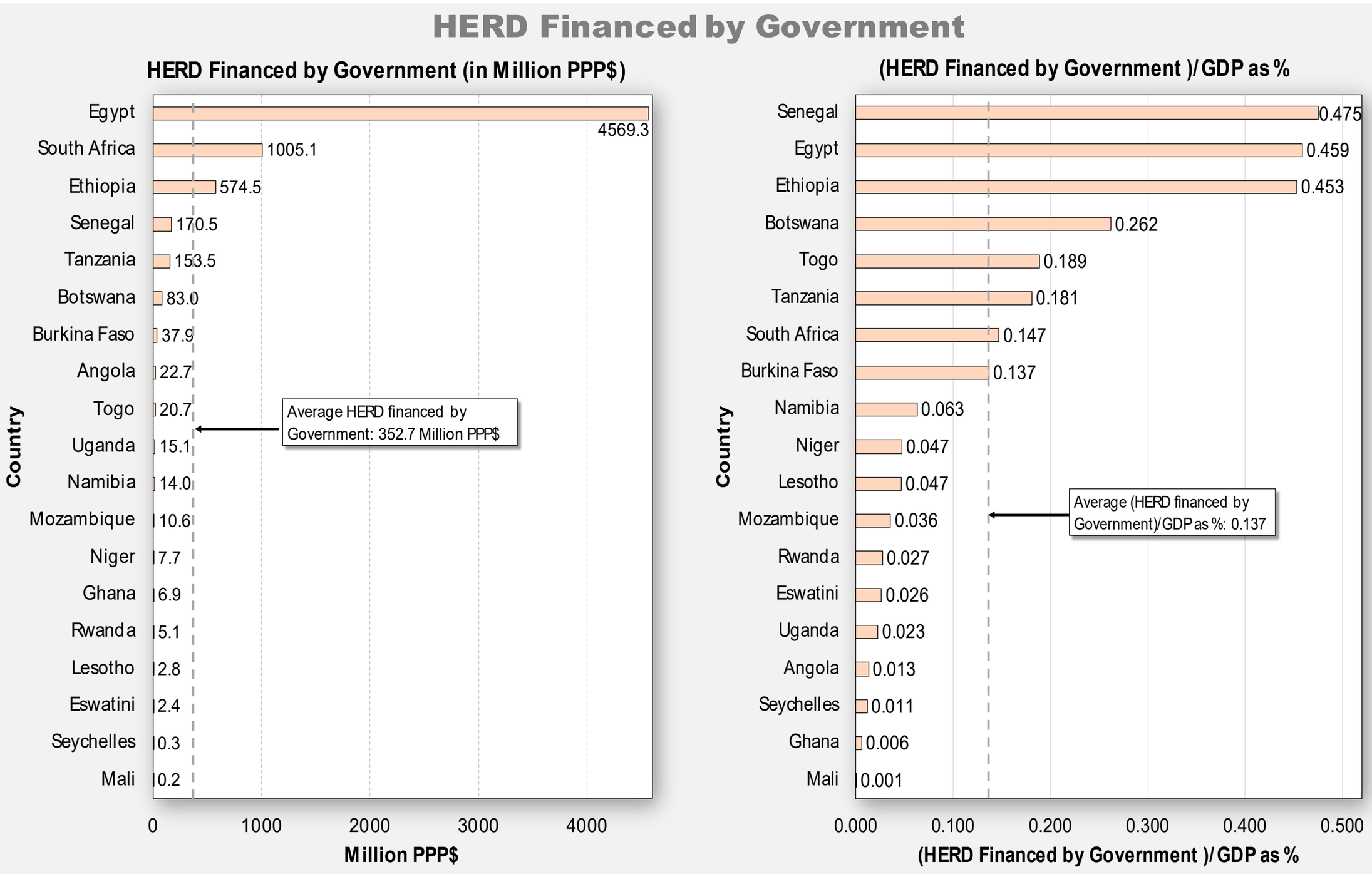


Figure 4. HERD Financed by Government and (HERD Financed by Government)/GDP as % for 19 out of 23 countries that submitted datasets with a focus on the 11 SGC countries

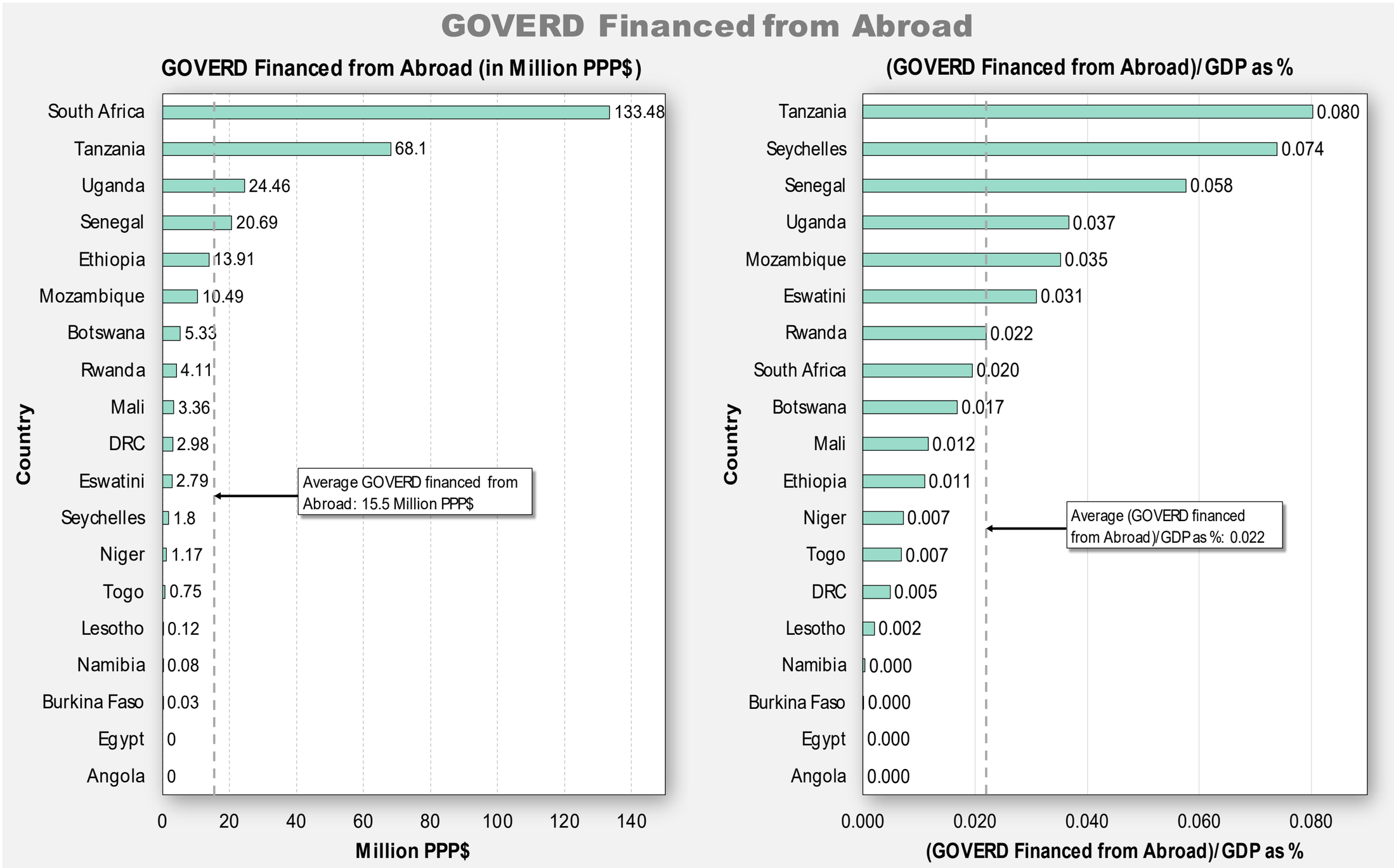
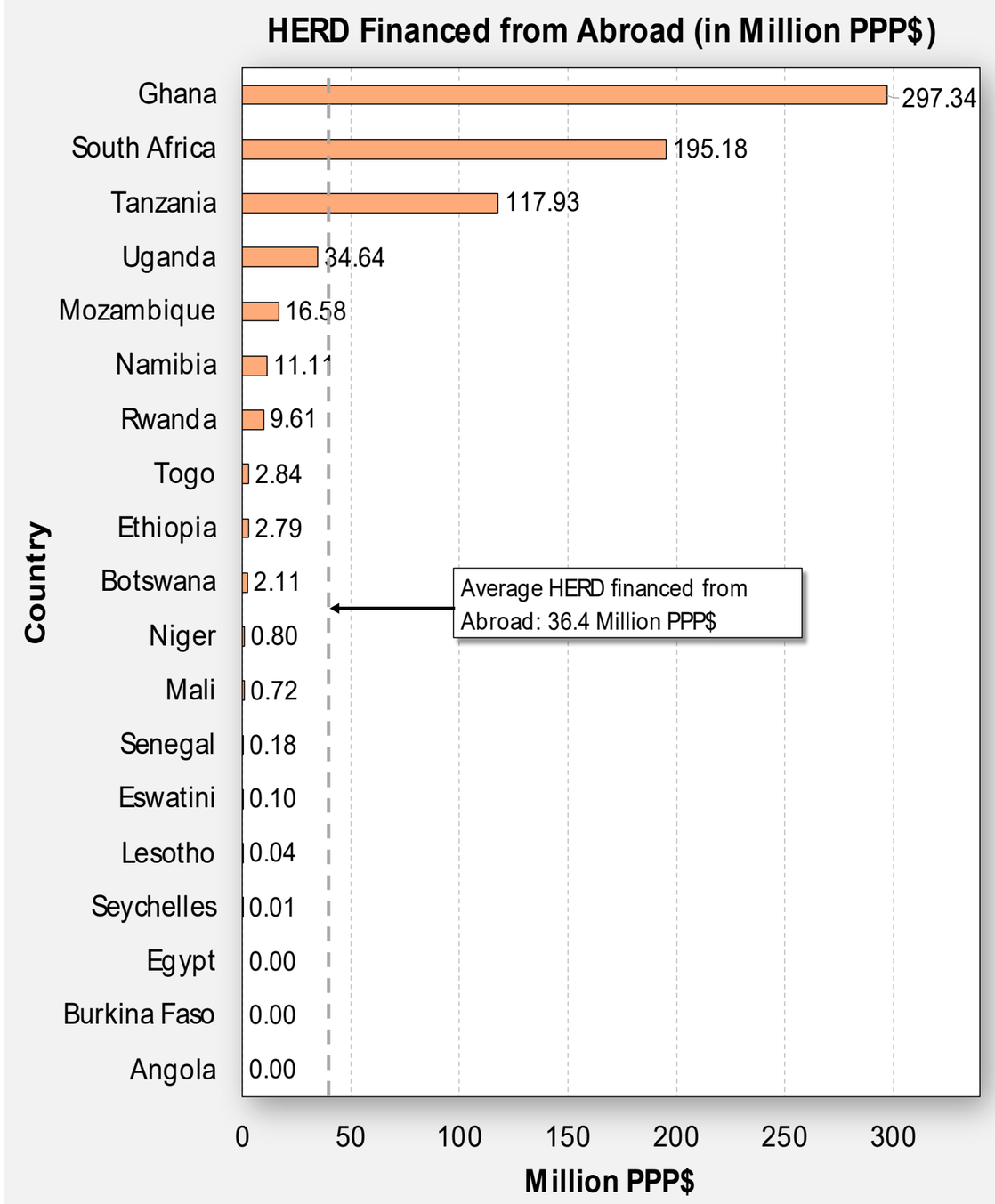


Figure 5. GOVERD Financed from Abroad (Rest of the World) and (GOVERD Financed from Abroad)/GDP as % for 19 out of 23 countries that submitted datasets, focusing on 10 SGC countries

HERD Financed from Abroad



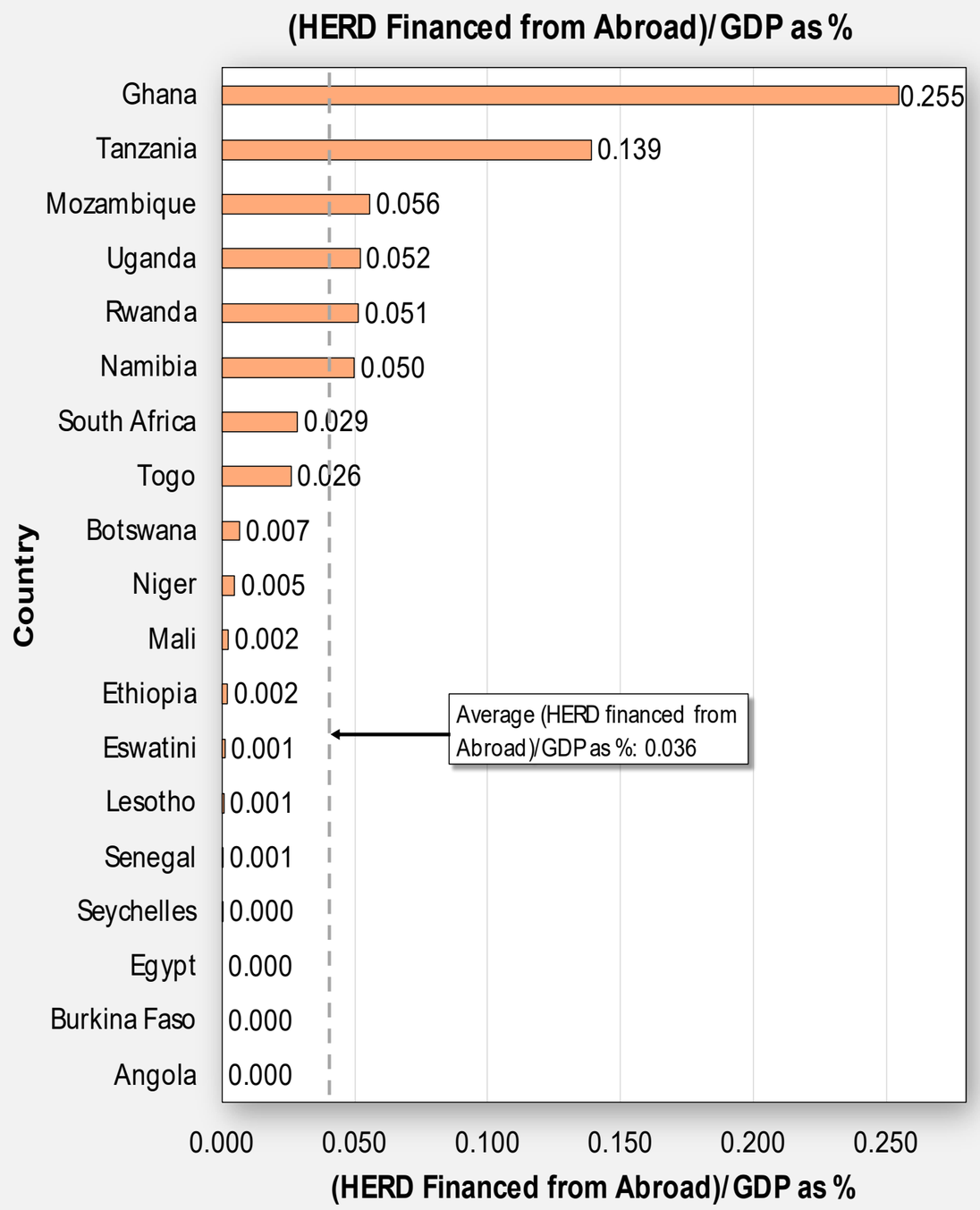


Figure 6. HERD Financed from Abroad (Rest of the World) and (HERD Financed from Abroad)/GDP as % for 19 out of 23 countries that submitted datasets, focusing on 10 SGC countries

The extent to which R&D activities performed in African countries are funded from abroad (or Rest of the World) is an important policy issue that has elicited debates in different fora on the African continent. High dependency on funds for R&D expenditure from abroad may be a strength in attracting R&D resources, but it may also be perceived as a weakness in that the national R&D systems may not develop in response to national development goals. As shown in Figure 5, the GOVERD financed from abroad for SGC countries ranged from zero for Burkina Faso to $68.1 million for Tanzania. When expressed as a ratio of GOVERD financed from the Rest of World to GDP (as %), the intensity ranged from 0% for Namibia to 0.08% for Tanzania. As shown in Figure 6, the HERD financed from the Rest of the World ranged from zero for Burkina Faso to $297.34 million for Ghana closely followed by Tanzania ($117.93 million). When expressed as a ratio of HERD financed from the Rest of World to GDP (as %), the intensity ranged from 0% for Burkina Faso to 0.26% for Ghana, followed by Tanzania (0.14%) and Mozambique (0.06%). Overall, the GOVERD+HERD financed from the Rest of the World is significant for countries with a low GDP compared to South Africa. For example, when GOVERD+HERD financed from the Rest of the World is expressed as a percentage of GDP, the amounts received by Tanzania ($186.03 million), Uganda ($59.1 million) and Mozambique ($27.07 million) are significant (Figures 5 and 6).

The policy implications of significantly high levels of funds from abroad (or development partners) has generated debate across the continent. Out of the 5 SGC countries, Uganda (53%) and Mozambique (43%) reported a higher share of their GERD that is funded from the Rest of the World. Generally, there are fears that international partners who provide funding may also exert undue influence on the nature and type of research performed by domestic business enterprises and public institutions. Such influence may lead to performance of R&D activities that are not aligned to national development needs. In most cases local institutions that are unable to raise funds from the limited domestic sources opt for international collaborations to cover for the R&D funding gap. The positive side to this situation is that external sources of funding for R&D could indicate knowledge links, collaborations and interactions between the African and the international research community. Therefore, SGCs should have the capabilities to access and analyze data on the various disaggregated components of GERD to get a detailed picture of

national and subnational R&D expenditure and the sources of funding. This information is critical for SGCs to advocate for increased investment in R&D (and innovation) and the allocation of such resources in sectors of the economy that need them most.

4. Share of GERD by Type of R&D

It is important to know the amount of money invested in R&D activities and for what type of R&D. Are the R&D activities focused on basic research, applied or experimental development research? What also matters is to understand; (1) How the money was spent, (2) Where the money was spent, and (3) What the money was spent on, as previously described. Although R&D expenditure is normally shown at sector level of performance the expenditures could be disaggregate so GERD is distributed by type of costs: labour, other current (facilities, consumables, etc.), capital (vehicles, land and buildings), and instruments, equipment and software. Most of the 23 countries that submitted datasets on R&D expenditure and personnel for R&D activities performed only in the government and higher education sectors. The data for the two sectors is relatively easy to collect and the response rates are normally higher compared to the business and private non-profit sectors. The current data does not give a complete picture of the distribution of funds and expenditure within the national R&D systems. Here, the results of the distribution of GERD by type of R&D activity performed are presented for the 4 SGC countries because the type of research raises important policy questions and the activities that publicly funded institutions perform.

R&D Expenditure Intensity by Type of R&D Activity						
	Basic Research		Applied Research		Experimental Development	
Country	Million PPP$	(R&D Expenditure)/GDP, as %	Million PPP$	(R&D Expenditure)/GDP, as %	Million PPP$	(R&D Expenditure)/GDP, as %
Ethiopia	87.83	0.07	355.29	0.28	329.50	0.26
Mozambique	30.57	0.10	57.40	0.19	24.65	0.08
Namibia	15.16	0.07	46.65	0.21	26.95	0.12
South Africa	1143.15	0.17	2272.05	0.33	1388.27	0.20
Eswatini	4.64	0.05	23.70	0.26	3.02	0.03
Uganda	34.11	0.05	55.05	0.08	27.61	0.04

Data for 4 SGC countries was disaggregated to calculate the amounts for type of R&D activity

Table 5. R&D Expenditure Intensity by Type of R&D Activity for 4 SGC countries (shaded in brown)

The 5 SGC countries largely performed applied research except for Ethiopia which had an almost equal share of applied and experimental development (Table 5). Although the characteristics and number of R&D personnel are important in determining the depth, diversity, quality and quantity of research activities related to creating and disseminating knowledge: the details on R&D personnel are beyond the scope of this *InfoBrief*.

5. SOUTH AFRICA: R&D DATA FOR ROBUST STI INDICATORS

South Africa has been collecting R&D and innovation survey data for a long time and has a mature measurement system compared to most African countries, thus setting a good example to learn from. Out of the 23 countries (11 SGCs) that submitted data on R&D, South Africa is the only country that *collected disaggregated data on the socio-economic objectives of the R&D performance*. Without a clearly stated context (socio-economic objectives) within which R&D and innovation activities take place, linking of R&D and innovation performance to the national development is problematic. In this InfoBrief because of South Africa's disaggregated data on SOEs, it is used as a good example of how to establish the context within which R&D and innovation could be measured. South Africa, in its National Development Plan 2030, acknowledges that its economy is still resource-intensive and that science and technology are key to revolutionize the way goods and services are produced and

traded. Furthermore, South Africa considers innovation as a necessary development pathway from a middle-income country[7] to a high-income country.

The purpose of R&D for South Africa is clarified by how its Gross Expenditure on Research and Development is distributed according to the national SEOs as shown by the trends in Figure 7. The SEOs for South Africa are grouped into five categories namely; economic development, society, environment, defense and expanding (advancing) knowledge. In 2014, the major portion of $2652 million (or 55% of GERD) was spent on R&D activities related to economic development as shown for economic divisions in Figure 8, followed by $872 million (or 18% of GERD) on R&D activities related to society, and $858 million (or 17.9% of GERD). The context is further refined by showing the distribution of GERD by socio-economic objectives for R&D performance across the four institutional sectors of the South African economy (Table 6). None of the 11 SGCs collected data at this level of disaggregation. From here on, the usefulness of GERD is related to important parameters of national development within which the R&D performance and innovation must produce results.

[7]South African National Development Plan 2030

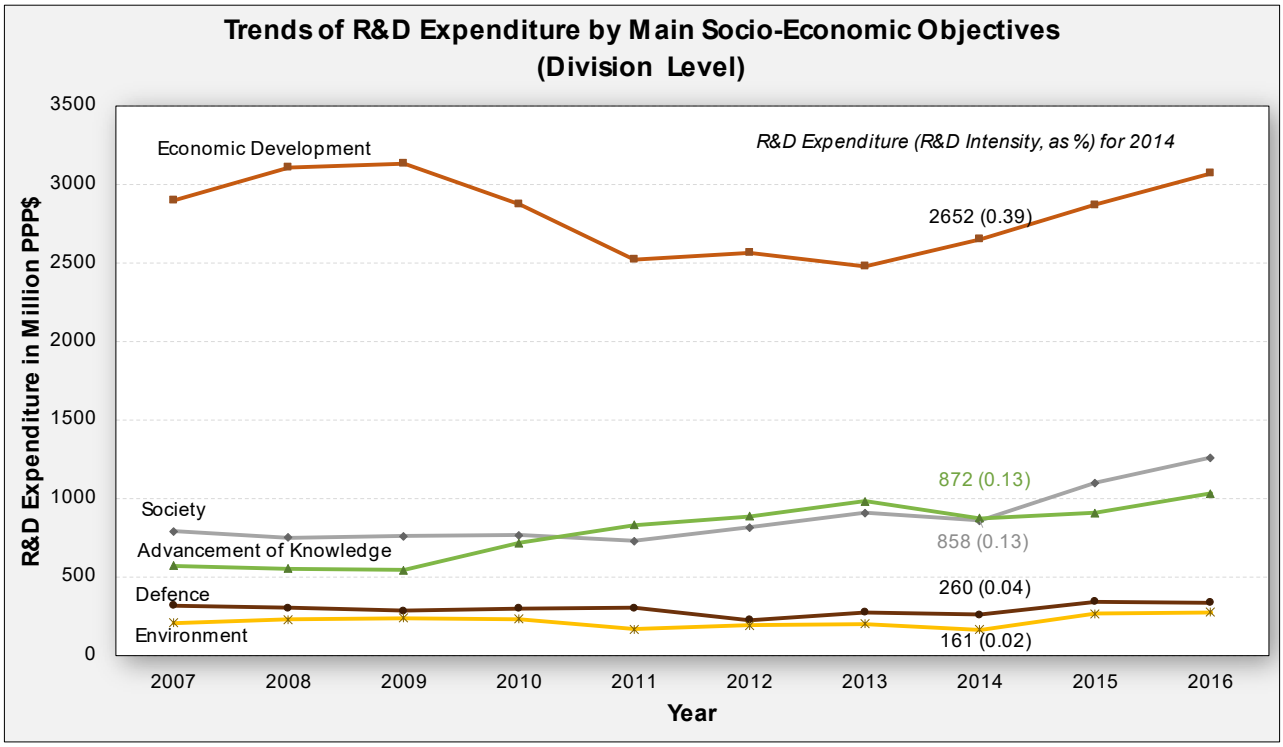


Figure 7. Trends of GERD (or R&D Intensity, as %) according to Main Socio-Economic Objectives (Sector Level) for South Africa. Source of Data: South African National Survey of Research and Experimental Development, STATISTICAL REPORT, 2015/2016

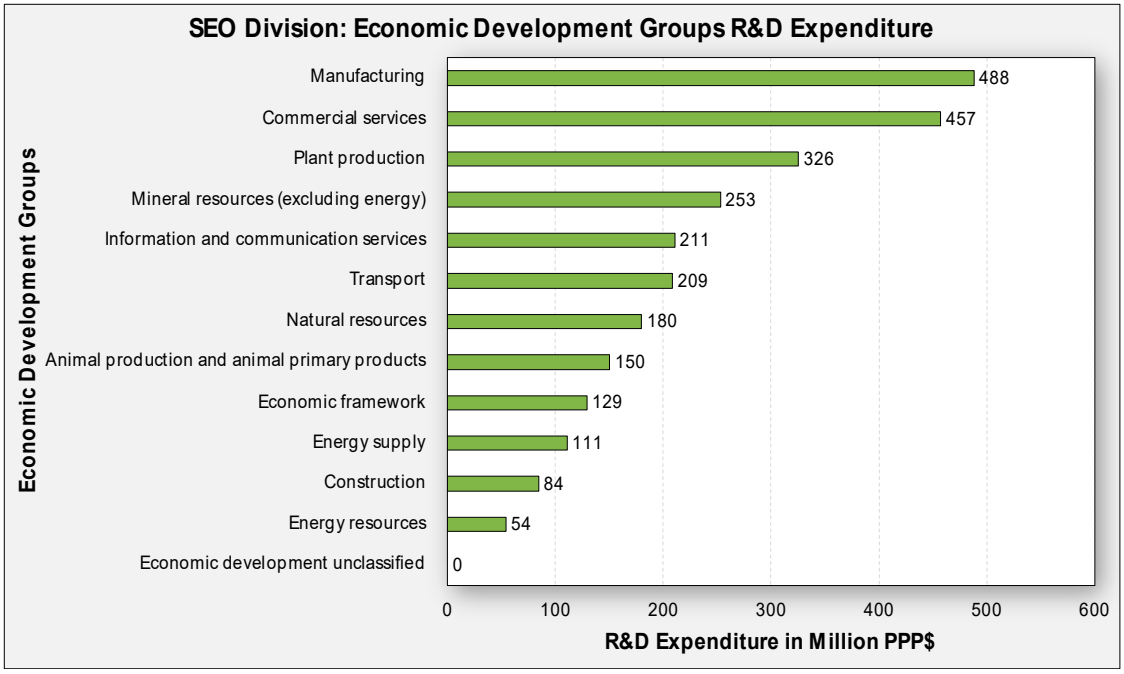


Figure 8. Distribution of GERD by Economic Development Groups (2013/2014)

For each of the SEOs, there a need to drill-down to get more details (Figure 8). As shown in Table 7, 32% of GERD was spent by the business sector pursuing the economic development objective, followed by the government sector that spent about half as much (12.5% of GERD) on the same objective. Interestingly, the business sector spent about 4% of GERD on all the other objectives, except for that on environment where a lowly 0.7% of GERD was spent (Table 7).

Distribution of Main SEOs for R&D Expenditure by Sector of R&D Performance											
	Economic Development		Advancement of Knowledge		Society		Defence		Environment		
R&D Performing Sectors	Million PPP$	%	Million PPP$	%	Million PPP$	%	Million PPP$	%	Million PPP$	%	TOTAL
Business Enterprise	1555.00	59	169.59	19	244.00	28	205.00	79	32.09	20	2205.68
Government	599.15	23	187.52	21	243.21	28	53.17	20	40.43	25	1123.48
Higher Education	476.44	17	507.84	58	293.51	34	1.37	1	86.01	53	1365.17
Private Non-Profit	21.28	1	7.31	2	77.71	10	0.00	0	2.84	2	109.14
TOTAL	2651.89	100	872.27	100	858.43	100	259.54	100	161.36	100	4803.47

Table 6. Distribution of GERD by Main SEOs and Sector of R&D Performance for South Africa (2013/2014)

These results show that as of 2014, the issues of the environment were not yet attracting much attention in the R&D circles within South Africa. As expected, the higher education sector spent 10.6% of GERD on R&D activities related to generating new knowledge and 6% of GERD on societal objectives. The GERD spent on R&D activities related to the SOEs was distributed as follows: economic development objective (55%), advancement of knowledge (18%), society (17.9%), defense (5%) and environment (3%). Since the business sector of South Africa spent the largest share of GERD on R&D activities related to economic development objectives, it is critical to understand the distribution of GERD by industry type (Figure 9).

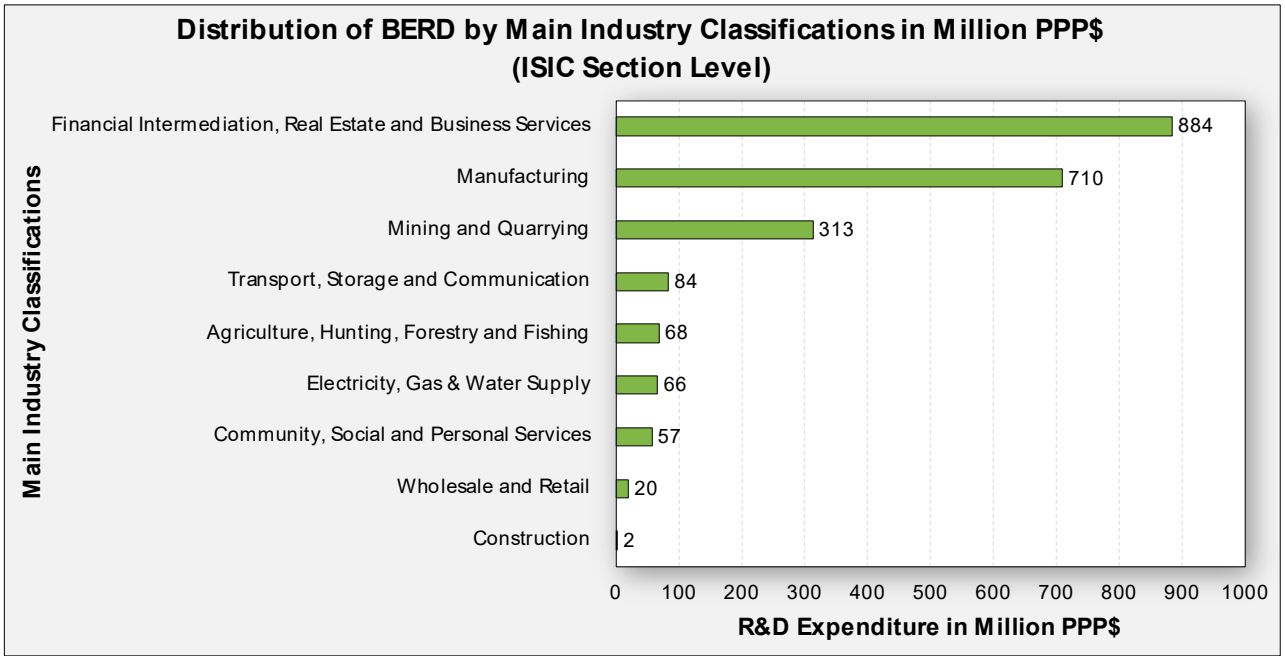
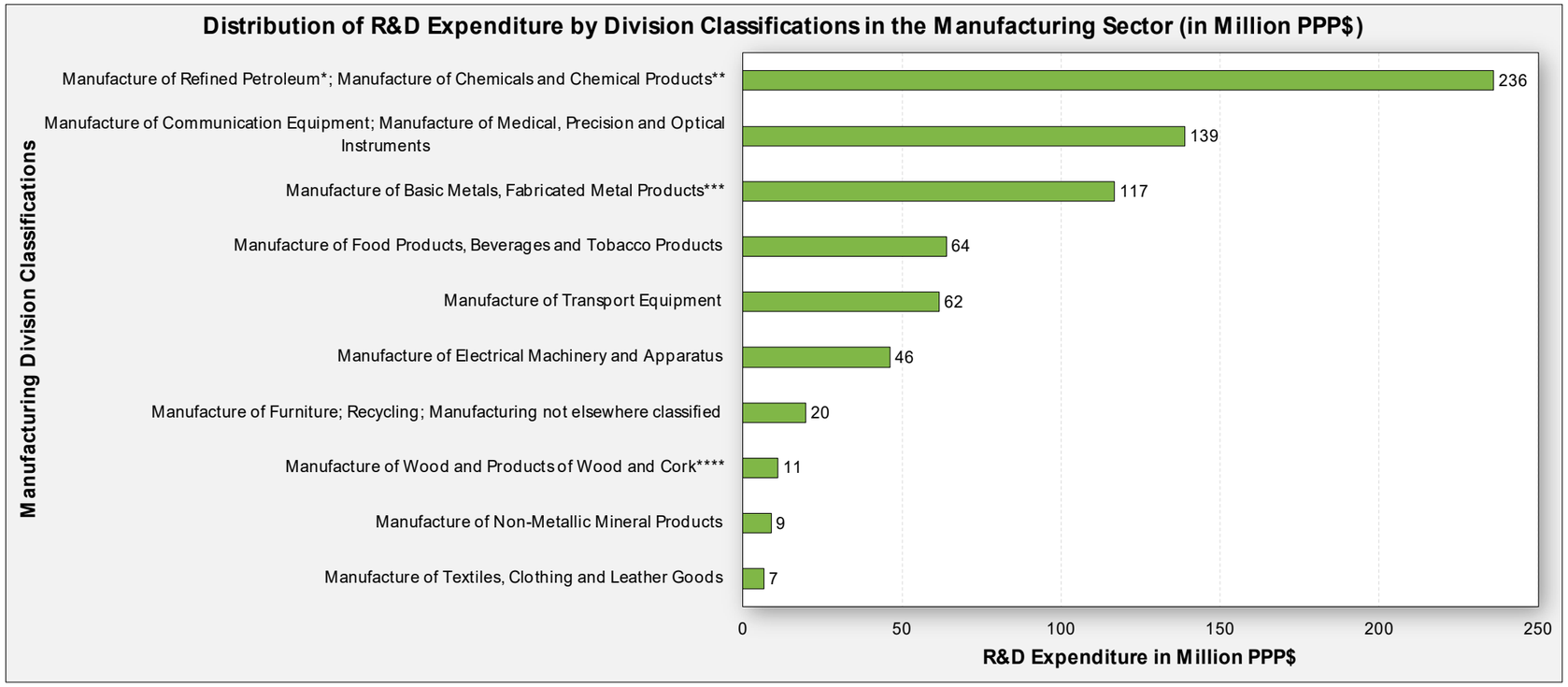


Figure 9. Distribution of BERD by Main Industry Type (ISIC rev4 Section Level; 2013/2014)

The three top industry types where most of the BERD was spent are finance, manufacturing and mining (Figure 9). These industry types are comprised of many subtypes making the picture of specific areas of R&D expenditure require further clarification. Given that manufacturing is a topical developmental issue in Agenda 2063, the distribution of BERD across all the divisions of manufacturing sector in South Africa is given as an example (Figure 10).



*This includes manufacture of Coke and Nuclear Fuel

**This includes manufacture of Pharmaceuticals as well as manufacture of Rubber and Plastic Products

***This includes manufacture of Machinery & Equipment; Manufacture of Office, Accounting and Computing Machinery

****This includes manufacture of Articles of Straw and Plaiting Materials as well as manufacture of Paper and Paper Products, Publishing, Printing and Reproduction of Recorded Material. This excludes manufacture of furniture.

Figure 10. Distribution of R&D Expenditure by Divisions of the Manufacturing Sector (2013/2014)

6. STRENGTHENING THE CAPACITY OF SGCs: MODIFYING STI MEASUREMENT INSTRUMENTS FOR INNOVATION (AND R&D)

To enrich the results of AIO 3 and develop a deeper understanding of the R&D and innovation concept (capabilities[8] and information gaps), AUDA-NEPAD working together with various Ministries and SGCs in Burkina Faso, Mozambique, Senegal and Ethiopia conducted face-to-face interviews with top management of firms, organizations and institutions. This exercise, to engage with policymakers and industry or public institution players, was comprised of two stages. The first stage involved face-to-face interviews to solicit for qualitative micro-level data on the firm or organization's R&D activities, innovation capabilities and broader issues that hindered the production and sharing of knowledge, production of goods and business processes (innovation) by the firms, public entities or organizations (e.g. Non-governmental) in the four SGC countries. On average, top management of at least 45-50 or more entities were interviewed. The main economic sectors were agriculture, manufacturing, construction, services, education and hospitals.

The information was intended to provide an understanding of how innovation can improve productivity and growth in the main economic sub-sectors of Burkina Faso, Mozambique, Senegal and Ethiopia as the representative SGCs countries. In Africa, the innovation concept is rooted in a laboratory mindset (it is easily confused with research) and innovation is sadly limited to a technology. The conversations conducted according to an interview guide (semi or structured), focused on the leadership's position on R&D and innovation with regards to the following five broad areas; (1) General Information about the Institution or Firm (e.g. respondents were asked questions on the strategic goals and/or main business activity of their institution), (2) Drivers of R&D and or Innovation in Firm or Organization (e.g. respondents were asked questions on what influenced their R&D or innovation activities and direction), (3) Challenges solved and Opportunities pursued by R&D or Innovation Efforts, (4) Barriers to R&D and or Innovation (e.g. respondents were asked about the obstacles that prevented their firm or institution from innovating) and

[8] *Capabilities is the individual, firm or organization's ability to undertake a set of tasks using specific skills sets to produce a desired result.*

(5) Potential R&D and Innovation Targets (e.g. respondents were asked specific innovation and R&D areas which their respective government (or the business sector) could focus investments and interventions on). The information collected was used to modify sub-sector specific innovation data collection instruments.

Burkina Faso, Mozambique, Senegal and Ethiopia are among the SGC countries that submitted R&D datasets for AIO 3. The R&D data for Burkina Faso and Senegal covered three main institutional sectors namely, government sector, higher education sector and private non-profit sector. The data mainly provided information on the personnel and expenditure for R&D activities in the three sectors. While the datasets for Mozambique and Ethiopia were complete. For the R&D expenditure to yield the requisite outputs and the much needed goods, services and business processes (innovations) that could drive the transformation of the economies for Burkina Faso, Mozambique, Senegal and Ethiopia from commodities to knowledge-based economies, a deeper understanding of the smallest unit of analysis for the main economic sub-sectors is required. Using information from the R&D data for South Africa (described elsewhere in this *InfoBrief*) and the face-to-face high-level information solicitation interviews qualitative data was collected. Burkina Faso, Mozambique and Senegal did not conduct firm level innovation surveys.

There was no information on innovation supporting activities such as R&D, acquisition of machinery, patents, sources of information, objectives of innovation, education and training of workers, and barriers to innovation. Also missing was information on whether firms or organizations intentionally plan for and managed their innovation efforts by way of having innovation strategies that related to their business and or corporate strategies. Firms needed to build the capabilities to thoughtfully plan for and intentionally manage their portfolio of innovation such that they could effectively allocate resources across their activities and monitor and mitigate any associated risks. The African Union Development Agency (AUDA-NEPAD) is strengthening the capabilities of AU Member States to use robust science, technology and innovation (STI) indicators to inform policymaking and to design innovation-led knowledge-based interventions. Such actions require the use

of robust indicators that are supported by micro-data from the smallest unit of analysis within the R&D and innovation systems.

The revision of the Oslo Manual[9] (OM 2018) has clarified and widened the scope of the innovation concept. Countries could come up with measurement frameworks and guidelines that relate to their context and provide for full alignment with United Nations' statistical classifications such as the System of National Accounts (SNA 2008[10]) and the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4[11]). The work with the SGC countries was motivated by the OM 2018 that now includes all SNA sectors of the economy such as general government, non-profit institutions servicing households and households themselves. Since innovations are key to transformative social and economic changes, the demand for effective public services delivery can be addressed by improving and using knowledge of the African national research and innovation ecosystems. Despite the acknowledged potential of innovation to transform African economies, major data and knowledge gaps exist on the role of innovations and the appropriate policies to support such innovations.

7. STAKEHOLDERS CONSULTATIVE MEETING

AUDA-NEPAD working together with the *Fonds National de la Recherche et l'Innovation pour le Developpement* (FONRID) conducted a Consultative Meeting attended by more than 100 participants from different entities within Burkina Faso to deliberate on innovation performance measurement and mapping of economic sub-sectors. The Consultative Meeting managed to capture important policy questions that were raised by different stakeholders within the innovation ecosystem of Burkina Faso. The aim was to capture the salient points about the "innovation concept" that needs to be measured, understood and exploited. The questions on topical issues about innovation were used to refine the attributes for economic sub-sector

[9] https://www.oecd-ilibrary.org/docserver/9789264304604-en.pdf?expires=1550139196&id=id&accname=guest&checksum=FBD847C82AC32AFC025D13D7D5D4BDA1
[10] https://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf
[11] https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf

innovation performance measurement. The following questions were captured from the deliberations with participants;

1. What's the difference between innovation projects and R&D projects?
2. Can you give example of R&D projects in humanities? How important are such projects for FONRID?
3. External data is of interest to foreign donors who fund it, what's the future of data collection in this respect?
4. What are some of the examples of innovation from Burkina Faso?
5. Can you give me example between innovation and imitation?
6. Do we put emphasis on protection of IP in Africa?
7. What's your view on the will to fund 1% GERD in Africa?
8. Burkina Faso has adopted the Oslo definition of Innovation; is the definition we have in Burkina allow it to compare with other countries?
9. Burkina Faso has predominant funding from foreign donors. How do we get increased internal sources of R&D funding? Should bilateral R&D funding be the best option?
10. Looking at the definition of innovation, isn't it an unstable concept?
11. Who should have the right to innovation?
12. How is ethics taken into consideration into Innovation?
13. Do you think the data collection a responsibility of a country or focal point?
14. You showed that innovation sometimes leads to loss of jobs, how do we protect jobs in Africa?
15. Researchers are most likely disconnected from reality, what can we do to take research outputs to the communities and wider beneficiaries and stakeholders?
16. How do you value a publication?
17. Most of the beneficiaries of R&D programmes are illiterate. How does FONRID provide them access to the outputs of the R&D programmes for beneficiation.
18. What's the difference between innovation and invention?
    a. Invention should be registered in Burkina Faso as such Burkina Faso has a lot of innovations but less invention.

19. What has Uganda and Egypt done for their progress in R&D and Innovation? What can Burkina Faso learn from their experiences?
20. How do you motivate the youth to take up careers in research?
21. All the actors in the NSI should be able to work together to productivity. However, the government of Burkina Faso is not providing the needed resources and platforms for such working relations, what's your thought on this issue?
22. Burkina Faso products are less attractive, and packaging compared to international products, why is this so?
23. What are the side effects of innovation e.g., robots replacing some categories of jobs?
24. What's the relationship between innovation and technology transfer?
25. How do you value innovation?
26. Collaboration is less in internally compared to internationally. Why is this so?

These questions informed the modification process for the STI measurement instruments.