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Policy support for sustainable agricultural intensification in Sub-Saharan Africa: Where are we 20 years on?

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ABSTRACT

This study critically reviewed policy documents and associated budgets of six sub-Saharan African countries (accounting for about 40% of Africa's population and (gross domestic product) GDP and almost 60% of inorganic fertilizer use in the region) to gauge government's commitment to agricultural intensification (AI) and sustainable agricultural intensification (SAI) during the last two decades. This is this is the first systematic assessment of African ag policy documents in relation to Sustainable Intensification and three key findings emerge. First, we find that all study countries have consistently prioritized AI as a key policy objective over the last two decades. This commitment to AI is supported by significant resource allocation to AI programs and interventions. Second, we find that policy focus on SAI is a more recent phenomenon and resource allocation to SAI is generally low. Though all study countries demonstrate interest in some aspect of SAI by 2010, this enthusiasm is not proportionately reflected in the resources allocated to SAI. Third, we find that all countries emphasize the need for investment in agricultural research and extension, but the resource allocation varies substantially and is not always proportionate to the expressed interest in the sector. Together these findings indicate that the focus of agricultural investments in Africa remains agricultural intensification in the main with only modest sustainable agricultural intensification and that only in recent years.

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Key words: Agricultural productivity, sustainable intensification, sub-Saharan Africa
JEL Codes: Q10, Q16, Q18

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
Agricultural intensification	AI
Agricultural Mechanization Service Centers	AMSEC
Gross Domestic Product	GDP
Growth Enhancement Support Scheme	GESS
National Agricultural Investment Plan	NAIP
Policy Research, Capacity, and Influence	PRCI
Purchasing Power Parity	PPP
Sub-Saharan Africa	SSA
Sustainable Agricultural Intensification	SAI
United States Agency for International Development	USAID
United States Dollar	USD

INTRODUCTION

Over the last two decades, there has been an increasing recognition of the critical role that agricultural intensification must play in ensuring food security and pro-poor economic growth in sub-Saharan Africa (SSA) (Larson and Frisvold, 1996; Kydd, et al., 2004; McArthur and McCord, 2017). Agricultural intensification (AI) is relevant now, more than ever due to challenges associated with increasing population density and land scarcity in many parts of rural SSA (Jayne, Chamberlin, and Headey, 2014). As a response, many governments across SSA have taken several strides to improve agricultural productivity, chief among which have been input subsidy programs, particularly those subsidizing inorganic fertilizers (Jayne and Rashid, 2013; Jayne et al., 2018; Holden, 2019). While farmer access to fertilizers has increased over the last two decades (due to government, donor, and private sector initiatives), the use of complementary inputs such as improved seed, irrigation, and manure (needed to increase the crop yield response to inorganic fertilizer) remains extremely low across SSA (Liverpool-Tasie et al., 2017; Sheahan et al. 2017). In addition, the use of modern agricultural inputs (including inorganic fertilizer) and productivity levels remain significantly lower in the region compared to the global average (OECD-FAO, 2016; AGRA, 2018).[1]

It is now also recognized that low and/or heterogenous agronomic response of crop yield to inorganic fertilizer is one of the reasons for the low adoption of the technology in the region (Marenya and Barrett, 2009; Suri, 2011; Kopper, Jayne and, Snapp, 2020; Burke, Snapp and Jayne, 2020; Chamberlin, Jayne, and Snapp, 2021). Soils across the SSA have been found to vary tremendously, with many cases of low inherent fertility and high vulnerability to degradation through cultivation (Tully et al., 2015). Low soil fertility is not only linked to low agricultural productivity, but could also potentially lead to loss in income, nutrition, and standard of life (Lal, 2018). These findings have led to a call for a reorientation from AI as a means of achieving food security to "sustainable agricultural intensification" (SAI) geared at expanding agricultural productivity as well as the long-term well-being of agricultural communities in SSA (Pretty, Toulmin, and Williams, 2011; Gnacadja and Wiese, 2016; Et al., 2018). SAI refers to a wide variety of agricultural practices that support "producing more output from the same area of land while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services" (Pretty, Toulmin, and Williams, 2011, p.7).[2]

There is an important role for the government in encouraging the adoption of SAI because its adoption by farming communities in developing countries is accompanied with several challenges.

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[1] For example, the average fertilizer consumption for SSA in 2018 was only 26 kg per ha of arable land as against the world average of 120. Similarly, the average maize and rice yields in the region in 2018 were approximately 2 metric tons per ha as compared to the world averages of 5.7 and 4.6 metric tons per ha, respectively (FAOSTAT, 2018).

[2] There is ongoing debate about the definition of sustainable intensification of agriculture. Several authors have pointed out that the narrow definition we used here does not address important aspects of sustainability such as human well-being due to nutrition and social status (Loos et al., 2014; Zureck et al., 2015; Grabowski et al., 2016). These are important issues for developing countries in SSA. However, for the purpose of this paper and to keep the analysis and discussion tractable, we focus on the narrow definition.

First, the impact of SAI on crop yield is highly heterogenous and dependent on locale specific characteristics (Reich, Paul, and Snapp, 2021). Successful and long-term adoption of SAI requires consistently adapting agronomic practices to local agro-ecological and social contexts (Droppelmann et al., 2017; Otsuka and Muraoka, 2017). Second, SAI is an evolving concept that requires frequent updating of the knowledge of farmers as well as researchers and extension workers (Jayne et al., 2019). Finally, some SAI activities are found to be very labor intensive (Dahlin and Rusinamhodzi, 2019; Montt and Luu, 2020) and may be faced with constraints in regions of SSA which have experienced increasing labor costs and labor market imperfections (Kopper and Jayne, 2019).

Public investment in agricultural research and extension has especially been found to be associated with improvement in agricultural productivity (Fan, Gulati and Thorat, 2008; Economist Intelligence Unit, 2008). Similarly, increased investment in agricultural research and extension, especially context specific farmer participatory research, is believed to be an essential prerequisite for the success of SAI (Snapp, DeDecker, and Davis, 2019; Jayne et al., 2019). Agricultural research and extension are particularly important for SAI because as mentioned above, the successful adoption and implementation of SAI is dependent on hyper-local biological and geographical features which requires constant adaptation of existing agricultural technologies to the local context (Reich, Paul, and Snapp, 2021).

Policy makers across Africa have indicated enthusiasm for agriculture led economic growth and often acknowledge the role of AI and SAI. However, the extent to which that enthusiasm translates into tangible policy action is not clear. Pernechele et al., (2021) in their broad analysis of the evolution of public expenditure on agriculture in 13 countries of SSA between 2004-2018 find that input subsidies continue to account for the largest share of expenditures. Only few countries (e.g., Malawi and Ethiopia) have implemented reforms in this sector and diversified resource allocation to social protection, infrastructure, irrigation, forestry and land management. However, public goods such as research and extension have remained underfunded across SSA. While these studies cover a breadth of issues related to agricultural policy in SSA, they do not address the evolution of policies specific to either AI or SAI. Other studies on policy initiatives related to AI or SAI are limited to one country and/or activity. [3] To the best of our knowledge, there is no comprehensive assessment of government commitment to AI and SAI across multiple African countries. This cross-country consideration is important to account for inter-continental variation due to agro-ecological conditions and national policies or priorities.

In response to this gap in the literature, this paper explores the evolution of government policies related to AI and SAI across six African countries. We critical reviewed agricultural policy documents from Ethiopia, Ghana, Kenya, Malawi, Nigeria, and Zambia over the last 20 years. These countries cover diverse economic and geographic conditions across SSA (Western, Eastern and Southern Africa) and are all low or lower middle-income countries where agriculture remains an

[3] See Holden (2018) for discussion of conservation agriculture in Kenya and Ethiopia; Ortiz-Crespo et al. (2020) for use of information and communication technology for providing SAI related agricultural extension services in Tanzania; Mdee et al. (2019) for a meta-analyses of SAI technologies in Tanzania.

important sector of the economy.[4] Together, they account for approximately 40% of the continent's population and GDP (World Bank, 2019) and almost 60% of all fertilizer use in SSA (FAOSTAT, 2018). [5] We pay particular attention to both stated commitments to AI and SAI as well as tangible commitments via resource allocation and implemented programs.

We develop a conceptual framework to guide the systematic extraction of data from government agriculture policy documents and associated budgets. The documents reviewed all pertained to the agriculture sector and were publicly available documents published between 2000 and 2021. The documents were filtered for evidence of government commitment to AI, SAI, and agricultural research and extension in terms of policy statements, programs, and their associated budgetary allocations. Our data analysis reveals three key findings: First, we find that all study countries have consistently prioritized AI as a key policy objective over the last two decades. This commitment is supported by significant resource allocation. Second, the policy focus on SAI is a more recent phenomenon and resource allocation to SAI is generally low. Though all study countries demonstrate interest in some aspect of SAI by 2010, this enthusiasm is not proportionately reflected in the resources allocated to SAI. Third, all countries emphasize the need for investment in agricultural research and extension, but the resource allocation varies substantially across countries and is not always proportionate to the expressed interest in the sector. Together these findings indicate that while there is an increasing interest in government's support to promoting sustainable agricultural intensification within SSA, the resources allocated to SAI remain much lower than those allocated to other areas of agricultural policy.

The rest of the paper is organized as follows: Section 2 presents a simple conceptual framework that guides the extraction of information from the policy documents and subsequent discussions. Section 3 describes our data and methodology while section 4 present the key study findings and discusses them in light of the conceptual framework. Section 5 concludes.

[4] Employment in agriculture as a percent of total employment as of 2019 for Ethiopia, Ghana, Kenya, Malawi, Nigeria, and Zambia was 66%, 29%, 54%, 44%, 35%, 49% respectively. Agriculture also contributes significantly to the GDP of these nations (the exception being Zambia, where agriculture only made up 3% of total GDP in 2019). Agricultural GDP as a percentage of total GDP in 2019 for Ethiopia, Ghana, Kenya, Malawi, Nigeria was 34%, 17%, 34%, 26%, 22% respectively (World Bank, 2019).

[5] This statistic excludes South Africa

CONCEPTUAL FRAMEWORK

AI and SAI both aim at increasing agricultural productivity. In addition, a stated goal of SAI is to improve or maintain the resource base while doing so, and to take into account sustainability goals (Pretty et al., 2018). This distinction can be sometimes difficult to establish, especially in policy documents when some policy measures incorporate aspects of both AI and SAI and/or when policy objectives are stated very broadly. For this study, we define AI to include all policy measures that aim at improving agricultural productivity (i.e., output per unit of input). This includes increased use of chemical fertilizers and improved seeds/planting material, irrigation facilities, and agricultural machinery, and improved land tenure security and property rights.[6]

We consider SAI to be a subset of AI with the special characteristic of improving agricultural productivity in a manner that sustains and/or improves the future productivity of land. This includes the AI activities that are accompanied with conservation agriculture, crop rotation, intentional fallowing, intercropping and agroforestry, tackling conditions such as soil acidity, low soil organic matter and soil carbon, reclamation of degraded land or aimed at improving long term soil quality. We also include soil testing and/or mapping, where conducted, with the aim of matching fertilizer application with inherent soil quality and improving land tenure and property rights to encourage cultivators to invest in soil health (See Figure 1 for a visual representation). We are systematic in applying our inclusion criteria across countries. For example, increased and efficient use of chemical fertilizers is an activity aimed at improving agricultural productivity and thus classified as AI. However, if/when it is interlinked with soil testing and deliberate efforts to match fertilizer recommendations with inherent soil fertility, we classify this as an SAI activity.

[6] Policy action pertaining to the improvement of land tenure and property rights may not fall entirely under the Ministry of Agriculture in all countries. In this paper are limited to issues that fall under the purview of the Ministry of Agriculture.

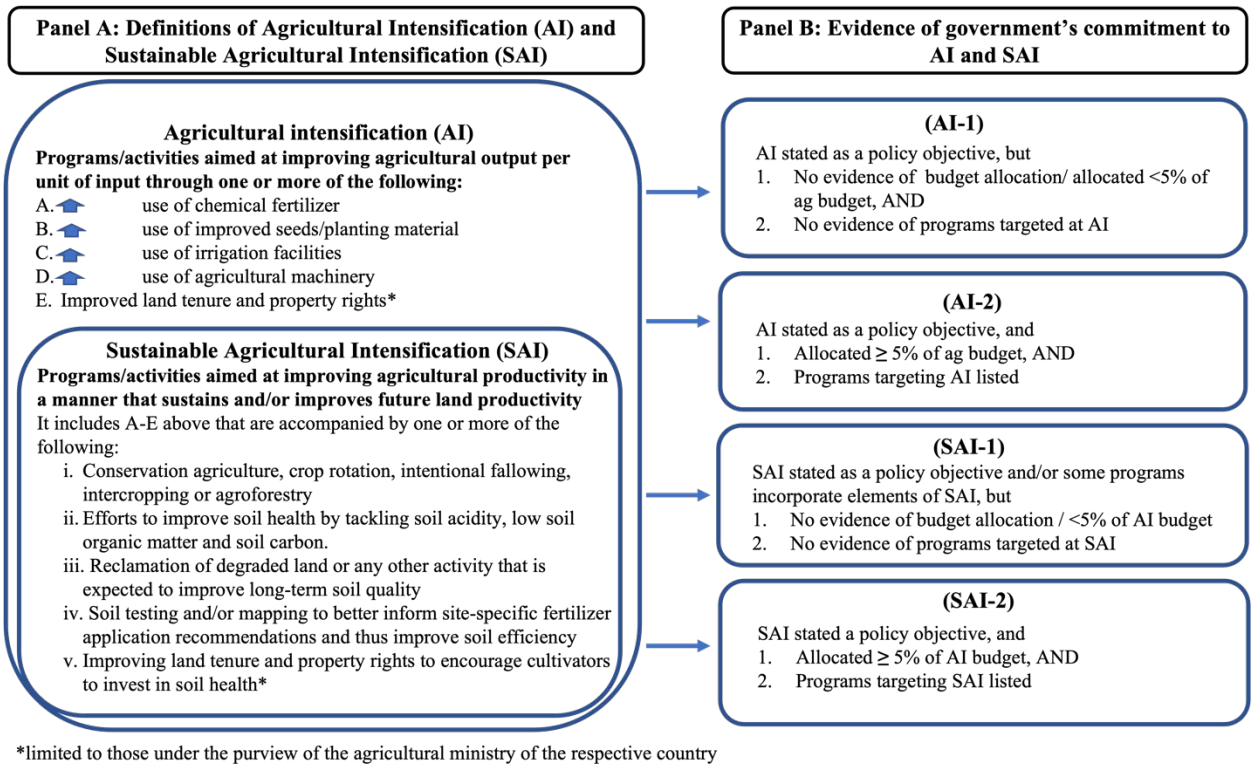

Figure 1. Conceptual framework for evaluating government commitment to AI and SAI

Government's commitment to AI is evaluated by categorizing countries as either AI-1 or AI-2. Countries that mention AI in policy objectives as a policy objective but allocate only small percentage of agricultural budget (<5%) and/or have not initiated any programs that focus primarily on AI, are classified as AI-1. Countries that complement their expressed interest in AI with significant budgetary allocation to AI (>= 5% of agricultural budget) and have initiated programs focussed on AI, are classified as AI-2. Similarly, a government's commitment to SAI is evaluated by categorizing countries as SAI-1 or SAI-2. Countries are classified as SAI-1 if they state SAI as a policy objective or incorporate some elements of SAI in the AI programs but allocate only a small percentage of the AI budget (<5%) and/or have not initiated any programs that are focused on SAI. Countries that complement their expressed interest in SAI with 5% or more of AI budget allocated to SAI activities and initiated programs that are targeted primarily to SAI, are classified as SAI-2.

The discussion on agricultural policy as a thrust to SAI is incomplete without consideration of the agricultural research and extension system. Yet, we have excluded this category from our classification of AI and SAI, primarily because the information available in policy documents of study countries was insufficient to determine whether the investments in agricultural research and extension was directed towards improving agricultural productivity and soil health or to other activities (such as training and education of farmers, women and youth in agri-business and trade, skill development, nutrition, etc.) However, we discuss the investment in agricultural research and extension made by sample countries as a separate but related topic.

DATA AND METHODOLOGY

The primary data source for this study is government agriculture policy documents for the sample countries from 2000 to 2020. These documents were largely obtained from the FAOLEX website and supplemented with documents supplied by staff of the government or donor agencies operating in the respective countries. A data extraction form (see Table A1, Appendix A) was created and filled in for each policy document for each year for which a policy document for the country was available during the time frame. The following information was extracted and analyzed:

1. Does the policy document include any AI/SAI activities, as categorized in this study, as a policy priority?
    - Note that any activity can be considered as policy priority if it is simply mentioned under the policy objectives/focus.
2. What specific AI/SAI activities are mentioned under the policy priorities?
    - Specifics on each activity mentioned under the conceptual framework were collected
3. Does the policy document provide a prospective budget with allocations made to different policy objectives and AI/SAI activities?
    - If yes, what are the indicative allocations made to each policy objective and if available, to the specific AI and SAI activities?

The list of all the policy documents studied for this paper are included in Table A2 Appendix A. The annual indicative allocation was computed by dividing the total budget allocation by the number of years the policy document covered. For countries that reported the budget in USD, the original numbers were retained. Otherwise, the budget numbers were converted from the local currency to the current international USD using the Purchasing Power Parity (PPP) exchange rate (World Bank, 2021) to enable comparison across countries. The numbers thus obtained were then converted to real terms using the international USD deflator with 2017 as the base year. Subsequently, these conversions are approximations at best (See Table B1 in Appendix B for full table with details on conversion factors).

RESULTS AND DISCUSSION

AI prioritization is widespread and backed by resource allocation

According to the most recent policy documents, the allocation to AI as a percentage of total agricultural budget ranged between 25% and 80% (Table 1). This represents an allocation between 13 to 51 USD per capita towards their agricultural budgets (Table 1). Thus, all country governments showed strong policy commitment to AI and backed the commitment through adequate resource allocation (classified as AI-2 according to the conceptual framework). The expenditure on

agriculture (as a percentage of agricultural GDP) was highest in Zambia at 30% followed by Malawi (13%). All other study countries allocated between 1-5% of their GDP to the agricultural budgets (Table 1).[7]

Tables B2-B7 in Appendix B summarize the evolution of indicative public expenditure to broad categories of agricultural policy for each of the study country. They reveal that while AI has continued to remain an important component of agricultural budgets, the allocation (expressed as a percentage of total agricultural budget) varies significantly across countries. The share of AI as a percent of total agricultural budget has increased over time for Nigeria and Ghana and declined for Malawi (See tables B2- B7 in Appendix B).[8] Only in the case of Kenya, we observed a slight decline in resources allocated to AI in absolute terms (Table B4, Appendix B).

Drivers of AI prioritization?

In Nigeria, the increase in allocation to AI was driven primarily by the expansion of the country's flagship program– Growth Enhancement Support Scheme (GESS).[9] For Ghana, it was driven by the expansion of resources allocated to accessing inorganic fertilizers, improved seeds, and agricultural mechanization. The increased focus on agricultural mechanization is perhaps due to Ghana's flagship program for agricultural mechanization -Agricultural Mechanization Service Centers (AMSEC).[10] Part of the decline in resources allocated to AI by Malawi is likely due to the five- fold increase in Malawi's agricultural budget on agricultural research and extension observed between the two subsequent policy periods considered (Table B5, Appendix B). Further, new investment was made in the policy objective of pest and disease management (7.2% of latest agricultural budget (Table B5, Appendix B).

The decline in allocation of resource to AI for Kenya was less clear. Over a 10-year period, resources to ag commercialization and private sector support more than doubled from 12.5% to 35.7% of the ag budget while public support for access to agricultural inputs declined from 37% to 13%. It is also important to note that in the most recent policy document, only 32% of Kenya's recent agricultural budget was committed by the public sector. The remaining was expected to be funded by the private sector through private-public partnerships in the form of new agro-processing hubs and private farms. It is not clear how the commitments expected from the private sector are to be ensured.

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7 Another measure of the government's commitment to agriculture is the agricultural budget as a percent of the total national budget. Under the Maputo Declaration of 2003, several African states committed to allocating 10% of their national budget to the agricultural sector annually. However, as of 2018, the actual average allocation to agriculture was only 6% of GDP for 13 countries of SSA. Malawi was the only country that consistently allocated more than 10% of its national budget to agriculture (Pernechele et al., 2021).

8 Comparable information across years were not available for Ethiopia and Zambia.

9 The GESS was introduced in Nigeria in 2012 with the liberalization of the fertilizer markets in the country. The government replaced direct intervention in the fertilizer markets with indirect support to the fertilizer markets through provision of subsidized fertilizes to smallholders (Uduji, Okolo-Obasi, and Asongu, 2019).

10 The AMSEC was introduced in Ghana in 2007 as a credit facility to provide agricultural machinery to private traders at a subsidized rate with the aim of increasing the mechanization of agriculture and thus improving productivity (Benin, 2015).

Evolution of AI over last 20 years

Among the activities included in our definition of AI, improving access to inorganic fertilizer and improved seeds has remained a priority since the early 2000s (Table B8, Appendix B). A similar trend is observed for irrigation and water harvesting and agricultural mechanization but with some exceptions. Ethiopia begun to prioritize irrigation and water management starting only in 2010 and Kenyan policy documents do not prioritize agricultural mechanization.

Focus on improving land tenure and property rights to improve agricultural productivity varies across the study countries. Zambia and Malawi have prioritized land tenure and property rights since the early 2000s. However, they both allocate less than 5% of the AI budget to this sector (Figures B7 and B11, Appendix B). For Nigeria, the need for land reforms was particularly stressed in the early 2010s (Usman, 2010) leading to a large allocation of resources (40% of AI budget) to documentation of land (Figure B9, Appendix B), that has persisted (Table B7 in Appendix B). We were not able to ascertain resource allocation to this sector for Ethiopia, Ghana, and Kenya. Kenyan policy documents mention improving land tenure and formulating laws to protect agricultural land but information on the allocation of resources to these resources could not be retrieved. Kenya initiated some efforts in this area as early as 2007 but investment in recent years has steeply declined.

Finally, all countries have focused on some component of agricultural research and extension throughout the 2000s. We were not able to obtain relevant information for Kenya in all but the most recent policy documents, where agriculture research and extension were prioritized.

Activities within AI receiving the most attention

Irrigation and water management

In the most recent policy documents, irrigation and water management emerged as the most important policy area among the various AI activities. Three countries (Kenya, Ethiopia, and Malawi) allocated the largest and two countries (Ghana and Nigeria) allocated the second largest share of their respective AI budget to this area (Figures B1, B3, B5, B7, and B9 in Appendix B).[11]

Access to inorganic fertilizers and improved seeds

All countries made substantial investments in improving the access of smallholders to inorganic fertilizers and improved seeds largely through maintenance or expansion of existing input subsidy programs. Three-fourths of Zambia's AI budget went to the agricultural input subsidy program (Figure B11, Appendix B) and half of Ghana's AI budget went towards improving access to chemical fertilizers and improved seeds (Figure B3, Appendix B). Kenya, Malawi, and Nigeria allocated approximately a quarter of their AI budgets towards improved access to agricultural inputs.

[11] Information on the details of budget allocation in Nigeria pertain to 2011-14 because comparable data for the most recent policy document was not available. We complement this information with qualitative information from the most recent policy document wherever possible.

In recent years, modern input access considerations have undergone several reforms, such as inclusion of a wide variety of agricultural inputs beyond chemical fertilizers and improved seeds, the introduction of e-voucher systems, and efforts to match fertilizer recommendations with inherent soil quality (See Table B7 in Appendix B).

Agricultural Equipment and Mechanization

There was considerable variation in resource allocations to improving access to agricultural equipment. Ghana allocated 30% of its AI budget to agricultural mechanization (Figure B3, Appendix B) while relative importance to agricultural mechanization in other countries was tepid (Malawi- 7%, Nigeria-1%, and Zambia <1% of AI budget) (Figures B7, B9, and B11 respectively, Appendix B). It was not possible to ascertain the resources allocated to this area for Ethiopia and Kenya even though policy documents for both countries mention ag mechanization as a priority.

Table 1. Annual indicative budget allocation to agriculture according to the most recent policy document

Country	Years	Annual budget allocation to agriculture		Allocation to AI	Allocation to SAI	
		USD per capita (2017)	*Percentage of Ag GDP (2017)*	*% of total*	*% of total*	*% of AI*
Ethiopia	2010-20	21	3.0%	61%	18%	29%
Ghana	2018-21	51	5.0%	73%	0.38%	0.52%
Kenya[a]	2019-24	24	2.0%	46%	0.28%	0.61%
Malawi	2017/18-2022/23	36	13%	25%	2.0%	8.2%
Nigeria[b]	2017-20	13	1.0%	80%	N/A	N/A
Zambia	2014-18	42	30.0%	44%	1.9%	4.8%

Source: Ethiopia- Ethiopia's Agriculture Sector Policy and Investment Framework (PIF) 2010-2020; Ghana- Investing for Food and Jobs (IFJ): An agenda for transforming Ghana's Agriculture (2018-2021), Published by Ministry of Food and Agriculture, Republic of Ghana in January, 2018; Nigeria- National Agricultural Investment Programme-2, for the implementation of the Nigerian Agriculture Promotion Policy (AAP) "The Green Alternative", 2017-2020, Federal Ministry of Agriculture and Rural Development; Kenya- National Agricultural Investment Plan (NAIP), 2019-2024, Ministry of Agriculture, Livestock, Fisheries, and Irrigation; Zambia- Zambia National Agricultural Investment Plan (2014-2018), Published by the Ministry of Agriculture and Livestock, May 2013 Malawi- NAIP, 2017/18-2022/23, published by Ministry of Agriculture, Irrigation, and Water Development in January, 2018. The numbers in this table represent average annual indicative budget computed for the years covered by the relevant policy document.

[a] For Kenya, the number in the table is an of a range provided in the source document.

[b] Information on investment on SAI was not available for Nigeria for the given years. The most recent years for which this information was available were 2011-2014. During 2011-2014, the Nigerian government projected investing 4.1 million USD in sustainable intensification (soil testing, conservation agriculture, reclamation of soil). This comprised of 3% and 5% of the indicative allocation to the whole agricultural sector and agricultural intensification, respectively.

See Table B1 in Appendix for full table with details on conversion factor.

SAI has recently gained the attention of policy makers, but resource allocation remains low

Evolution of SAI over the study period

Across all study countries, SAI has only gained prominence in policy documents in the last 10 years. Figure 1 presents the timeline of SAI as a focus area or policy objective. We find that Ethiopia, Zambia, and Nigeria begun emphasizing some aspects of SAI as a policy objective by 2005. Kenya, on the other hand, came to prioritize SAI in its agricultural policies 2010 onwards. We do not have enough information to confirm the policy objectives of Malawi and Ghana prior to 2005. However, both countries adopted SAI as a policy objective by 2006 and 2007, respectively (based on the most recent policy documents we could obtain).

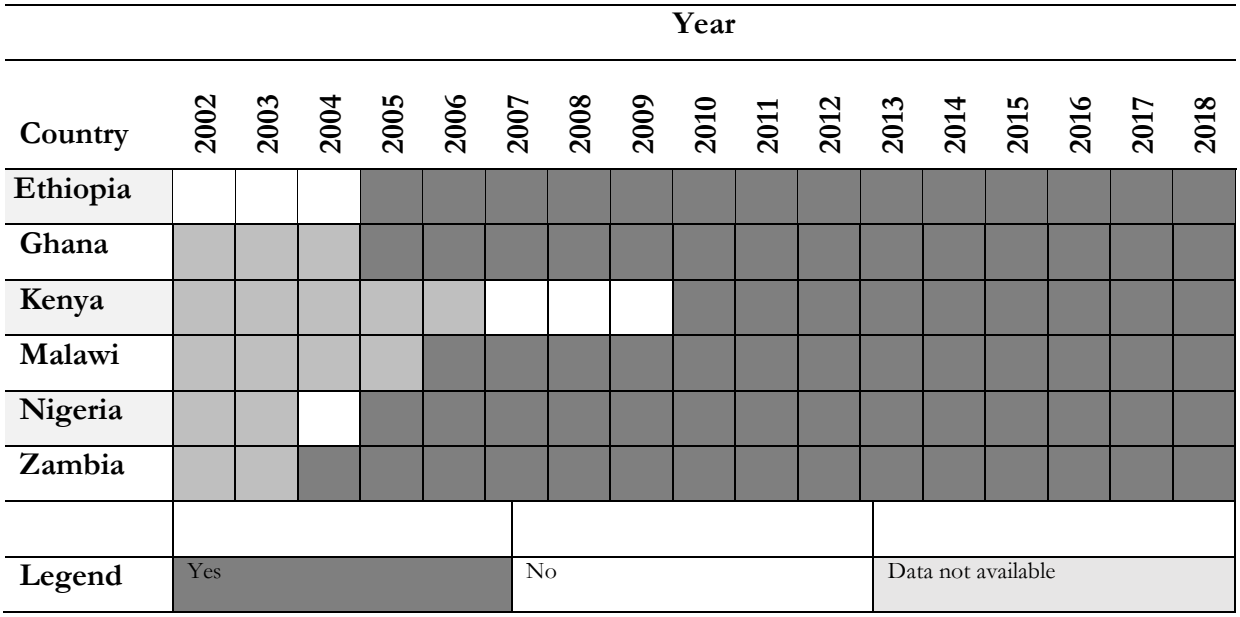

Figure 2. Timeline for mention of SAI as a focus area/policy objective in the policy documents

Since attention to SAI is a more recent policy objective in SSA (compared to AI), we do not have comparable information on resource allocation to SAI across countries and years. Thus, we rely on a detailed reading of policy documents of each country since the early 2000s to assess whether countries were emphasizing SAI as a policy objective. Ethiopia stands out as an early adopter of several SAI activities such as land reclamation, agro-forestry, improved land tenure and soil health and continues to emphasize these activities in its recent agricultural policy documents (Figure B2, Appendix B). Ghana begun focussing on improved soil health and land tenure starting 2010 and more recently also included soil testing and conservation agriculture in its policy documents (Figure B4, Appendix B). The evolution of SAI in Kenya is somewhat inconsistent. While improved land tenure was emphasized as early as in 2005, it was subsequently discontinued. Similarly, land reclamation and agro-forestry were emphasized in 2010 but they find no mention in the most recent

policy documents. Kenya's focus on soil testing to inform fertilizer recommendations has remained intact since 2010 and improving soil health was emphasized starting 2015 (Figure B6, Appendix B). Malawi had prioritized improved land tenure as early as 2005 and agro-forestry and conservation agriculture in its policy documents starting from 2010. The focus on conservation agriculture in Malawi was discontinued following 2015. It is possible that the term 'conservation agriculture' was subsumed into the new categories of soil health that gained traction from 2015 (Figure B8, Appendix B). Nigeria recognized the importance of SAI activities like agro-forestry, conservation agriculture, and improved land tenure to encourage soil fertility management as early as 2005. Starting 2015, it also begun to diversify to improving soil health and reclamation of degraded soil (Figure B10, Appendix B). Zambia begun to prioritize improved soil health, reclamation of degraded land, soil testing to inform fertilizer recommendation, conservation agriculture and improved land tenure starting from 2010 and agro-forestry starting from 2015 (Figure B12, Appendix B).

Resource allocation to SAI

As opposed to AI, the expressed interest in SAI by governments is not adequately supported by resource allocations in most countries. Only Ethiopia and Malawi allocated more than 5% of the AI budget to SAI activities (with 29% and 8.2% respectively), followed closely by Zambia at 4.8%. For Ghana and Kenya this number was less than 1%. Nigeria's latest policy document does not contain adequate detail to enable us to compute the percentage of budget allocated to SAI activities. However, Nigeria allocated 5% of its AI budget to SAI in its prvious policy document 2011-14 (Table 1). Moreover, in its most recent policy document, Nigeria's flagship program, GESS, has aimed at incorporating several aspects of SAI into its ambit. Primary among this were customizing fertilizer blends to match local soil conditions, promoting the use of High-Yielding Varieties, conservation agriculture, and reclamation of degraded soil.

Which SAI activities received most attention?

All countries except Kenya allocated some budgetary resources in the most recent policy documents to conservation of forest resources and agro-biodiversity (Tables B2-B7 in Appendix B). Every country directed some resources to direct measures to improve the soil quality, such as, conservation agriculture (Ghana and Nigeria), increasing soil organic matter (Ethiopia), farmer level production of manure to be used as organic fertilizer (Malawi), promotion of crop rotation and intercropping with legumes (Malawi and Nigeria), liming as a solution to combat soil acidity (Zambia) and development of soil maps to match fertilizer recommendations with soil quality for Kenya (Tables B2-B7 in Appendix B).[12] Development of soil maps received particularly significant attention. Four out of the six countries (exceptions being Ethiopia and Zambia) allocated some resources to soil testing and building soil maps to match fertilizer recommendations with local soil needs.

[12] Though sustainable management of water resources is not a part of our definition of SAI, we find that Ethiopia and Malawi placed significant emphasis on this component. Water resource management could have indirect impact on soil efficiency and productivity. Further, this is a caveat to keep in mind when considering the resource allocation to SAI, since it was not possible to disentangle the amount of resource expenditure on SAI that was allocated exclusively to management of water resources (Tables B2 and B5, Appendix B).

S*trong advocacy for agricultural research and extension is not always supported by adequate resource allocation*

We noted earlier that all countries in our sample had recognized the importance of agricultural research and extension since the early 2000s. The budgetary allocations reveal that the highest allocation of the total agricultural budget to research and extension was 17%, made by Malawi (Table B5, Appendix B). Malawi allocated more than half of the research and extension funds towards activities that could potentially improve crop productivity such as training of farmers, setting up of demonstration plots, organization of agricultural fairs. The remaining was set aside for other extension activities not directly related to improvement of crop productivity, such as nutrition, gender, and agribusiness.[13]

Kenya and Zambia allocated 10% and 9% of their budgets to agricultural research and extension respectively. In Kenya, the bulk of this investment was for wage payments to existing extension agents and development of new extension systems (Table B4, Appendix B). In Zambia resources were primarily directed towards extension and outreach for small farmers. A smaller proportion was to be utilized in agricultural research and certification and registration of improved seeds (Table B7, Appendix B).

While Nigeria's policy documents stressed strengthening agricultural research and extension as a key enabler of agricultural reform, only 3% of the agricultural budgets (in both 2011-14 and 2017-20) was allocated to research and extension activities (Table B6, Appendix B). Ghana contributed only 0.6% of its agricultural budget to the sector. It was not possible to disentangle the allocation to research and extension activities for Ethiopia. However, Ethiopia has expressed interest in agricultural research and extension since the early 2000s and in its latest policy document, mentions conducting scientific research and developing technologies suitable for each agro-ecological zone as an action item (Table B2, Appendix B).

Together, these results suggest that while the governments of all study countries expressed interest in agricultural research and extension, this is not proportionately supported with resource allocation.

CONCLUSION

Three key messages emerge from this systematic review of agricultural policy documents of six sub-Saharan African countries to gauge government commitment to AI and SAI in SSA from 2000 till date. First, all countries showed strong commitment to AI that has remained consistent since the early 2000s. This commitment is backed by adequate allocation of resources in planned budget allocations. Although a large part of the AI budget continues to be spent on subsidy programs, we see significant diversification towards other areas, such as, irrigation and water management.

[13] Obtaining similar detailed information about different types of research and extension activities was not possible for other countries because of the lack of detailed information that was found in the policy documents of Malawi.

Investment in other areas, such as agricultural mechanization and improved land tenure varied across countries.

Second, the recognition of SAI as an important means of achieving and sustaining agricultural productivity and soil health seems to have gained traction among the policymakers more recently. By 2010, all countries were incorporating some aspect of SAI in their policy objectives. However, the stated commitment to SAI was rarely backed by proportionate resources in form of budget allocation. More specifically, only Ethiopia and Malawi allocated enough resources to SAI (29% and 8.2% of AI budget respectively) to be considered as demonstrating strong commitment to SAI using the study criteria. The two most common SAI activities in our sample were conservation of agro-biodiversity (e.g., agro-forestry) and soil testing/mapping to inform locale specific fertilizer recommendations. All countries dedicated some resources towards measures to improve soil health although the means to achieve this differed widely.

Finally, all countries promoted agricultural research and extension, hitherto identified as key to increased agricultural productivity and the successful implementation of SAI. However, the stated objectives were rarely met with significant resource allocation. Allocations ranged from a high of 17% of the agricultural budget in Malawi to less than 1% in Ghana. There was Precise information on resource utilization within the different aspects of agricultural research and extension was limited and precluded a distinction between resources for recurrent payments (such as wages to extension workers) and services (such as those promoting self-employment through agribusiness) and those that were geared specifically to improving agricultural productivity.

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APPENDIX A

Table A1. Data extraction form

Country	Document name	Year (published)	Sub-section	Variable/Information to be collected	Data
			AI/SAI. is a priority	Does the document mention agricultural intensification as a government priority/objective?	
				Does the document mention sustainable agricultural intensification as part of its priority/objective	
			Are there specific programs which are designed to achieve or promote AI and SAI? AND/OR are resources allocated to AI/SAI through the agricultural budget?	Does the document mention specific agricultural programs that will deal with AI and SAI?	
				If yes, how many?	
				If yes, description of each program and the department/agencies involved in implementing.	
				Does the document present an agricultural budget?	
				If yes, what is the absolute amount of agricultural budget?	
				What is the proportion of resources allocated to AI?	
				What are the different AI to which resources are allocated?	
				What are the different SAI activities to which resources are allocated?	
			Does the policy document emphasize agricultural research and extension?	If yes, are there resources/programs allocated to ag research and extension?	
				Are there resources/programs allocated to ag research and extension that deals exclusively with AI and SAI?	

Table A2. List of policy documents studied

Country name	Policy document
Ethiopia	Federal Democratic Republic of Ethiopia (2002) *Food Security Strategy*. Author
	Federal Democratic Republic of Ethiopia, Ministry of Agriculture and Rural Development (2006) *Agricultural Policies, Programs and Targets for a Plan of Accelerated and Sustainable Development to End Poverty (PASDEP)*. Author
	Federal Democratic Republic of Ethiopia, Ministry of Agriculture and Rural Development (2010) *Ethiopia's Agriculture Sector Policy and Investment Framework (PIF*). Author
	Federal Democratic Republic of Ethiopia, Ministry of Agriculture and Rural Development (2016) *Agriculture and Natural Resources Sector Growth and Transformation Plan II (2015-2020)*. Author
Ghana	Republic of Ghana, Ministry of Food and Agriculture (2007) *Food and Agriculture Sector Development Policy (II)*. Author
	Republic of Ghana, Ministry of Food and Agriculture (2009) *Medium Term Agriculture Sector Investment Plan (METASIP), 2009-2015, Volume 2- Programme of Action*. Author
	Republic of Ghana, Ministry of Food and Agriculture (2015) *Medium Term Agriculture Sector Investment Plan (METASIP) II, 2014-2017*. Author
	Republic of Ghana, Ministry of Food and Agriculture (2015) *Investing for Food and Jobs (IFJ)- An Agenda for Transforming Ghana's Agriculture (2018-2021)*. Author
Kenya	Government of Kenya (2007) *Kenya Vision 2030- The Popular Version*. Author
	Government of Kenya (2010) *Agriculture Sector Development Strategy- Medium Term Investment Plan (MTIP) (2011-2015)*. Author
	Government of Kenya, Ministry of Agriculture, Fisheries, Livestock and Irrigation (2019) *Agricultural Sector Transformation and Growth Strategy (ASTGS)*. Author
Malawi	Republic of Malawi, Ministry of Agriculture and Food Security (2006) *Food Security Policy*. Author

Country name	Policy document
	Republic of Malawi, Ministry of Agriculture and Food Security (2008) *Food Security Action Plan, Volume I*. Author
	Republic of Malawi, Ministry of Agriculture and Food Security (2010) *The National Agricultural Policy*. Author
	Republic of Malawi, Ministry of Agriculture and Food Security (2011) *Malawi Agricultural Sector Wide Approach (2011-2015)*. Author
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	Republic of Malawi, Ministry of Agriculture, Irrigation and Water Development (2018) *National Agricultural Investment Plan (NAIP): Prioritized and Coordinated Agricultural Transformation Plan for Malawi (FY 2017/18-2022/23)*. Author
Nigeria	Federal Republic of Nigeria, Nigerian National Planning Commission (2004) *Meeting Everyone's Need- National Economic Empowerment and Development Strategy*. Author
	Federal Republic of Nigeria, Federal Ministry of Agriculture and Rural Development (2011) *Agricultural Transformation Agenda: We will grow Nigeria's Agricultural Sector*. Author
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	Federal Republic of Nigeria, Federal Ministry of Agriculture and Rural Development (2016) *The Agriculture Promotion Policy (2016-2020)-Building on the success of the ATA, Closing Key Gaps Policy*. Author
	Federal Republic of Nigeria, Federal Ministry of Agriculture and Rural Development (2017) *National Agricultural Investment Plan, NAIP-2, For the Implementation of the Nigerian Agricultural Promotion Policy (APP) "The Green Alternative" (2017-2020)*. Author
Zambia	Republic of Zambia, Ministry of Agriculture and Cooperatives (2004) *National Agricultural Policy (2004-2015)*. Author
	Republic of Zambia, Ministry of Agriculture and Cooperatives (2011) *National Agricultural Policy (2012-2030)*. Author
	Republic of Zambia, Ministry of Agriculture and Livestock (2013) *National Agriculture Investment Plan (NAIP)* 2014-2018. Author

APPENDIX B

Table B1. Annual indicative budget allocation to agriculture according to the most recent policy document

Country	Years	Annual budget allocation to agriculture					Allocation to AI	Allocation to SAI	
		Amount	*mn USD (current prices)*	*mn USD (constant prices 2017=100)*	*USD per capita (2017)*	*USD per USD of Ag GDP (2017)*	*% of total*	*% of total*	*% of AI*
Ethiopia	2010-20	1,799 mn USD	1,799	2,202	21	0.03	61%	18%	29%
Ghana	2018-21	2,635 mn Ghanian cedi	1,494	1,494	51	0.05	73%	0.38%	0.52%
Kenya[a]	2019-24	50 bn Kenyan shillings	1,247	1,217	24	0.02	46%	0.28%	0.61%
Malawi	2017/18-2022/23	643 mn USD	643	643	36	0.13	25%	2.0%	8.2%
Nigeria[b]	2017-20	281 bn Naira	2,427	2,427	13	0.01	80%	N/A	N/A
Zambia	2014-18	683 mn USD	683	700	42	0.30	44%	1.9%	4.8%

Source: Ethiopia- Ethiopia's Agriculture Sector Policy and Investment Framework (PIF) 2010-2020; Ghana- Investing for Food and Jobs (IFJ): An agenda for transforming Ghana's Agriculture (2018-2021), Published by Ministry of Food and Agriculture, Republic of Ghana in January, 2018; Nigeria- National Agricultural Investment Programme-2, for the implementation of the Nigerian Agriculture Promotion Policy (AAP) "The Green Alternative", 2017-2020, Federal Ministry of Agriculture and Rural Development; Kenya- NAIP, 2019-2024, Ministry of Agriculture, Livestock, Fisheries, and Irrigation; Zambia- Zambia National Agricultural Investment Plan (2014-2018), Published by the Ministry of Agriculture and Livestock, May 2013 Malawi- NAIP, 2017/18-2022/23, published by Ministry of Agriculture, Irrigation, and Water Development in January, 2018. The numbers in this table represent average annual indicative budget computed for the years covered by the relevant policy document.

The conversion factors used by authors are as follows: Ghana: 1 Ghanian cedi= 0.57 USD; Nigeria: 1 Nigerian Naira = 0.0086 USD. The exchange rate used in the policy documents are as follows: 1 Ethiopian birr=0.06 USD; Malawi: N/A; Zambia: 1 USD= 5 Zambian Kwacha. The amounts thus obtained in current USD were then further converted to real terms using the international USD deflator. From the policy documents it is not clear if the budget numbers were computed at constant or current prices. We assume all numbers to be current prices as of the year of compilation of the policy document and use the appropriate year's index. The conversion factors used are as follows: Ethiopia, price index as of 2010 = 0.817; Ghana price index as of 2017= 1.00; Kenya: price index as of 2018= 1.02; Malawi: price index as of 2017= 1.00; Nigeria: price index as of 2017=1.00; Zambia: price index as of 2014= 1.03.

[a] For Kenya, the number in the table is an of a range provided in the source document.

[b] Information on investment on sustainable intensification was not available for Nigeria for the given years. The most recent years for which this information was available were 2011-2014. During 2011-2014, the Nigerian government projected investing 4.1 million USD in sustainable intensification (soil testing, conservation agriculture, reclamation of soil). This comprised of 3% and 5% of the indicative allocation to the whole agricultural sector and agricultural intensification, respectively.

Table B2. Indicative investment in Ethiopia's agriculture sector (mn USD) #

Policy area	Sub-categories	2010/11-2019/20	
		mn USD	% of total
Disaster Management/Emergency preparedness		4912.4	27.3%
Ag commercialization/ Agribusiness/ Private sector involvement in agriculture		995	5.5%
Agricultural Intensification	Access to agricultural inputs [a]	1808.5	10.1%
	Irrigation/Water Management	5922	32.9%
	Sustainable intensification [b]	3179.5	17.7%
Others [c]		1172	6.5%
Total		**17989.4**	

Source: Ethiopia's Agriculture Sector Policy and Investment Framework (PIF) 2010-2020; https://projects.worldbank.org/en/projects-operations/project-detail/P113032?lang=en&tab=ratings

Notes: #The exchange rate used was sourced from the original document (@1Ethiopian birr=0.0606 USD)**;** [a] The budget does not present a more detailed break-up of this category. However, the activities and targets indicated to be covered under it comprise increasing productivity in agriculture and livestock, increase in number of households with access to agricultural inputs, increased supply of chemical fertilizers and improved seed, and scientific research for developing technologies suitable for each agro-ecological zone. This also includes resources allocated to the Agricultural Growth Program (AGP). The AGP is a 5-year program (2013-2018) aimed at increasing agricultural productivity and market access for key crop and livestock products in targeted areas, with increased participation of women and youth.**;** [b] This category consists of two components: Activities covered under "Natural Resource Management" comprise of 94% of the allocated money and aim at increasing area under irrigation, conservation of precipitation, increasing crop yield per unit of water, increase in area under improved land management and forest cover, rehabilitation of degraded land, increasing the normalized difference in vegetation index, change in in agrobiodiversity index, increase in soil organic carbon, and issuing of land certificates. The remaining 6% is allocated to the Sustainable Land Management Program (SLMP phase II which ran from 2013-2018). It aimed at reducing land degradation and improving land productivity in selected watersheds in targeted regions in Ethiopia; [c] Includes money allocated for contingencies.

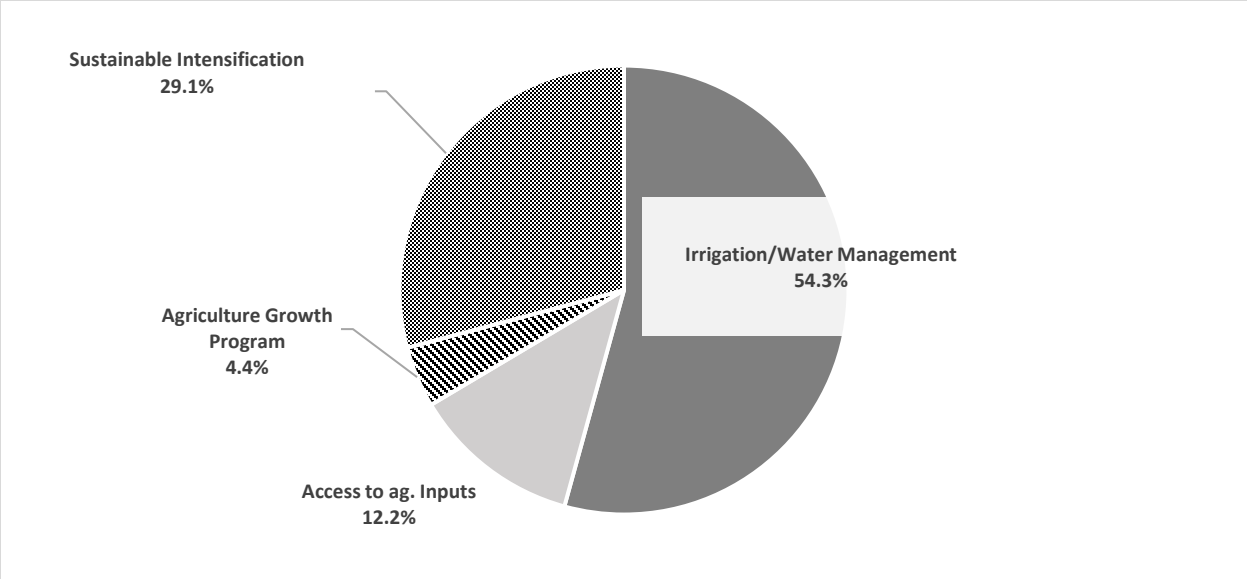

Figure B1. Composition of indicative budget allocation to AI and SAI in Ethiopia's most recent policy document (2010/11-2019/20)

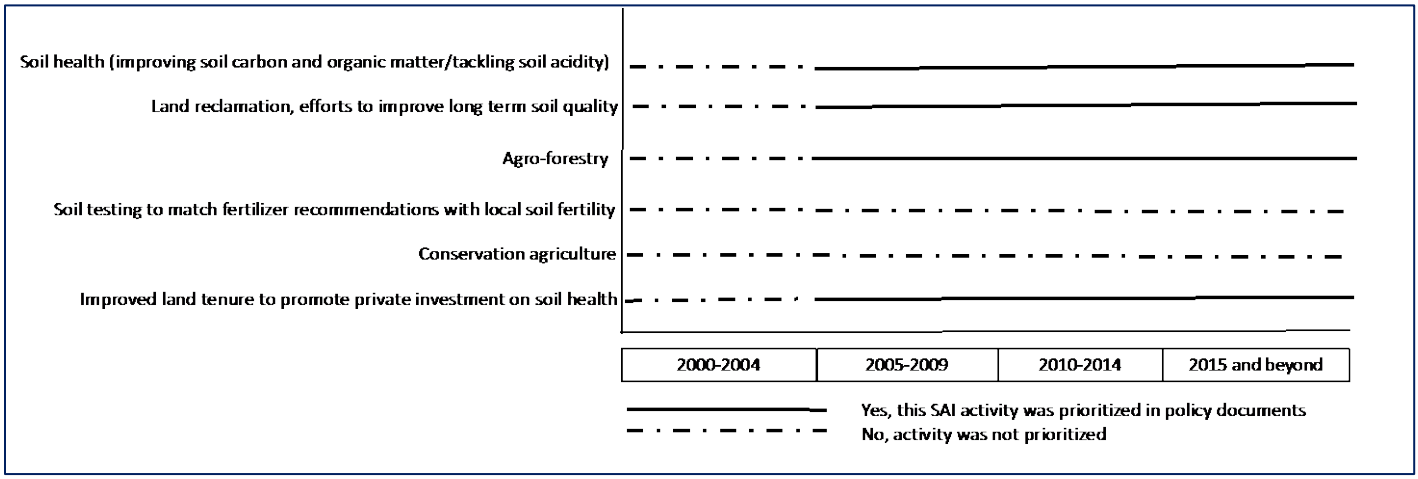

Figure B2. Evolution of SAI activities noted in Ethiopia's agricultural policy documents

Table B3. Indicative investment on Ghana's agricultural sector across different policy regimes (mn USD) #

Policy area	Sub-categories	2011-2015[1]		2014-2017[2]		2018-2021[3]	
		mn USD	% of total	mn USD	% of total	mn USD	% of total
Management/Administration		1.63	0.6%	1.98	0.7%	138.5	7.7%
Climate change resilience		-		0.28	0.1%	155.53	8.7%
Livestock/ High value agriculture/Nutrition		31.47	12.1%	12.67	4.6%	62.08	3.5%
Disaster Management/Emergency preparedness		1.48	0.6%	0.05	0.02%	50.68	2.8%
Ag markets and trade/Post-harvest management		-		-		43.29	2.4%
Ag commercialization/ Agribusiness/ Private sector involvement in agriculture		119.92	46.0%	117.28	42.7%	20.94	1.2%
Agricultural Research/Extension/Capacity building		8.86	3.4%	24.23	8.8%	10.81	0.6%
Others [a]		3.62	1.4%	-		3.16	0.2%
Agricultural intensification	Access to agricultural inputs	23.14	8.9%	5.34	1.9%	643.22	35.9%
	Agricultural mechanization	17	6.5%	41.24	15.0%	398.48	22.3%
	Irrigation/Water Management	48.65	18.7%	69.56	25.3%	258.26	14.4%
	Sustainable Intensification [b]	4.74	1.8%	1.91	0.7%	4.32	0.2%
Total		**260.5**		**274.5**		**1789.3**	

Source: [1]Investing for Food and Jobs (IFJ): An agenda for transforming Ghana's Agriculture (2018-2021), Published by Ministry of Food and Agriculture, Republic of Ghana in January, 2018; [2]Medium Term Agriculture Sector Investment Plan (METASIP) II, 2014-2017, Published by the Ministry of Food and Agriculture, Republic of Ghana in December, 2015; [3]Medium Term Agriculture Sector Investment Plan (METASIP) I, 2011-2015, Published by the Ministry of Food and Agriculture, Republic of Ghana in September, 2010

Notes: # computed at exchange rate as of 10.01.2020 (1 Ghanian cedi = 0.17 USD)

a Others consists of nutrition sensitive agriculture and renewable energy;

b Sustainable Intensification consists of different but related activities across years. For 2018-2021, it comprised of soil testing, conservation agriculture and natural resource management. The term conservation agriculture and natural resource management itself comprised of the following activities: protecting, conservation, and sustainable use of

biologically diverse ecosystems and habitat, promoting the conservation and sustainable management of forest resources, and promoting land banking along with secured land tenure; For 2014-2017 it comprised of activities to improve land tenure security, community land use, creating awareness about sustainable land management, creating programs with incentives to adopt less exploitative agricultural practices; For 2011-2015 it consisted of activities focused at awareness creation and use of sustainable land management activities technologies by farmers.

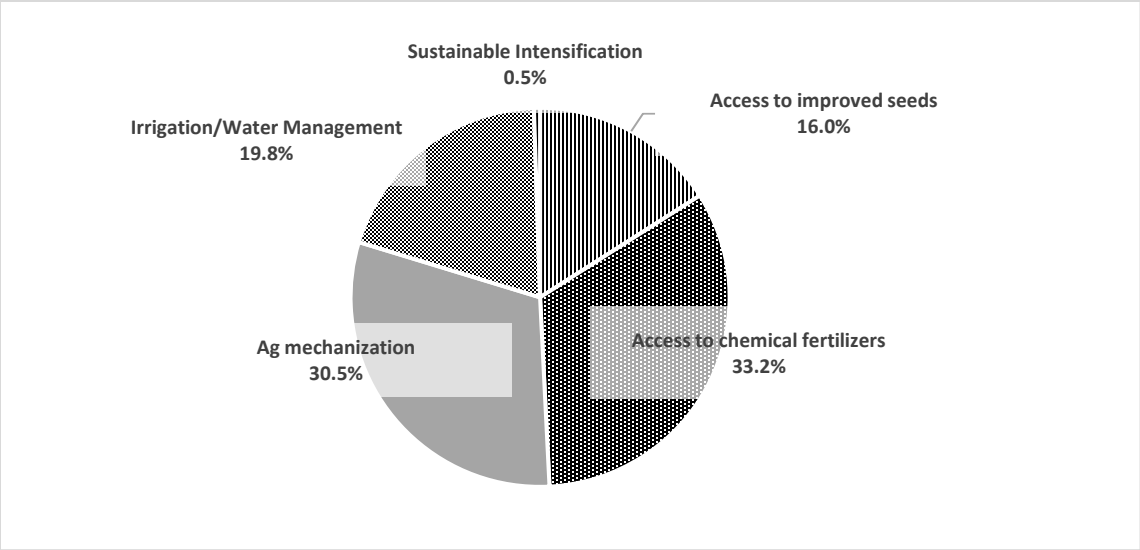

Figure B3. Composition of indicative budget allocation to AI and SAI in Ghana's most recent policy document (2018-2021)

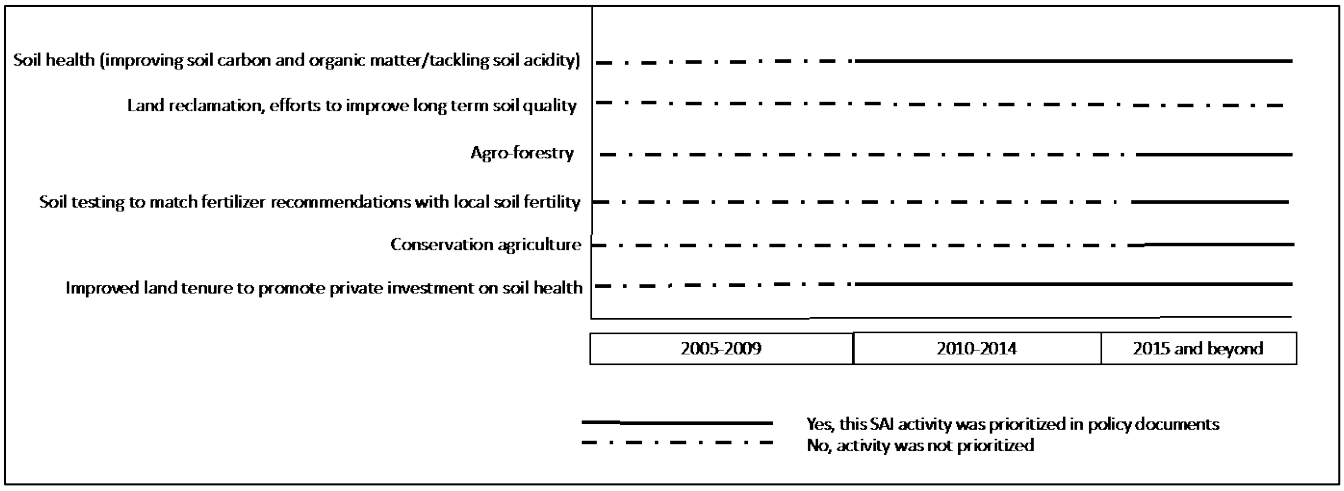

Figure B4. Evolution of SAI activities noted in Ghana's agricultural policy documents

Table B4. Indicative investment on Kenya's agricultural sector across different policy regimes (mn USD) #

Policy area	Sub-categories	2010-2015 [1]		2019-2024 [2]	
		mn USD	% of total	mn USD	% of total
Management/Administration		15	0.5%	29.4	1.3%
Disaster Management/Emergency preparedness		-	-	83.3	3.6%
Ag markets and trade/Post-harvest management		247	8.0%	79.1	3.4%
Ag commercialization/ Agribusiness/ Private sector involvement in agriculture [a]		386	12.5%	819.7	35.7%
Agricultural Research/Extension/Capacity building [b]		-	-	232.8	10.1%
Agricultural intensification	Access to agricultural inputs [c]	1143	37.0%	297.6	13.0%
	Irrigation/Water Management [d]	-	-	746.1	32.5%
	Sustainable Intensification [e]	1297	42.0%	6.4	0.3%
Total		**3088**		**2294.5**	

Source: [1]Agriculture Sector Development Strategy, Medium term Investment Plan: 2010-2015, Government of Kenya; [2]NAIP, 2019-2024, Ministry of Agriculture, Livestock, Fisheries, and Irrigation

Notes: # The exchange rate used in converting the values from Kenyan Shilling to USD was 1 KES = 0.0092 USD (as of 10.05.2020). Further, the numbers for 2019-24 are averages of a range provided in the source document;

[a] For 2019-2024, only 1% of the investment in this category is to be contributed by the government, the bulk of investments are expected to be contributed by the private sector;

[b] The budget allocation to extension services in 2019-2024, includes USD 66.24 million to be allocated to developing youth led extension services as well as an anticipated 138 USD million for payment of wages to existing extension workers over a span of 5 years (@ USD 27.6 million/year).

[c] For 2010-2014, apart from access to agricultural inputs this category includes agro-ecological area specific activities for improving productivity of agriculture and livestock. For high rainfall areas, these include promoting intensive use of agricultural technologies, conservation agriculture, post-harvest management and other means for improving livestock and fishery productivity. In semi-arid and arid regions, it includes promoting the use of drought tolerant crop varieties, conservation agriculture, agro-forestry, water-harvesting and means to improve livestock and fishery productivity; For 2019-2024, the budget allocation comprised of ag-input subsidies worth USD 67.62 million aimed at development of e-voucher system and better targeting of subsidies, and USD 230 million for continuation of existing subsidy program (@ USD 46 million/year).

[d] For 2019-2024, less than 1% of this amount is to be contributed by the government; the bulk of investments are expected to be made by the private sector.

[e] This category comprised of the following activities: For 2010-2015, introducing laws and regulations for protecting agricultural and natural resources, identification and mapping of degraded land, designing programs for rehabilitation of degraded land; For 2019-2024, it included primarily resources for building soil maps.

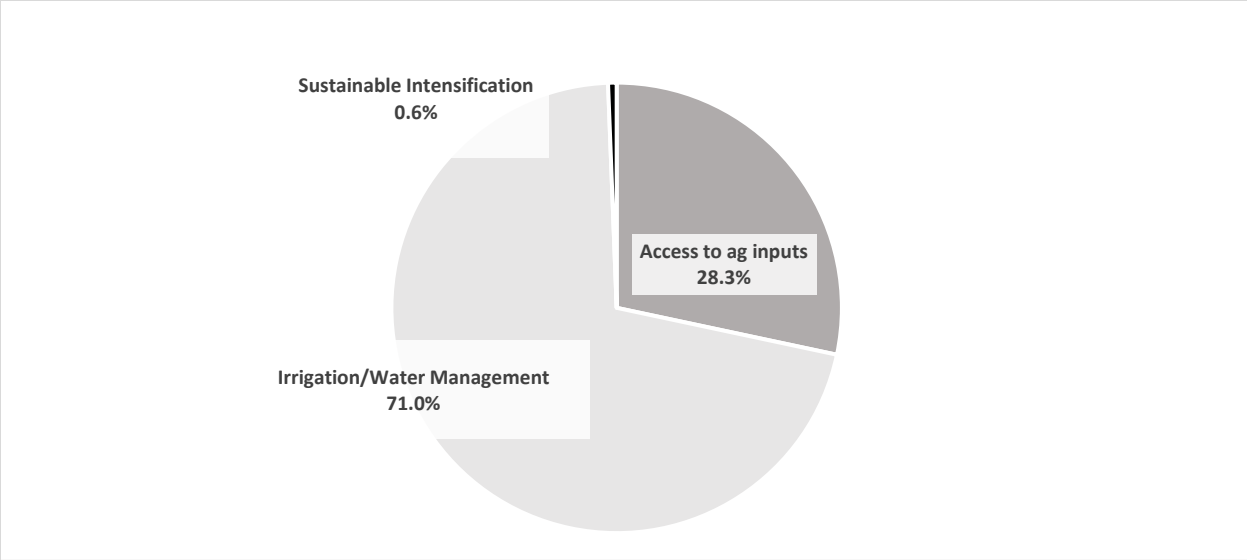

Figure B5. Composition of indicative budget allocation to AI and SAI in Kenya's most recent policy document (2019-2024)

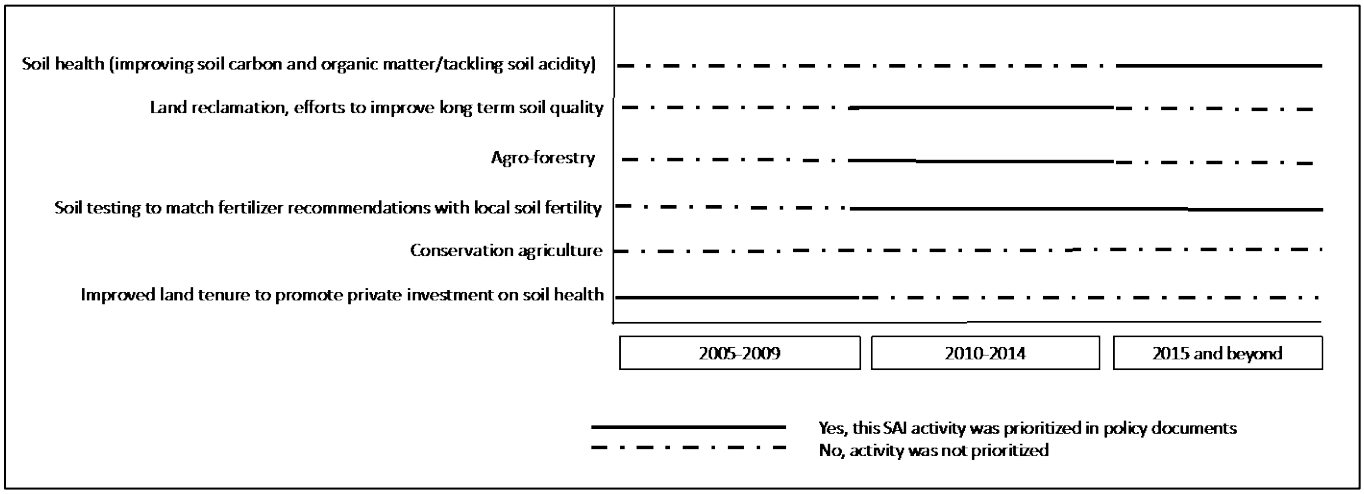

Figure B6. Evolution of SAI activities noted in Kenya's agricultural policy documents

Country profile: Malawi

Table B5. Indicative investment on Malawi's agricultural sector across different policy regimes (mn USD) #

Component	Sub-component	2011/12-2014/15 [1]		2017/18-2022/23 [2]	
		mn USD	% of total	mn USD	% of total
Management/Administration		98.36	5.9%	176.52	5.5%
Disaster Management/Emergency preparedness		19.85	1.2%	412.53	12.8%
Ag markets and trade/Post-harvest management		2.39	0.1%	203.12	6.3%
Ag commercialization/ Agribusiness/ Private sector involvement in agriculture		158.84	9.5%	521.92	16.2%
Livestock/ High value agriculture/Nutrition		75.17	4.5%	324.98	10.1%
Pest and Disease Management		-		232.1	7.2%
Agricultural Research/Extension/Capacity building [a]		103.56	6.2%	547.06	17.0%
Others [b]		28.5	1.7%	1.96	0.1%
Agricultural Intensification	Access to agricultural inputs [c]	741.56	44.2%	242.88	7.6%
	Irrigation/Water management	392.07	23.4%	396.46	12.3%
	Ag mechanization	-		55.47	1.7%
	Land use planning/tenure security	-		35.74	1.1%
	Sustainable intensification [d]	58.24	3.5%	65.49	2.0%
Total		**1678.53**		**3216.23**	

Source: 1 Malawi Agricultural Sector Wide Approach (ASWaP) 2011-15, Ministry of Agriculture, Irrigation and Water Development; 2 NAIP, 2017/18-2022/23, published by Ministry of Agriculture, Irrigation, and Water Development in January 2018.

Notes: # All the information in this table was reported in the original documents in USD. In case of 2011/12-2014/15 there was a difference of 513.1 mn USD between the total presented here and the one included in the original document. This difference arose because the total amount of money mentioned under sustainable water management (classified as irrigation here) in the original document exceeded the sum total of money allocated to all components under sustainable water management.

a 65% of these resources were allocated to training and capacity building of extension workers for a broad range of activities including, but not limited to nutrition, gender inclusiveness, farmer organizations, and activities that were specifically focused towards improving farmer's knowledge and skills in livestock management and agricultural trade. The remaining 35% consisted of funds allocated to research activities and extension focussed on AI activities, such as training of farmers, setting up of demonstration plots, organization of agricultural fairs. The research spending for 2011/12-2014/15 pertains specifically to spending on development of improved seeds and pest management.

b Others: Included aspects relating to gender and HIV

c For 2011/12-2014/15: Comprises of money to be allocated to distribution of fertilizers and maize seeds (87%), and distribution of improved legume and tuber planting material (12%), and pest and disease management (4%); For 2017/18-2022/23: Comprises of resources allocated to allocation towards the Farmer Input Support Programme (FISP) (79%), and increasing access to improved seeds (21%)

d Sustainable Intensification includes the following sub-components: For 2011/12-2014/15 it included activities aimed at sustainable agricultural land management through promotion of conservation agriculture, agro-forestry, wetland (dambo) management, and prevention of river degradation; For 2017/18-2022/23 it included sustainable management of water

resources(54%), agro-forestry(30%), farmer level production of manure and fertilizer(8%), updating soil maps(4%), refurbishment of soil maps(2%), and area-specific fertilizer recommendation(2%).

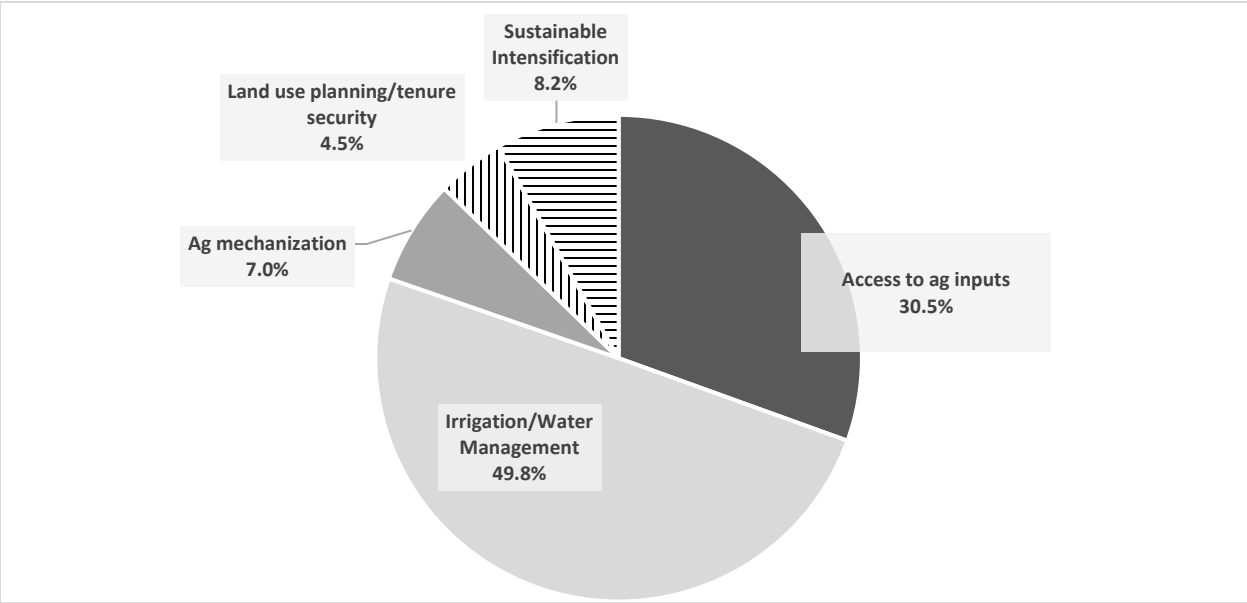

Figure B7. Composition of indicative budget allocation to AI and SAI in Malawi's most recent policy document (2017/18-2022/23)

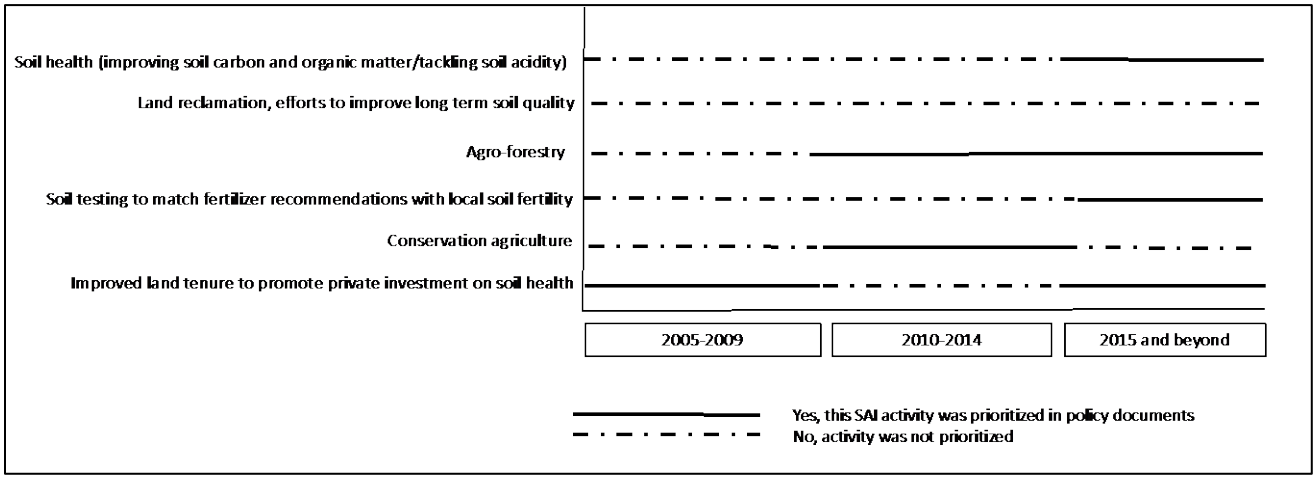

Figure B8. Evolution of SAI activities noted in Malawi's agricultural policy documents

Table B6. Indicative investment on Nigeria's agricultural sector across different policy regimes (mn USD) #

Policy area	Sub-category	2011-14 [1]		2017-2020 [2]	
		mn USD	% of total	mn USD	% of total
Livestock/ High value agriculture/Nutrition		97.02	15.9%	223.62	10.2%
Ag markets and trade/Post-harvest management		76.34	12.5%	49.63	2.3%
Ag commercialization/ Agribusiness/ Private sector involvement in agriculture		58.97	9.7%	108.14	4.9%
Management/Administration		5.85	1.0%	N/A	
Others [a]		10.43	1.7%	-	
Agricultural Research/Extension/Capacity building		18.66	3.1%	63.45	2.9%
Agricultural intensification	Ag mechanization	3.46	0.6%	N/A	
	Access to agricultural inputs [b]	85.04	14.0%	1256	57.2%
	Irrigation/ Water management [c]	91.31	15.0%	494.28	22.5%
	Land management/documentation	145.08	23.8%	N/A	
	Sustainable Intensification [d]	16.43	2.7%	N/A	
Total		**608.59**		**2195.12**	

Source: [1] NAIP (2011-2014), Published by Ministry of Agriculture and Rural Development, September 2010; [2]National Agricultural Investment Programme-2, for the implementation of the Nigerian Agriculture Promotion Policy (AAP), 2017-2020, Federal Ministry of Agriculture and Rural Development.

Notes: # The exchange rate used in converting the values from Nigerian Naira to USD was 1 Naira=0.0026 USD (as of 10.06.2020)

[a] Includes investments made for promotion of organic fertilizer, youth careers, development of pest free crop area.

[b] For 2011-2014, includes investments in programs such as Fadama III, National Programme for Food Security (NPFS), NERICA, and Presidential initiative in Rice production in Nigeria; For 2017-2020 includes activities to increase access to agricultural inputs like fertilizers, seed/seedlings, mechanization and other agrochemicals, Specific activities include expanding GES to farmers with >5ha land, customizing fertilizer blends to local soil conditions, promoting the use of High-Yielding Varieties

[c] Includes expansion of a river-basin water utilization program, utilization of dams for irrigation, expansion of aquaculture program

[d] Includes activities such as soil testing, conservation agriculture, and reclamation of soil

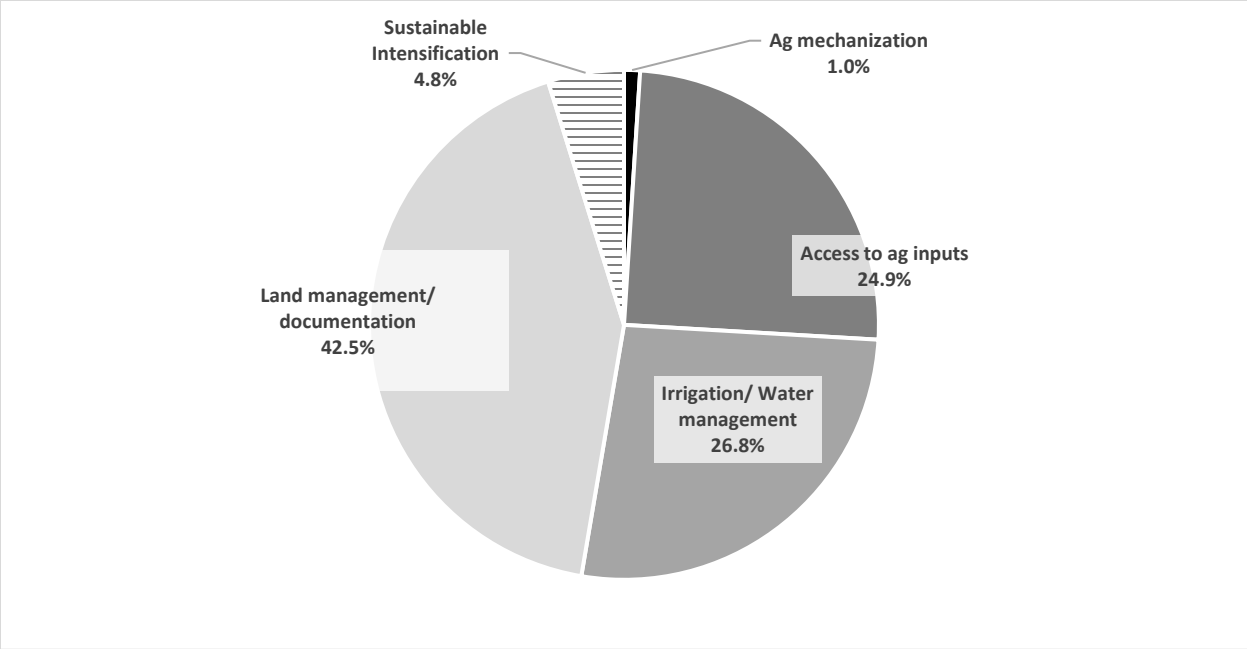

Figure B9. Composition of indicative budget allocation to AI and SAI in Nigeria's most recent policy document for which detailed data was available (2011-2014)

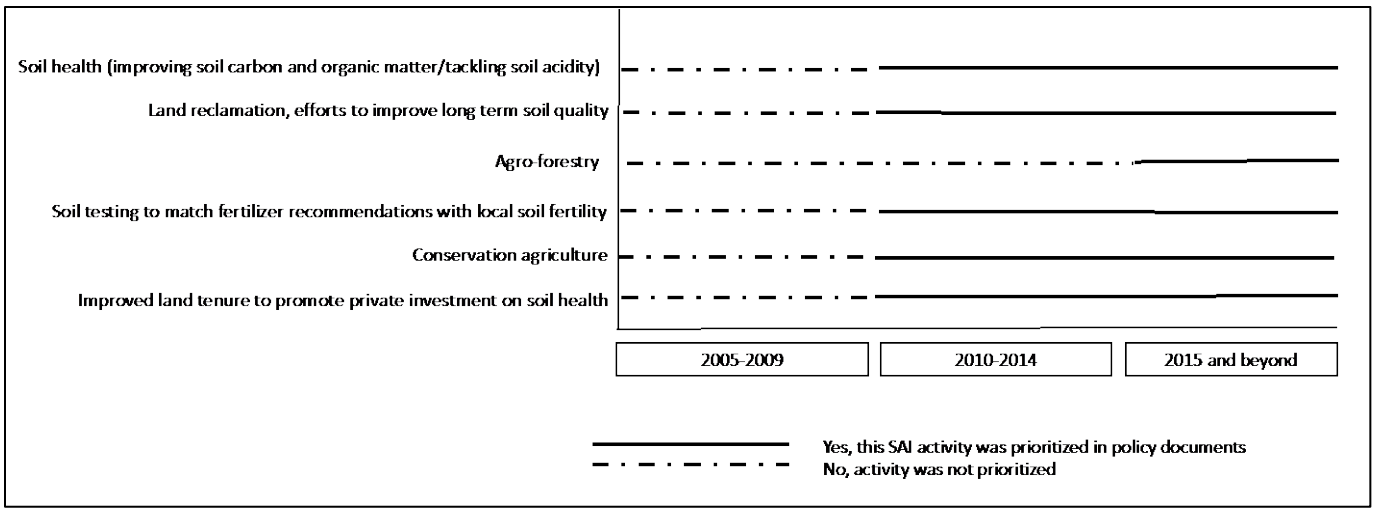

Figure B10. Evolution of SAI activities noted in Nigeria's agricultural policy documents

Table B7. Indicative investment on Zambia's agricultural (mn USD) #

Policy area	Sub-category	2014-18	
		mn USD	% of total
Management/Administration		19.9	0.7%
Livestock/ High value agriculture/Nutrition		446.9	16.4%
Ag markets and trade/Post-harvest management		257.2	9.4%
Disaster Management/Emergency preparedness		659.9	24.2%
Agricultural Research/Extension/Capacity building [a]		254.5	9.3%
Agricultural intensification	Access to agricultural inputs [b]	831.4	30.4%
	Ag mechanization	0.54	0.02%
	Irrigation/Water management	169.3	6.2%
	Land management/documentation	37.2	1.4%
	Sustainable intensification [c]	52.7	1.9%
Others [d]		1.2	0.0%
Total		**2730.73**	

Source: Zambia National Agricultural Investment Plan (2014-2018), Published by the Ministry of Agriculture and Livestock, May 2013.

Notes: # The exchange rate used in converting the values from Zambian Kwacha to US dollars was the same as that used by the authors of source document (1 ZMW =20 USD)

[a] Comprises of allocations to increasing production, certification and registration of improved seeds (10%), agricultural research (15%), extension focused on small farmers (48%), and agricultural training and education (27%).

[b] Almost 99% of this allocation is made towards access to inputs through the Farm Input Support Programme (FISP). The remaining is to be used for improving productivity through crop diversification and use of improved varieties.

[c] Includes promotion of conservation agriculture, afforestation, agro-forestry, community woodlots, and tackling issues of soil acidity

[d] Includes promoting efficient energy use from natural resources

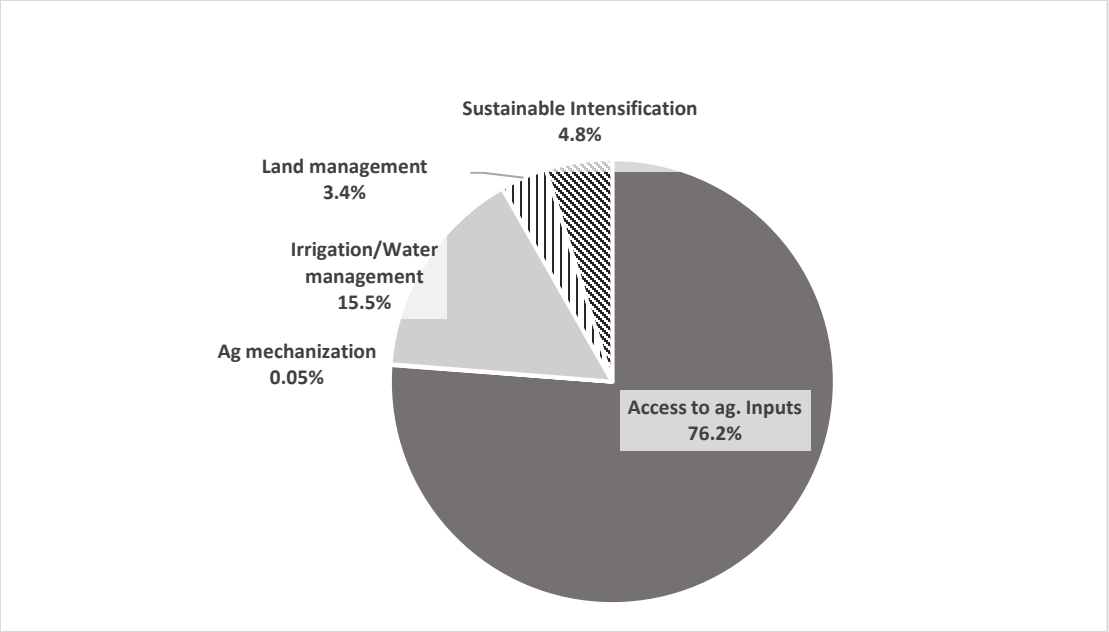

Figure B11. Composition of indicative budget allocation to AI and SAI in Zambia's most recent policy document for which detailed data was available (2014-2018)

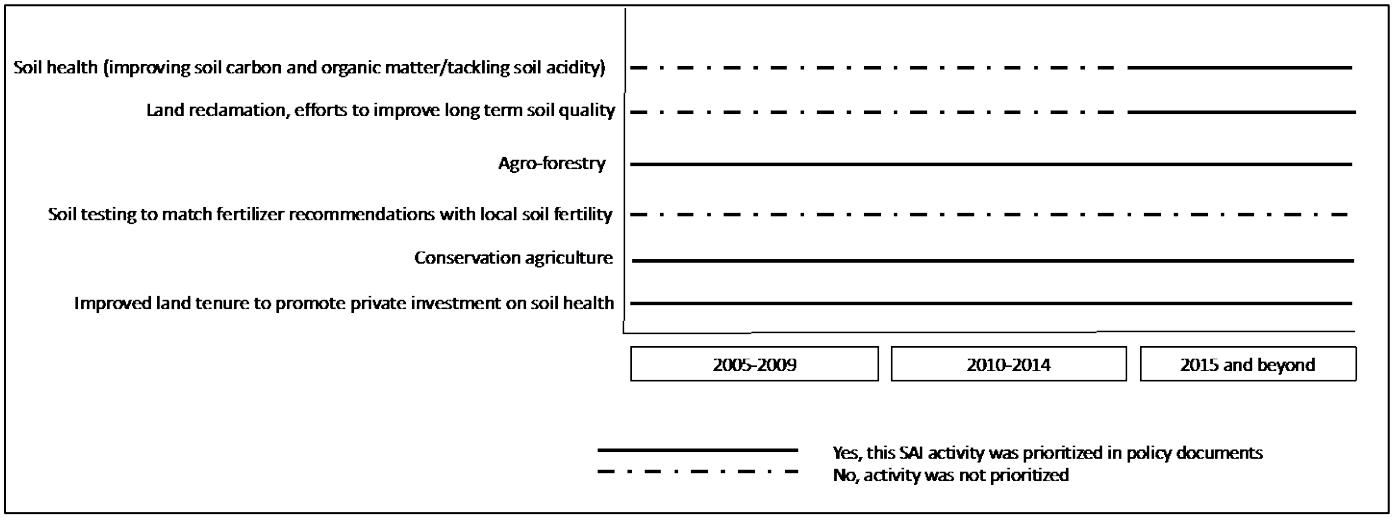

Figure B12. Evolution of SAI activities noted in Zambia's agricultural policy documents

Table B8. Government initiated programs related to AI mentioned in the most recent policy documents for sample countries

Sector	Country	Program	Remarks
Irrigation and Water management	*Ethiopia*	Participatory Small-Scale Irrigation Development Program (PSSIDP).	The project aimed at improving the food security and nutritional outcomes of small-scale farmers in drought prone areas of Ethiopia through development of small and community owned irrigation systems
	Ghana	One Village, One Dam	Project aimed at providing year-round supply of irrigation water to farm households in the Northern Region of the country.
	Kenya		Almost all of the investment in this area was expected to be made by large private farms through private public partnerships, while the government's role was designated as a facilitator in designing land lease contracts
	Malawi	-	
	Nigeria	-	
	Zambia	-	
Access to inorganic fertilizers and improved seeds	*Ethiopia*		There was no input subsidy program being implemented in Ethiopia according to the most recent policy document. However, Rashid et al. (2013) report that large amounts of fiscal expenditure is made on promoting fertilizer use since 2008.
	Ghana	Planting for Food and Jobs (PFJ)	Among other components, the program aimed at improving farmer's access to chemical fertilizers and improved seeds
	Kenya	National Accelerated Agricultural Inputs Access	Resources allocated to continue existing subsidy programs and develop an e-voucher system

Sector	Country	Program	Remarks
		Program (NAAIAP), and input subsidy program administered by the National Cereal and Produce Board (NCPB)	
	Malawi	Farm Input Support Programme (FISP)	FISP is a subsidy program primarily aimed at improving farmer's access to agricultural inputs. The ongoing reforms in FISP include improved targeting of subsidy beneficiaries, increasing the involvement of private sector in the fertilizer supply chain through an e-voucher system, increasing farmers' contribution towards the input cost, and promoting crop diversification through FISP. There is also an expressed interest in modifying FISP to incorporate aspects of soil fertility, such as matching fertilizer provisions with soil fertility and cropping systems and crop rotation with legumes and oilseeds.
	Nigeria	Growth Enhancement Support Scheme (GESS)	Access to improved seed and fertilizer are given highest priority among other agricultural inputs in Nigeria, although there is increasing interest to improve farmers access to a wide variety of agricultural inputs (K. Andam, personal communication, March 12, 2021).
	Zambia	Farm Input	FISP is Zambia's subsidy program aimed at

Sector	Country	Program	Remarks
		Support Programme (FISP)	improving farmer's access to agricultural inputs. Some major reforms were introduced to FISP during the most recent policy document covered in this study (2014-18). These include the e-voucher system that aims to enable farmers to purchase any agricultural input of their choice from an agro-dealer at a discounted price and is expected to diversify farmer's agricultural input demand beyond chemical fertilizers and improved seeds
Agricultural Equipment and Mechanization	*Ethiopia*	-	
	Ghana	Agricultural Mechanization Services Centers (AMSECs)	
	Kenya	-	
	Malawi	-	
	Nigeria	-	
	Zambia	-	
Improved land tenure and property rights	*Ethiopia*	-	
	Ghana	-	
	Kenya	-	
	Malawi	-	
	Nigeria	-	Land Use Act was amended to facilitate titling of land; Initiated program to create databases and maps of current titles, making them easily available to farmers and financing institutions
	Zambia	-	

Table B9. Earliest year (since 2000) when the AI activity was prioritized in country's agricultural policy document

Country	Year of earliest policy document	Access to inorganic fertilizer/ improved seed	Irrigation and water harvesting	Agricultural mechanization	Improved land tenure and property rights [a]	Agricultural research and extension
Ethiopia	2002	2002	2010	2002	2010	2005
Ghana	2007	2007	2007	2007	2018	2007
Kenya	2007	2007	2007	-	2007[b]	2010
Malawi	2006	2006	2006	2006	2006	2006
Nigeria	2004	2004	2004	2004	2011	2004
Zambia	2004	2004	2004	2004	2004	2004

[a] Pertaining only to the Ministry of Agriculture

[b] This activity was not mentioned in subsequent policy documents of Kenya