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Public expenditure analysis for climate change adaptation and mitigation in the agricultural sector

A case study of Uganda

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Abstract

This paper presents a methodology for public expenditure review and analysis for climate change adaptation and mitigation in the agricultural sector. It outlines the basic methodological concepts, including the classification of public expenditures in the context of their links to climate change adaptation and mitigation. It also illustrates how such analysis can usefully contribute to policy decision making to better achieve the climate change adaptation and mitigation goals using the case study of Uganda.

The proposed classification allows for analysing the level and the composition of public expenditures that influence adaptation capacity of the sector to climate change, and actions that increase or decrease greenhouse gas emissions (GHG) in agriculture. This, in turn, allows for assessing whether the sector is stimulated in a way that allows achieving a country's climate change adaptation and mitigation objectives and form a basis for further evaluation of the effectiveness of individual measures in reaching these objectives.

The case study of Uganda reveals that most of the expenditures in support of the food and agriculture sector have an effect on climate change adaptation and mitigation efforts. The majority of these measures support increasing the adaptive capacity of the farming sector and the associated expenditures have been significantly increasing over the last ten years, yet the majority are donor-funded. Measures with potential impacts on GHG emission levels were not sufficiently detailed for a conclusive assessment, which constitutes a major drawback for this analysis.

Keywords: public expenditures, agriculture, climate change, policy analysis.

JEL codes: Q18, Q28, Q54, Q58.

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1 Introduction

Climate change is accelerating and agriculture is one of the most affected sectors. Agriculture is also one of the major contributors to climate change: agriculture, forestry and other land uses account for about one fourth of global human-activity-induced emissions through current unsustainable crop and livestock production practices and deforestation (IPCC, 2014). To ensure food security and improve livelihoods while simultaneously reducing the pace of climate change, there is an urgent need to increase the adaptive capacity of the sector and to reduce crop and livestock production emissions.

Until very recently, the public expenditures in support of agriculture have been giving priority to key socio-economic issues, such as enhancing short- and medium-term food security and livelihoods. Yet, improving climate outcomes has become a key element of ensuring sustainable and long-term growth of the agricultural sector. Depending on the policy instrument applied, public expenditures may enhance or impede climate change adaptation and mitigation potential of the agricultural sector and, therefore, reinforce or undermine meeting the socio-economic objectives over the longer-term.

Further, the interest in ensuring accurate measuring and reporting of climate finance under the Paris Agreement has increased in recent years given its potential to effectively increase accountability, transparency and trust between Parties and overall monitor the progress towards the achievement of national targets. Countries formulate their climate change priorities and needs through various policy instruments, including National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs). Often, these policy instruments express also financial targets to achieve the identified priority climate actions. However, measuring the progress towards these financial targets presents several challenges including lack of standard methodology, as well as low capacity and experience, especially in developing countries.

Bridging these knowledge and capacity gaps and helping policy makers to understand how the current public expenditure patterns influence the climate-related outcomes is the first step in ensuring that the expenditure measures in agriculture are fully supportive of the key socio-economic goals over the long-term in the face of changing climate. This working paper aims at filling in this important knowledge gap by proposing a methodology for public expenditure review and analysis for climate change adaptation and mitigation (PERCC) in the agricultural sector. The study explains the basic methodological concepts, presents classification of the expenditures and illustrates how it contributes to policy analysis in the context of climate change adaptation and mitigation using the case study of Uganda.

PERCC has been developed to establish which public expenditures in support of the agricultural sector development have negative and positive effects on climate change adaptation and mitigation. PERCC aims at analysing the level and the composition of public expenditures that influence the adaptation capacity of the sector to climate change, and actions that increase or decrease GHG emissions in agriculture. It looks at all measures addressing climate change adaptation and mitigation in the sector, regardless of the source of financing, instrument used or perceived economic impacts. It analyses the way in which each of the expenditure measures is implemented and assesses the economic signals it sends to the sector. As the application to the Uganda case study shows, the results help assessing whether the sector is stimulated in a way that allows achieving a country's climate change adaptation and mitigation objectives and form a basis for further evaluation of the effectiveness of individual measures in reaching these objectives. Furthermore, the combination of PERCC with a standard public expenditures

analysis sheds light on how well the government performs in tackling the simultaneous challenges of improving socio-economic outcomes, while building resilience to climatic shocks, enhancing farmers' adaptation to changing climate and contributing to slowing down the pace of climate change.

Overall, PERCC contributes to building key evidence for informed decision-making processes for a range of stakeholders, and particularly the policy makers and donor community. The analysis provides useful insights that help in determining key areas for policy reform and future investments and can usefully feed into building national level strategies and plans for building a climate-friendly, sustainable and productive agricultural sector.

2 Public expenditure review and analysis for climate change adaptation and mitigation (PERCC) methodology

The PERCC methodology builds on analysis of public expenditure in support of the food and agriculture (PEA) framework developed under FAO's project on Monitoring and Analysing Food and Agricultural Policies (MAFAP). PERCC aims at analysing the level and the composition of public expenditures for climate change adaptation and mitigation in agriculture by adding an additional dimension to the standard MAFAP's PEA analysis: each expenditure measure is labelled as related, or not, to climate change adaptation and mitigation (or marked as not determined if information is insufficient to make a proper choice). These are further broken down into measures that are enhancing or constraining climate change adaptation and enhancing or impeding climate change mitigation efforts through decreased or increased GHG emissions, respectively. In cases where it is not possible to establish the role of the measure in climate change adaptation or mitigation, they are marked as "not determined". Box 1 outlines the adopted adaptation and mitigation definitions.

Box 1. Climate change adaptation and mitigation definitions

PERCC adopts FAO's definitions of adaptation and mitigation.

FAO defines *adaptation* as "the vital response to the adverse effects of climate and the preparation for future impacts". This include adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploit beneficial opportunities (IPCC, 2014). In agriculture, adaptation actions encompass technological responses, enhancing smallholder access to credit and other critical production resources, and strengthening institutions at local and regional levels. Specific responses consist of developing new crop varieties adapted to changes in CO_2, temperature and drought, fostering the capacity for climate risk management, offsetting economic impacts of land use change, crop insurance, and information systems to support early warning and proactive planning.

Mitigation, according to FAO includes all the "human interventions to reduce the emissions of greenhouse gases by sources or to enhance their removal from the atmosphere by sinks (e.g. forests, vegetation or soils that can reabsorb the CO_2)". Mitigation measures in agriculture include technological innovation and transfer, crop diversification, climate-smart agricultural practices to increase soil quality and decrease soil erosion (IPCC, 2014).

2.1 Principles of MAFAP public expenditures analysis

Before labelling expenditures as linked to climate change adaptation and mitigation (referred to as "climate change relevant" to simplify), a comprehensive PEA in support of agriculture sector development is necessary. The following summarises the most important methodological features as described in Ilicic-Komorowska (2010) and MAFAP (2015).

All measures supporting the agricultural sector are considered regardless of their financing source, the finance instrument used, objectives or perceived economic impacts. PEA includes expenditures from the national budget undertaken by either a central or a regional government (regardless of the ministry or agency that implements the policy), and development aid. The agricultural sector is understood in broad terms and it includes forestry and fisheries. Further, as some of the key expenditures for agricultural development address more broadly rural areas,

they are also included (e.g. rural roads). General expenditure measures that target the entire economy are not considered, even if they generate monetary transfers to the agricultural sector.

Expenditure measures are analysed and classified according to the way in which they are implemented. The classification makes a broad distinction between expenditures that are agriculture-specific (direct support for the agricultural sector), agriculture-supportive (indirect support for the agricultural sector) and non-agricultural expenditures. Within the agriculture-specific category, the classification makes a distinction between support for producers and other agents in the value chain (e.g. input subsidies, cash transfers), and general or collective support for the sector (e.g. expenditures on research or feeder roads). The agents in the value chain include agricultural producers, input suppliers, processors, consumers, traders and transporters. Agriculture-supportive expenditures are not strictly directed to the agricultural sector but have a strong influence on agricultural sector development such as investment in rural infrastructure. The detailed classification of support follows the principle of classifying policies according to their economic characteristics (i.e. the way they are implemented), which provides the basis for further policy analysis. It allows understanding economic signals that public expenditures provide to the sector and evaluating the sector's (and agents' operating in the sector) response to them. Box 2 presents the detailed classification.[1]

Box 2. Classification of public expenditures in support of agriculture sector development

1. Agriculture-specific expenditure – monetary transfers that are specific to the agricultural sector, i.e. agriculture is the only, or principal, beneficiary of a given expenditure measure.

1.1 Payments to agents in the food and agriculture sector – monetary transfers to individual agents in the food and agriculture sector.

1.1.1 Payments to producers – monetary transfers to individual agricultural producers (farmers).

A. Production subsidies – monetary transfers to agricultural producers that are based on current output of a specific commodity.

B. Input subsidies – monetary transfers to agricultural producers that are based on on-farm use of inputs:

B1. Variable inputs (seeds, fertiliser, energy, credit, other) – monetary transfers reducing the on-farm cost of a specific variable input or a mix of variable inputs.

B2. Capital (machinery and equipment, on-farm irrigation, other basic on-farm infrastructure) – monetary transfers reducing the on-farm investment cost of farm buildings, equipment, plantations, irrigation, drainage and soil improvements.

B3. On-farm services (pest and disease control/veterinary services, on-farm training, technical assistance, extension etc., other) – monetary transfers reducing the cost of technical assistance and training provided to individual farmers.

C. Income support – monetary transfers to agricultural producers based on their level of income.

[1] Administrative costs are not reported in the classification in the box, even though they are part of MAFAP classification of PE measures.

D. Other payments to producers – monetary transfers to agricultural producers individually for which there is insufficient information to allocate them into the above listed categories.

1.1.2 Payments to consumers – monetary transfers to final consumers of agricultural commodities individually in the form of:

E. Food aid – monetary transfers to final consumers to reduce the cost of food.

F. Cash transfers – monetary transfers to final consumers to increase their food consumption expenditure.

G. School feeding programmes – monetary transfers to final consumers to provide free or reduced-cost food in schools.

H. Other payments to consumers – monetary transfers to final consumers individually for which there is insufficient information to allocate them into the above listed categories.

1.1.3 Payments to input suppliers – monetary transfers to agricultural input suppliers individually.

1.1.4 Payments to processors – monetary transfers to agricultural commodities processors individually.

1.1.5 Payments to traders – monetary transfers to agricultural traders individually.

1.1.6 Payments to transporters – monetary transfers to agricultural commodities transporters individually.

1.2 General support to the food and agriculture sector – public expenditures generating monetary transfers to agents of the agri-food sector collectively.

I. Agricultural research – public expenditures financing research activities improving agricultural production.

J. Technical assistance – public expenditures financing technical assistance for agricultural sector agents collectively.

K. Training – public expenditures financing agricultural training.

L. Extension/technology transfer – public expenditures financing provision of extension services.

M. Inspection (veterinary/plant) – public expenditures financing control of quality and safety of food, agricultural inputs and the environment.

N. Agricultural infrastructure – public expenditures financing off-farm collective infrastructure

N1. Feeder roads – public expenditures financing feeder roads.

N2. Off-farm irrigation – public expenditures financing off-farm irrigation.

N3. Other off-farm infrastructure – public expenditures financing agricultural infrastructure that are not feeder roads or off-farm irrigation.

O. Storage/public stockholding – public expenditures financing public storage of agri-food products.

P. Marketing – public expenditures financing assistance in marketing of food and agriculture products.

Q. Other general support to the food and agriculture sector – other transfers to the agri-food agents collectively for which there is insufficient information to allocate them into above listed categories.

2. Agriculture-supportive expenditure – public expenditures that are not specific to agriculture, but which have a strong influence on agricultural sector development.

R. Rural education – public expenditures on education in rural areas.

S. Rural health – public expenditures on health services in rural areas.

T. Rural infrastructure – public expenditures on rural infrastructure.

T1. Rural roads – public expenditures financing rural roads.

T2. Rural water and sanitation – public expenditures financing rural water and sanitation.

T3. Rural energy – public expenditures financing rural energy.

T4. Other rural infrastructure – public expenditures financing rural infrastructure that are not rural roads, rural water and sanitation, rural energy and other rural infrastructure.

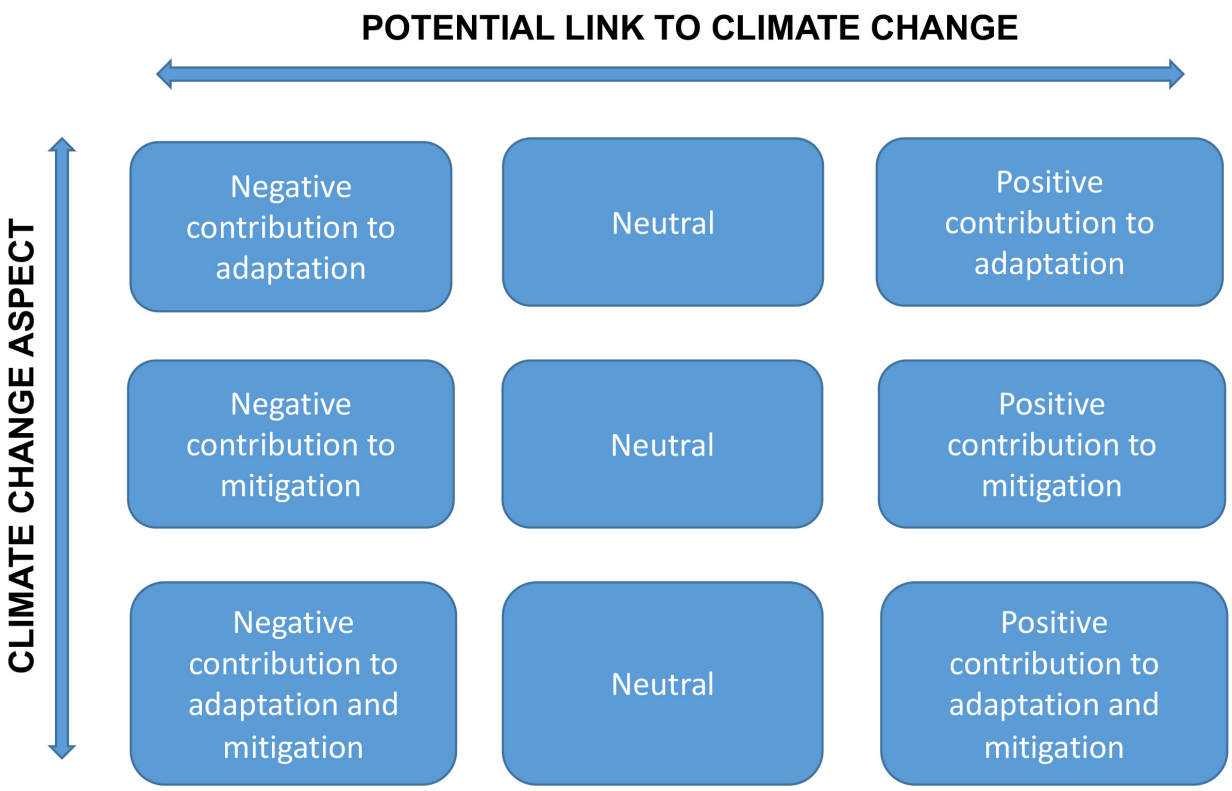
U. Other support to the rural sector – other public expenditures on rural areas benefiting agricultural sector development for which there is insufficient information to allocate them into above listed categories.

Source: FAO, 2015.

2.2 PERCC climate change labels

PERCC brings the PEA analysis a step further by assigning the climate change labels to each of the measures in the classification. There are multiple options to consider as the same measure can be linked only to adaptation or mitigation, or it can be linked to both, adaptation and mitigation. Each measure can stimulate the two in a positive (enhancing) or in a negative (constraining) way. Furthermore, the measures related to adaptation and mitigation may send signals to the sector that are of opposite signs, for example a measure can enhance adaptive capacity and, at the same time, impede country's mitigation efforts by inducing additional GHG emissions. Figure 1 summarises the matrix of possible options.

Figure 1. Matrix of interactions between public expenditures and climate change aspects

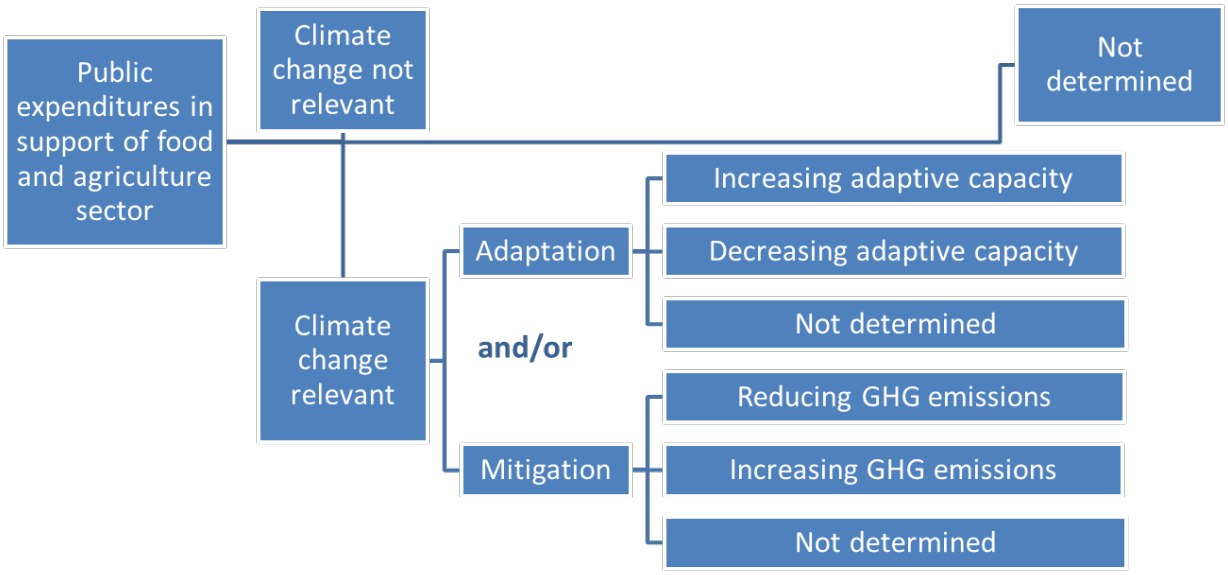


Source: Authors' own elaboration.

Considering all the options, and taking into account that for a number of measures it may not be possible to determine how the economic signals they send influence climate change adaptation and mitigation, the following set of labels was defined (Figure 2).

The set of labels distinguishes between measures that are climate change relevant, those that are not, and those that cannot be determined. Moreover, it indicates if a measure is positively or negatively linked to (or not determined) adaptation and to mitigation. Adaptation and mitigation labels are not mutually exclusive, allowing measures to be linked to both climate change adaptation and mitigation, and not necessarily in the same direction.

Figure 2. Defined set of labels



Source: Authors' own elaboration.

The labelling is based on the potential of each expenditure to address (or not) climate change issues, rather than its objectives. In addition, only the first order response of the sector to the policy measure is taken into consideration. The provision of subsidised inputs such as seeds, for example, will figure among adaptation-supportive measures despite their known adverse effects on the sustainability of the agricultural sector. For the same principle, expenditures related to livestock subsector are all considered as increasing GHG emissions and hence negatively contribute to climate change mitigation – any support linked to production in the livestock subsector is assumed to increase numbers of livestock and hence increase GHG emissions. Whether overall emissions will effectively increase depends on a particular measure in place and on other factors in the subsector including other measures that may be implemented helping better management of livestock.

The same expenditure measure may be attributed a different label across countries depending on their characteristics. For example, a fertilizer input subsidy will clearly have a negative link to climate change mitigation as it increases GHG emissions; however, investments in irrigation may have a positive or negative link to climate change adaptation depending on the water resources and climate conditions in a given country. The project aims at preparing a set of rules based on countries' typologies to guide analysts in assigning the labels, and the criteria for attributing the labels are being refined as the work on case studies develops. Nevertheless, accounting for all possibilities may not be feasible and expert judgement may be necessary.

2.3 PERCC classification criteria

A set of criteria for each measure has been taken into account for PERCC classification. However, it is not possible to generalize a priori the link of public expenditure measures to climate change adaptation and mitigation, as it largely depends on several factors i.e. the specific measure, the local context, etc. Table 1 below describes the general criteria for PERCC classification and shows how different labels could be applied to the same measure depending on the circumstances.

Table 1. Classification criteria

Measure	Adaptation/mitigation link		Note
AGRICULTURE-SPECIFIC EXPENDITURES			
1.1 Payments to agents in the food and agriculture sector			
1.1.1 Payments to producers			
A. Production subsidies	Negative	Negative	Reducing adaptive capacity and mitigation being highly distortive: they create greater incentives to increase production of the supported commodity, above optimal level (excess supply). This likely leads to larger use of inputs (and larger GHG emissions), incentivizes monocropping (reducing adaptation) and isolates farmers from market signals.
B. Input subsidies			
B1. Variable inputs	Not det.	Not det.	Depends on specific activity.
	Positive	Positive	Improving adaptative capacity and mitigation in case of inputs such as improved seeds, organic fertilizers, etc.
	Negative	Negative	Reducing adaptative capacity and mitigation when incentives to use subsidized input may lead to overuse of that input (reducing adaptative capacity, and likely increasing GHG emissions). Reducing adaptative capacity also if the use of the wrong inputs is incentivized.
B2. Capital	Positive	Not det.	Generally improving adaptative capacity, but often not determined for mitigation. It largely depends on the activity (it may also be not related).
		Positive	Generally improving adaptative capacity, and enhancing mitigation when activities reduce GHG emissions.
		Negative	Generally improving adaptative capacity, and reducing mitigation when activities still enhance GHG emissions – for instance, new infrastructure may enhance adaptative capacity (e.g. irrigation), however at the same time increase emissions from irrigation use.
B3. On-farm	Positive	Not det.	Generally improving adaptative capacity, but often not determined for mitigation. It largely depends on the activity (it may also be not related).
		Positive	Generally improving adaptative capacity, and improving mitigation when activities reduce GHG emissions.
		Negative	Generally improving adaptative capacity, and reducing mitigation when activities still enhance GHG emissions – for instance, livestock still represents a significant source of GHG emissions.
C. Income support	Positive	Not det.	Generally improving adaptative capacity, but not determined for mitigation.
	Not det.		Sometimes not determined for adaptation as being linked to production, it may introduce distortions with consequences as in cat. A and B1 (though to a lesser extent).

Measure	Adaptation/mitigation link		Note
D. Other payments to producers	Not det.	Not det.	Depends on specific activity or may not be related.
1.1.2 Payments to consumers			
E. Food aid	Positive	Not det.	Enhancing adaptive capacity. Not determined for mitigation as it depends on specific activity (may be not related).
F. Cash transfers	Positive	Not det.	Enhancing adaptive capacity. Not determined for mitigation as it depends on specific activity (may be not related).
G. School feeding programmes	Positive	Not det.	Enhancing adaptive capacity. Not determined for mitigation as it depends on specific activity (may be not related).
H. Other payments to consumers	Not det.	Not det.	Depends on specific activity / may be not related.
1.2 General support to the food and agriculture sector			
I. Agricultural research	Positive	Positive	Agricultural research is crucial to discover new ways of coping with climate change, enhancing adaptive capacity and/or reducing GHG emissions.
		Not det.	Not determined for mitigation when the outcomes do not affect GHG emissions.
J. Technical assistance	Positive	Positive	Technical assistance is essential to disseminate and implement new discoveries with a potential positive impact on climate change.
K. Training	Positive	Positive	Knowledge transfer/trainings are essential to disseminate and implement new discoveries with a potential positive impact on climate change.
		Not det.	Not determined for mitigation when not related to improving GHG related activities.
L. Extension / technology transfer	Positive	Positive	Knowledge transfer/trainings are essential to disseminate and implement new discoveries with a potential positive impact on climate change.
		Not det.	Not determined for mitigation when not related to improving GHG related activities.
M. Inspection (veterinary/plant)	Not det.	Not det.	Enhanced product quality is beneficial for adaptation. It can go in all three dimensions for mitigation (e.g. livestock).
N. Agricultural infrastructure	Positive	Not det.	Improving adaptative capacity. It can go in all three dimensions for mitigation (e.g. if some environmental damages occur). Beneficial to improve market access and market development.
N1. Feeder roads	Not det.	Not det.	Not determined for adaptation and mitigation. It depends on specific activity.
N2. Off-farm irrigation	Positive	Positive	Generally improving adaptative capacity and mitigation.

Measure	Adaptation/mitigation link		Note
N3. Other off-farm infrastructure	Not det.	Not det.	Not determined for adaptation and mitigation, as it depends on the circumstances.
O. Storage/public stockholding	Not climate relevant.		
P. Marketing	Not climate relevant.		
Q. Other general support to the food and agriculture sector	Positive	Positive	Positive/not determined for both adaptation and mitigation. Depends on specific activity.
	Not det.	Not det.	
AGRICULTURE-SUPPORTIVE EXPENDITURES			
R. Rural education	Positive	Not det.	Improving climate change adaptation of the sector because they enhance adaptive capacity of the beneficiaries. Not determined for mitigation.
S. Rural health	Positive	Not det.	Improving climate change adaptation of the sector because they enhance adaptive capacity of the beneficiaries. Not determined for mitigation.
T. Rural infrastructure			
T1. Rural roads	Not det.	Not det.	Not determined for adaptation and mitigation, as it depends on the circumstances (e.g. for mitigation: the travel time before and after the investment, traffic intensity change or impact of the investment on the landscapes (e.g. clearing forest to build the road) that will all contribute to change in GHG emissions).
T2. Rural water and sanitation	Positive	Not det.	Generally improving adaptative capacity, but not determined for mitigation.
T3. Rural energy	Positive	Not det.	Generally improving adaptative capacity, but not determined for mitigation.
T4. Other rural infrastructure	Positive	Not det.	Generally improving adaptative capacity, but not determined for mitigation.
U. Other support to the rural sector	Positive	Not det.	Generally improving adaptative capacity, but not determined for mitigation.

Source: Authors' own elaboration.

2.4 PERCC and evaluation of policy measures addressing climate change

The classification and PERCC labelling of expenditure measures feeds into policy analysis in multiple ways. It allows for monitoring the level of expenditures in agriculture that are linked to climate change and thus provide for a greater understanding of how much are having a potentially positive result, or subsequently further contribute, to climate change. It will also allow for assessing how much of the expenditures are addressing adaptation issues and how much target climate change mitigation. This, in turn, combined with countries' climate change profiles,

helps to assess whether the spending pattern addresses the most critical issues; determining if the support does not produce counterproductive outcomes in terms of climate change adaptation and mitigation; and assessing whether the spending pattern is coherent with governments' climate change objectives. Finally, the classification, based on economic characteristics of expenditure measures, will be further used in modelling work to evaluate how effective the expenditures are in reaching the stated objectives. All of the above will feed into evidence-based policy making and help improve national climate change adaptation and mitigation plans for the agricultural sector and contribute to setting up more realistic climate change targets for the whole economy.

2.5 PERCC and other initiatives

PERCC has been initiated to fill in the gaps in research on how agricultural support can be more effective in contributing to climate change adaptation and mitigation in the agricultural sector. Most of the public expenditure reviews with climate change focus consider the overall levels of public spending, all sectors combined. For example, the United Nations Development Programme's (UNDP) Climate Public Expenditure and Institutional Review (CPEIR), initiated in 2011, looks at how governments allocate national budgets on their national climate change responses (UNDP, 2015). CPEIR, combined with reviews of fiscal policies and development of national climate change financing frameworks, helps policy makers to understand the resource level required; monitor climate finance flows; assess cost effectiveness and impact of existing expenditures; increase transparency in resource allocations; and formulate economy-wide policy reforms. Public expenditure studies with an agricultural sector focus are very limited and concentrate on selected aspects of climate change. For example, the Inter-American Development Bank (IDB) has linked agricultural support to GHG emission (Joseling *et al.*, 2017) to establish the consistency between agricultural policy objectives and nationally established climate change targets. The authors analysed whether the products that contribute the most to GHG emissions are also those that receive the most protection and whether incentives emerging from agricultural support are in line with GHG emission mitigation objectives. A recent study by the Organisation for Economic Cooperation and Development (OECD, Henderson and Lankoski, 2019) looks at how main categories of agricultural support policies influence selected agro-environmental indicators. Using a combination of a farm-level model and a partial equilibrium framework for a limited number of OECD countries, the study evaluates the impacts of selected agricultural support measures on GHG emissions and nutrient balances and attempts to determine the strength of the relationship between support measures and their environmental impacts. PERCC aims at providing a comprehensive approach in analysing agricultural policies from the perspective of their climate change friendliness.

3 Case study of Uganda

3.1 Agricultural sector in Uganda

Uganda is an agriculture-based economy. Despite the decreasing relevance of the sector contribution to the GDP, agriculture still represents almost one quarter of the overall economy and 85 percent of its export earnings. Agriculture employs around 70 percent of the working population and more than 80 percent of Ugandans live in a rural area (World Bank, 2019). The contribution to the agricultural GDP by different sub-sectors includes crops (67 percent), livestock (16 percent), fisheries (12 percent), and forestry (4 percent) (FAO, 2019). Despite the increase of the GDP per capita, still one-fifth of the population lives below the national income poverty line and the prevalence of undernourishment is on the rise (from 24.5 percent of the total population in 2006 to 41 percent in 2016) (FAO, 2019; World Bank, 2019).

Food crop cultivation dominates the agricultural sector representing more than 50 percent of the overall production (FAO, 2019). Despite favourable climate conditions in many areas, and rich water and land resources, the sector shows low productivity levels. The majority of farmers are smallholders who grow a limited number of food crops for subsistence.

Uganda's agricultural sector is predominantly rain fed (96 percent of the farming parcels depend on rain, 3 percent parcels use swamps/wetlands, and only 1 percent use irrigation). Extensification of agricultural activities continues; agricultural land has been expanding at roughly 1 percent per year during the last ten years. If this pace remains unchanged by 2040, 90 percent of Uganda's land will be destined to agriculture, mostly at the expense of the country's forests and wetlands despite its ongoing afforestation efforts (MAAIF, 2018a; FAO, 2020).

3.2 Ugandan agriculture and climate change

Climate change poses a great challenge to Ugandan agriculture as it comes with higher average temperatures and higher probability of extreme weather conditions to which predominantly poor smallholder farmers are particularly vulnerable. The frequency of droughts has increased alongside with their magnitude, leading to degraded grazing and cropping lands, shrinking of water ponds, reduced surface water and river flows, increased wildfire outbreaks and dust storms. Floods, strictly linked to El Niño or La Niña episodes, follow extreme rainfall conditions that have been regularly affecting Eastern Uganda. Floods combined with prolonged dry seasons have been negatively affecting the growing periods, distorting the timing of planting activities, increasing pests and diseases, and resulting in lower yields. The heavy dependency on rain-fed agriculture exacerbates the challenges. Livestock production has also been negatively affected: reduced water and pasture availability, and increased diseases reduced livestock feed intake, growth, mortality and reproduction (MAAIF, 2018a).

Uganda emitted 60 Megatons of CO_2 equivalent ($MtCO_2eq$) of GHG in 2014 (CAIT, 2019) and the emissions have been increasing rapidly in recent years. The main contributing sector is the land-use, land use change and forestry (LULUCF) with almost 26 $MtCO_2eq$, closely followed by the agricultural sector with 24 $MtCO_2eq$ (FAO, 2019). Within the agricultural sector, enteric fermentation and manure left on pastureland account for the highest share in GHG emission (43 percent and 31 percent respectively) while the Savannah burning accounts for another 12 percent. Manure management and manure applied to soil reach together 5 percent, the cultivation of organic soils accounts for another 5 percent, whereas crop residuals and rice cultivation contribute the smallest shares (1.4 percent and 0.7 percent) (FAO, 2019).

Table 2. Actions under National Adaptation Plan for agriculture in Uganda

Category	Actions	Appraisal		Cost (USD)
		Cost	Priority	
Agriculture - crops	Promote and encourage highly adaptive and productive crop varieties and cultivars in drought-prone, flood-prone and rain-fed crop farming systems.	Medium	High	28 089 981
	Promote and encourage conservation agriculture and ecologically compatible cropping systems to increase resilience to the impacts of climate change.	Low	High	13 014 701
	Strengthen water harvesting and irrigation farming to build resilience to droughts.	High	High	54 652 627
	Promote and encourage agricultural diversification and improved post-harvest handling, storage and value addition.	Medium	High	19 688 406
	Support community-based adaptation strategies through expanded and climate smart extension services.	Low	Medium	11 482 890
	Subtotal			**126 928 605**
Agriculture - livestock	Promote and encourage highly adaptive and productive livestock breeds.	High	High	32 900 993
	Promote technologies for improved livestock feeds/ feeding and sustainable management of rangelands and pastures through integrated rangeland management.	Medium	High	15 385 021
	Promote sustainable Animal health management systems.	Low	High	6 593 580
	Promote and encourage diversification and improved livestock value chains.	Medium	High	19 688 406
	Subtotal			**74 568 000**
Fisheries	Promote climate resilient fisheries sector and integrated fisheries resource management.	High	High	53 862 654
	Promote aquaculture in order to ensure climate resilient fisheries resources.	Medium	High	17 954 218
	Subtotal			**71 816 872**
Climate information, early warning and disaster preparedness systems	Strengthen climate information and early warning and disaster preparedness systems to support sustainable agriculture.	Low	High	6 216 166
	Support innovative insurance schemes to protect farmers against climate risk related crop and livestock losses.	High	High	105 442 110
	Subtotal			**111 658 276**
Forestry, land and natural	Increase water use efficiency and water storage.	Low	Medium	11 580 711
	Strengthen catchment management in agricultural planning.	High	Medium	75 892 113

Category	Actions	Appraisal		Cost (USD)
		Cost	Priority	
resources management	Adopt sustainable agricultural land and water management to reduce degradation.	Medium	Medium	16 469 996
	Promote appropriate forest and ecosystem management practices to increase the resilience of agrarian communities to the impacts of a changing climate.	Low	Medium	11 821 936
	Subtotal			**115 764 756**
Research for climate resilient agricultural development	Mainstream climate change in agricultural research and innovations.	Low	High	10 565 090
Knowledge management and partnerships for climate action	Develop knowledge management and communication systems to support climate resilient agriculture.	Low	High	3 668 456
	Strengthen partnerships and networks to enhance a common approach to climate resilient agriculture.	Low	Medium	4 569 989
	Subtotal			**8 238 445**
Gendered approach to climate change adaptation	Mainstream gender in climate smart agriculture.	Low	High	2 300 000
	Grand total			**521 972 044**

Source: MAAIF, 2018a.

To respond to the climate change challenges, Uganda established a National Adaptation Plan (NAP) that integrates climate change adaptation policies into the national decision-making processes. It contributes to the Second National Development Plan (NDP II) by prioritising the use of climate change resilient technologies and practices. It aims to promote climate resilient systems affecting cropping, livestock and fisheries production and value chains, and Climate Smart Agriculture practices integration. It intends to strengthen weather information systems to improve disaster preparedness and enhance the resilience of agriculture and agrarian communities to a changing climate. The specific actions to decrease the vulnerability and increase the adaptive capacity of agriculture were outlined in the National Adaptation Plan for the agricultural sector (NAP-ag). The NAP-ag defines specific adaptation actions as well as their priority and associated costs (Table 2). The overall NAP-ag implementation requires approximately USD 522 million (UGX 1 945 billion)[2] from 2015 to 2030 (about USD 35 million or UGX 130 billion per year). The NAP-ag assumes that about 70 percent of resources to support the actions that would have come from donors (MAAIF, 2018a).

Uganda also established the Nationally Determined Contribution Partnership Plan (NDC-PP). Uganda's commitments under this plan include reducing national GHG emissions by 22 percent

[2] All monetary values quoted in USD (UGX) in the text are accompanied with values in brackets in UGX (USD) converted using average annual exchange rates UGX/USD from IMF (2019).

by 2030, reducing climate vulnerability of climate sensitive sectors, particularly agriculture, building climate resilience of key sectors, and managing disaster risks (MAAIF, 2018b).

3.3 PERCC in Uganda

The PERCC analysis is carried out from 2003/04 to 2017/18 for which public expenditure data is available in the 2019 edition of the MAFAP database. Actual spending values for 2017/18 have been estimated using the average budget execution rate from previous years[3]. The analysis starts with an investigation of the share of public expenditures in support of food and agricultural sector that is related (positively or negatively) to climate change adaptation and mitigation efforts of Uganda. Next, the level and composition of public spending for adaptation and mitigation are examined, as well as a comparison between actual expenditures and budgetary allocations. The last section assesses the coherence of observed spending patterns with the government's objectives stated in the strategies summarized above.

All expenditure measures identified by MAFAP were closely analysed to assign the PERCC climate change labels described in the methodology section. In many cases, available information was not detailed enough to assign the label with full confidence[4]. To facilitate the work, a number of assumptions were made on how to treat specific measures drawing on information gathered from secondary sources. These are outlined in detail in Annex 1. PERCC labelling assumptions In some cases, even when using the assumptions, information was insufficient to determine if (and how) a given measure was linked to climate change adaptation and mitigation. These measures are marked as "not determined".

Level and composition of spending

MAFAP recognises that many important public expenditures for the agricultural sector development may occur outside government agencies specifically responsible for agricultural matters. In the case of Uganda, the expenditures from the following ministries and institutions have been considered[5]: Ministry of Agriculture, Animal Industry and Fishery (MAAIF), the main government body responsible for agriculture and four autonomous organisations: National Agricultural research Organisation (NARO), the National Agricultural Advisory Service (NAADS) Secretariat, the Uganda Cotton Development Organisation (UCDO) and the Uganda Coffee Development Agency (UCDA); Ministry of Finance, Planning and Economic Development; Ministry of Energy and Mineral Resources; Ministry of Works and Transport; Ministry of Local Government; Ministry of Water and Environment; Ministry of Health; Ministry of Education and Sports; Ministry of Tourism, Trade and Industry; Ministry of Gender, Labour and Social Development; Ministry of Lands, Housing and Urban Development; and the Office of the Prime Minister. All expenditures of these ministries have been examined and all the expenditures in support of the food and agriculture sector development have been included in the analysis.

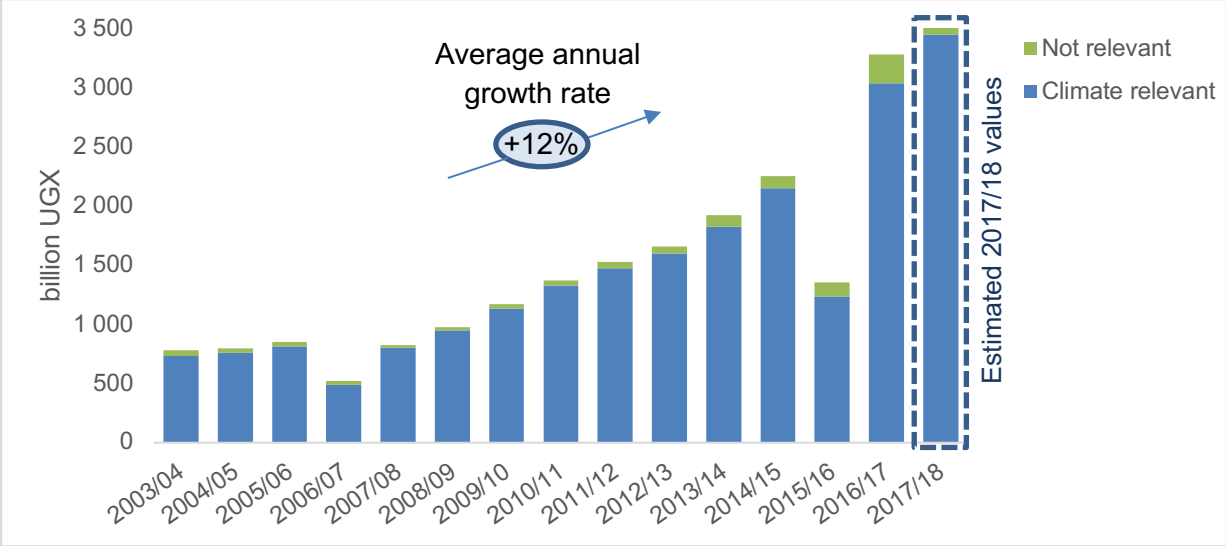
[3] The execution rate (budget/actual expenditures) has been calculated for each period from 2003/04 to 2016/17. The average of the years has then been derived, and eventually applied to the 2017/18 budget to estimate actual 2017/18 expenditures.

[4] On the one hand, the MAFAP database, which relies on readily available descriptions, was not detailed enough to retrieve the necessary information on climate relevance of each measure. On the other, only some project documentation was available in secondary databases at our disposal, further limiting information collection.

[5] Referring to the institutions covered in the MAFAP database.

Most of public expenditures in support of the food and agriculture sector in Uganda affect its capacity to adapt to climate change as well as the level of GHG emissions coming from this sector. The classification of measures based on the information available in the MAFAP dataset shows that for every period considered more than 90 percent of the agricultural spending influences – either positively or negatively – the sector's capacity to adapt to climate change or levels of emissions or both (referred to as "climate relevant" spending for simplicity, Figure 3). The amount of climate relevant spending substantially increases over the period from UGX[6] 735 billion (USD 375 million) to UGX 3 447 billion (USD 954 million), showing an average annual growth rate of 12 percent. This increase is relatively constant throughout the analysed years, except for a small decline in 2006/07 and a sharp downturn in 2015/16, related to the need to divert government resources to cover for unexpected events requiring government intervention.

Figure 3. Public expenditures in support of food and agriculture sector and climate change related spending, 2003/04–2017/18

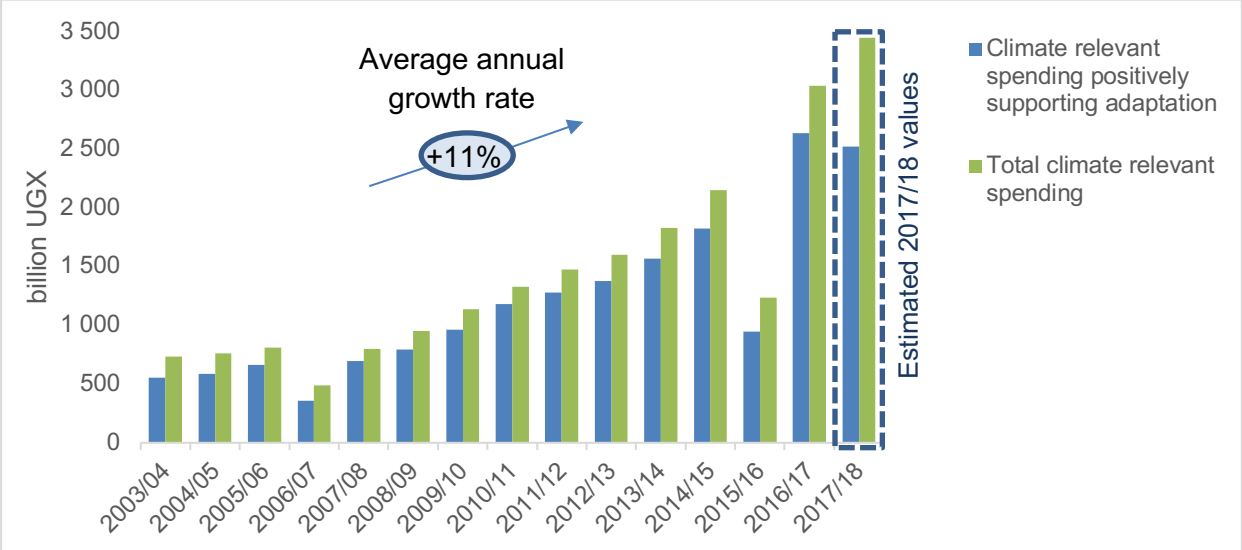


Source: Authors' own calculations based on MAFAP database.

Within all agricultural climate relevant spending, on average, 82 percent of expenditures were positively stimulating the adaptive capacity of the agricultural sector. The remaining 18 percent resulted "not determined" in terms of either the link with adaptation or the direction of stimuli. The spending on adaptation-supportive measures substantially grew over the periods considered, from UGX 555 billion (USD 282 million) in 2003/04 to UGX 2 522 billion (USD 698 million) in 2017/18 (11 percent per year on average over analysed period) (Figure 4). Its trend is consistent with the overall climate relevant spending pattern, except for the 2017/18 projection, which shows a small decline in adaptation-enhancing spending. However, this reduction is rather driven by the way the projection was calculated (2017/18 values are estimated based on previous years' values).

[6] Current UGX.

Figure 4. Climate relevant agricultural spending supporting adaptation, 2003/04–2017/18

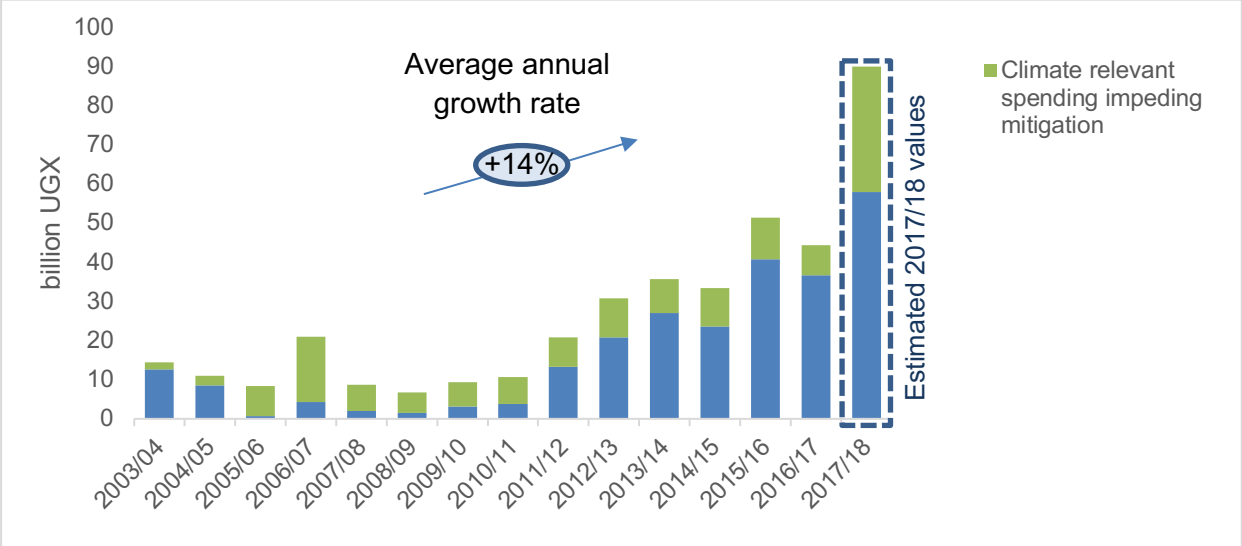


Source: Authors' own calculations based on MAFAP database.

Measures affecting GHG emissions accounted for 1.8 percent of climate relevant agricultural spending. Among these, 1.2 percent were enhancing mitigation, while 0.6 percent were increasing GHG emissions. In monetary terms, the underlying annual values substantially increased from UGX 14 billion (USD 7 million) in 2003/04 to UGX 90 billion (USD 25 million) in 2017/18, growing on average by 14 percent per year (Figure 5). The mitigation-enhancing measures grew on average by 44 percent per year since 2009/10 demonstrating positive trends in the reduction of GHG emissions in most recent years. However, the overwhelming remaining share of 98 percent of GHG emission-related measures has been labelled as not determined, a result of insufficient description of measures in our available data sources:[7] the existing information did not allow to either establish a link between those measures and emissions, or determine whether they were increasing or reducing the GHG emissions.

[7] Please see note No. 4 (page 15).

Figure 5. Climate relevant agricultural spending enhancing/impeding mitigation, 2003/04–2017/18

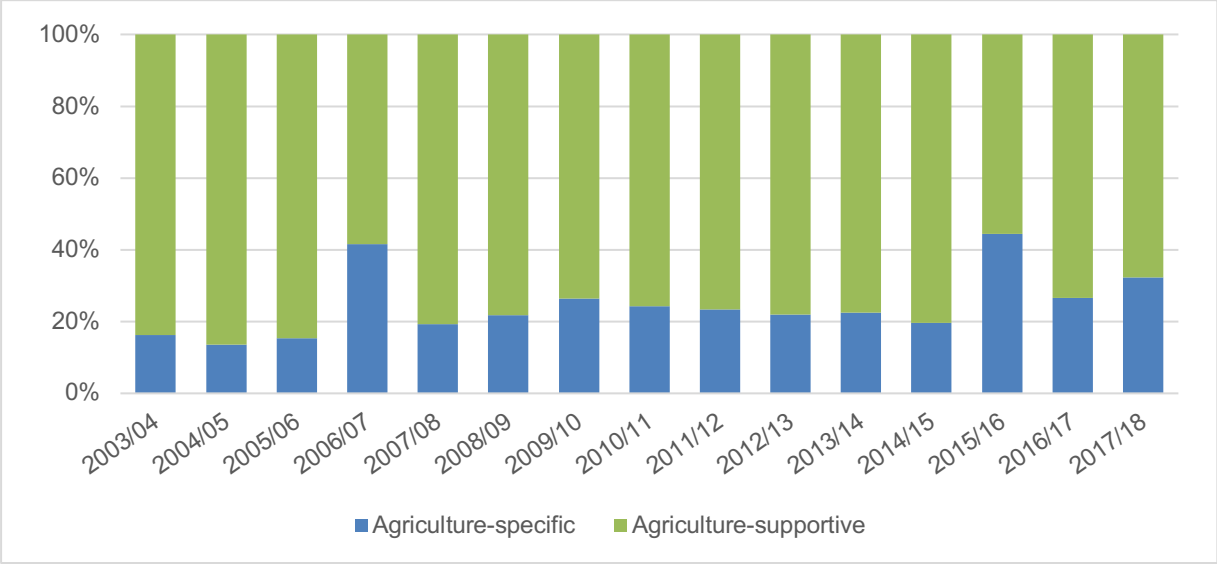


Source: Authors' own calculations based on MAFAP database.

The analysis of average composition of public expenditures related to climate change adaptation and mitigation allows for the determination of the type of measures employed that help tackle climate change-related issues and that equally constraint those efforts.

Within spending enhancing adaptive capacity of the sector, a first broad disaggregation between agriculture-specific and agriculture-supportive measures shows that a much larger share is spent on the latter (on average, 75 percent) (Figure 6).

Figure 6. Agriculture-specific vs. agriculture-supportive public expenditures supporting adaptation

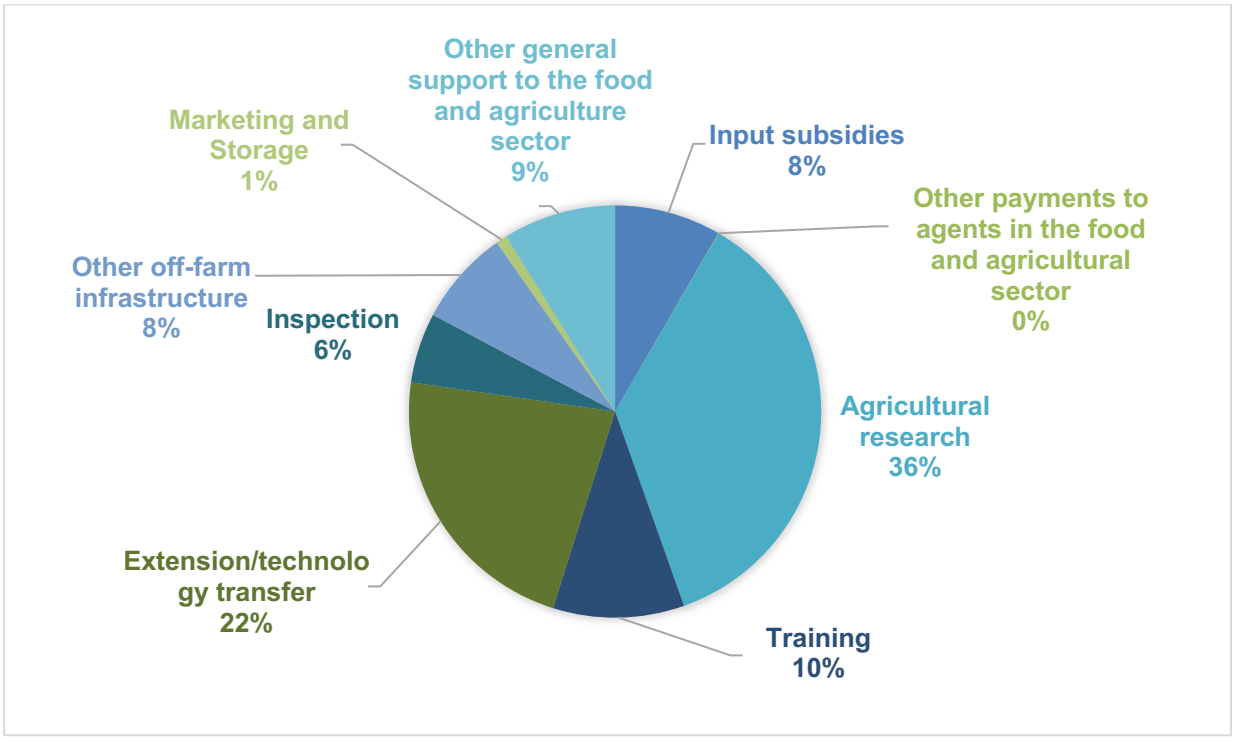


Source: Authors' own calculations based on MAFAP database.

A further disaggregation of agriculture-specific public spending supporting adaptation (Figure 7) shows that the highest shares are spent on agricultural research, extension and technology transfers (including technical assistance), and training (covering on average 36 percent, 22 percent and 10 percent, respectively). Other general support to the food and agriculture sector accounts for 9 percent, followed by input subsidies (especially variable inputs such as improved quality seeds) and other off-farm infrastructures (particularly off-farm irrigation) in equal proportions (8 percent). Inspection constitutes a lower, but still significant share (6 percent).

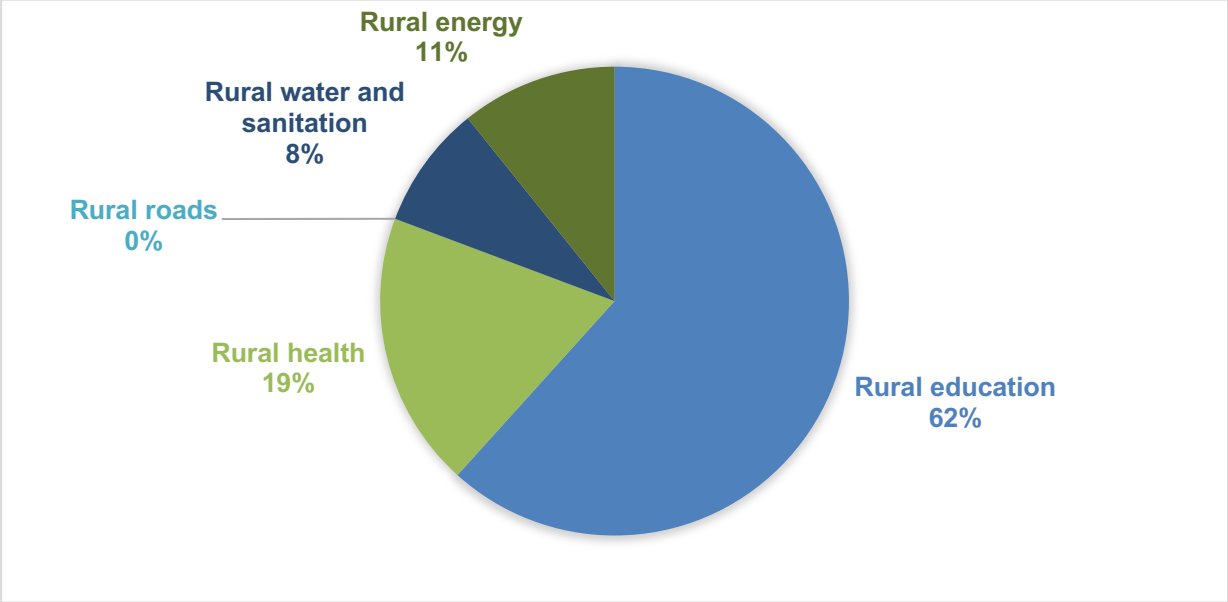
Agriculture-supportive public expenditures enhancing adaptive capacity of the sector (Figure 8) are mainly composed of spending on rural education (62 percent on average), followed by rural health (19 percent), rural energy (11 percent) and rural water and sanitation (9 percent). Spending on rural roads make up the rest, but the share is negligible.

Figure 7. Composition of agriculture-specific public expenditures supporting adaptation, 2003/04–2017/18 average



Source: Authors' own calculations based on MAFAP database.

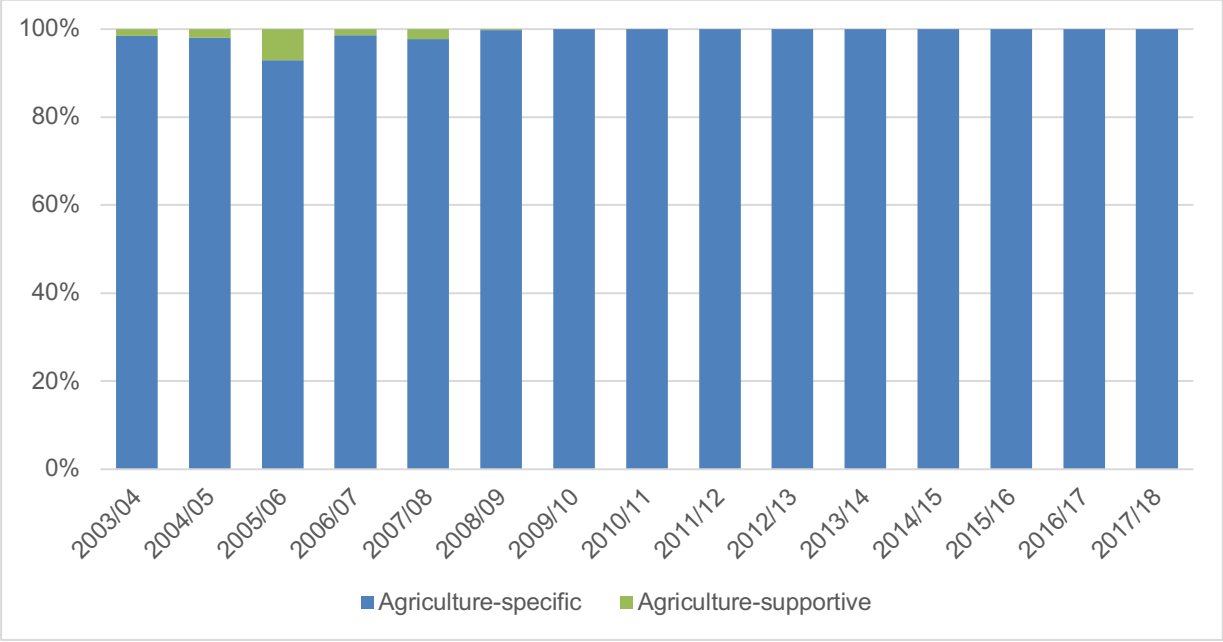
Figure 8. Composition of agriculture-supportive public expenditures supporting adaptation, 2003/04–2017/18 average



Source: Authors' own calculations based on MAFAP database.

For identified spending related to GHG emissions, the first disaggregation reveals that agriculture-specific measures are almost the only component, while the share of agriculture-supportive measures is negligible (Figure 9).

Figure 9. Agriculture-specific/agriculture-supportive public expenditures with a link to mitigation

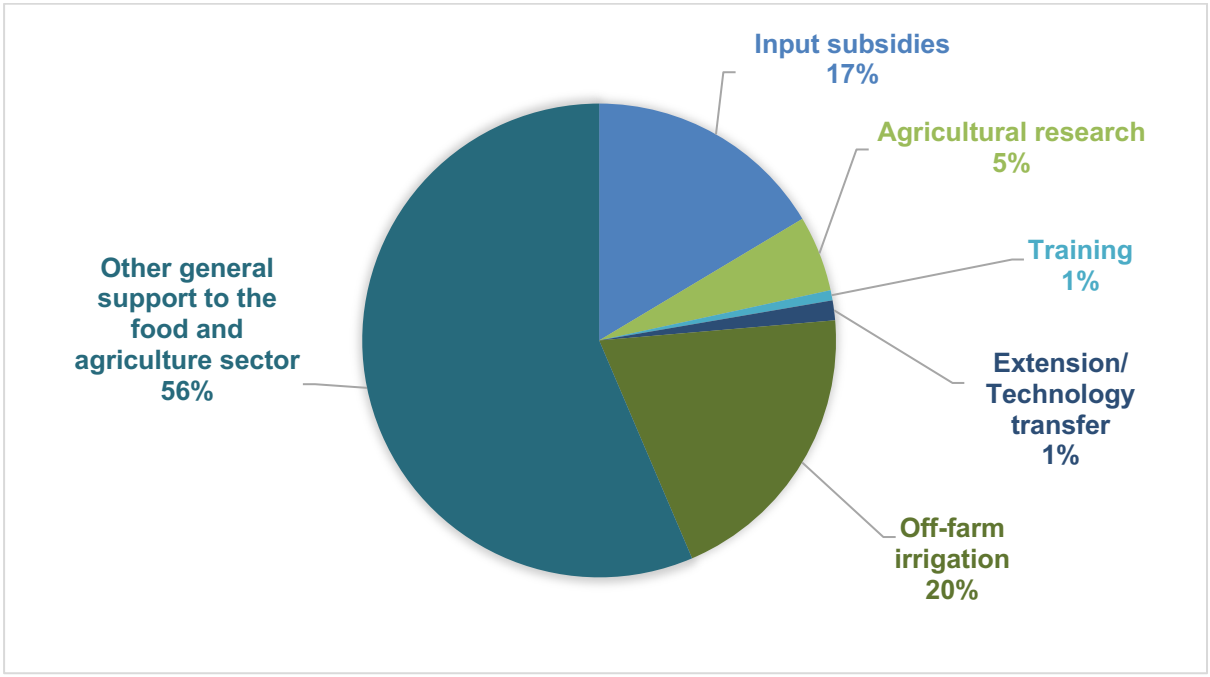


Source: Authors' own calculations based on MAFAP database.

Among the measures reducing GHG emissions (Figure 10), it is evident that most of them fall under other general support to the food and agricultural sector (56 percent on average). Off-farm irrigation projects[8] and input subsidies (mainly variable inputs such as improved rice seeds that help reduce emissions in production process) contribute 20 percent and 17 percent respectively, while agriculture research accounts for 5 percent. Training and extension, and technology transfer make up the rest.

Measures in support of the food and agriculture sector development that increase GHG emissions fall mostly under the inspection category (70 percent, Figure 11). The support to capital inputs, within input subsidies category, covers an important share as well (14 percent). Both categories increase emissions via enhancing livestock sector expansion. Feeder roads and off-farm irrigation contribute 5 percent each, while the remaining share is spent on training, extension and technology transfer, other off-farm infrastructure, marketing and rural water, and sanitation (between 0 and 2 percent each). These measures increase the emissions through increased used of fuel-fed machinery or equipment and by stimulating livestock sector expansion.

Figure 10. Composition of public expenditures enhancing mitigation efforts, 2003/04–2017/18 average

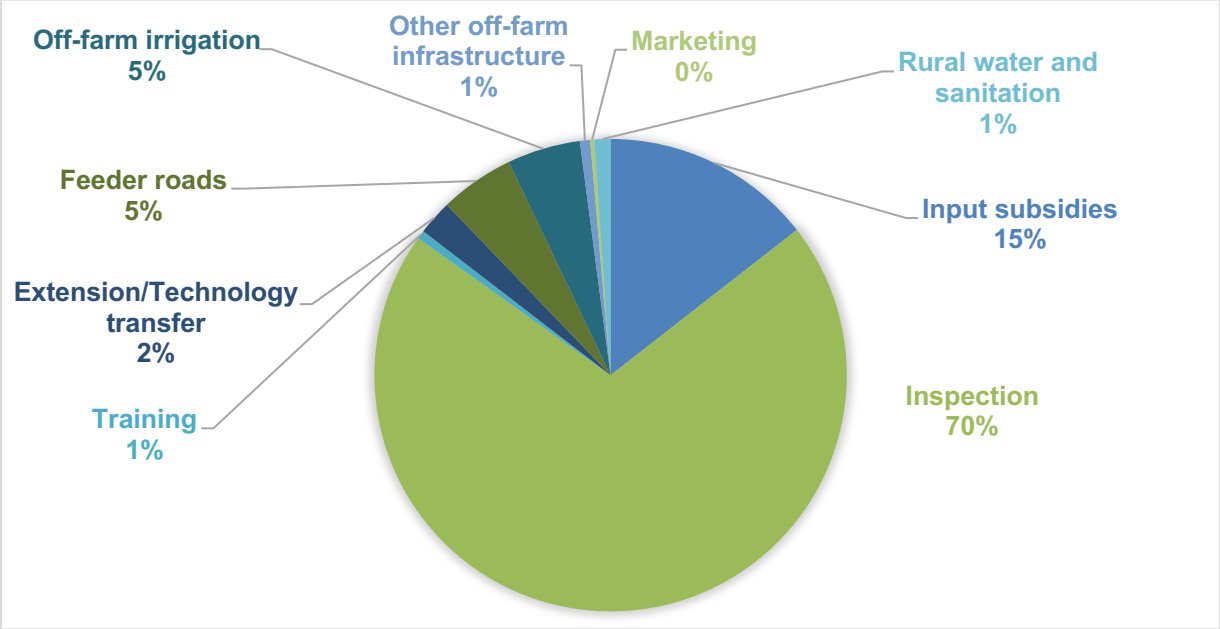


Note: All categories are agriculture-specific.

Source: Authors' own calculations based on MAFAP database.

[8] Based on the information available in the environmental assessments of the associated projects.

Figure 11. Composition of public expenditures impeding mitigation, 2003/04–2017/18 average



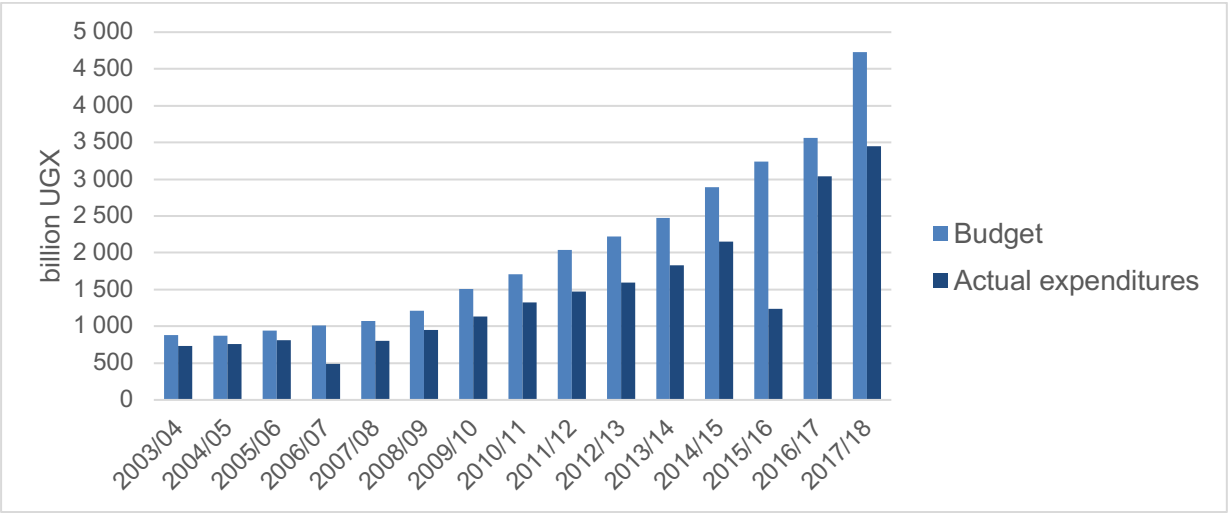
Note: All categories are agriculture-specific, except "Rural water and sanitation".

Source: Authors' own calculations based on MAFAP database.

Budgeted amounts versus actual spending

Climate relevant actual expenditures are lower than the corresponding budgetary allocations in each fiscal year considered (Figure 12). The average budget execution rate of 73 percent shows that an important part of the allocations is not disbursed. Adaptation enhancing measures received, on average, 74 percent of allocated funds while mitigation enhancing measures only 34 percent. Mitigation-impeding measures received 58 percent of allocated amount.

Figure 12. Comparison between budget and actual climate relevant expenditures (2003/04–2017/18)



Source: Authors' own calculations based on MAFAP database.

Comments and recommendations

Overall, the public expenditures in support of the food and agriculture sector are consistent with objectives set out in NAP-ag, particularly for crops, livestock and fisheries sub-sectors. Still, the specific actions outlined in NAP-ag may be better mainstreamed. Furthermore, the budgetary allocations foreseen by the NAP-ag are very ambitious. The NAP-ag assumes an average budget of USD 35 million (UGX 130 billion) a year for the adaptation actions, in major part financed through donor funding. Although in most recent years, the broadly defined expenditures in support of climate change adaptation in agriculture surpassed the foreseen amounts, making sure all NAP-ag actions are implemented as planned will require securing continuous and full engagement of the donor community. Another key step in securing the required resources will be improving current budget execution rates.

Although the labelling of GHG emission-related measures is not complete due to insufficiently detailed information, the observed patterns of labelled measures suggest that the majority were enhancing Uganda's mitigation efforts and the allocated expenditures were significantly increasing in monetary terms over recent years. Yet, some of the GHG emission-related measures lead to increased use of fuel-based machinery and enhance livestock production, which ultimately leads to increased GHG emissions. Given Uganda's commitments under NDC-PP, it is key to consider the impacts of long-term investments in the livestock sector and design actions that will reduce emissions from the use of fuel and livestock.

More detailed links with NDCs and NAPs specific targets and objectives requires substantial additional information not available for this study. MAFAP public expenditures database has limited descriptions of individual expenditure measures, which are indispensable to determine the links to climate change adaptive capacity and GHG emissions of the sector. Existing descriptions allowed for clear labelling of all adaptation related measures, while determining the relationship between expenditures and climate change mitigation requires much more information. As a result, the analysis identified only a small proportion of measures as affecting GHG emissions level, while a much higher share is expected. Moreover, much more detailed information on specific measures within each of the MAFAP categories would be necessary to assess the coherence with specific objectives outlined in the national climate change related strategies. The information available for this study allows for drawing conclusions only on the broad direction of spending patterns. Finally, to conduct a comprehensive assessment, in addition to the more complete public expenditure data, a detailed contextual database would be necessary, including information on soil quality/land degradation, nutrient balances, GHG emissions from agriculture, forest coverage, frequency and type of extreme weather events, among many others. This is because the same expenditure measures may potentially lead to different environmental outcomes depending on a given country context. Unfortunately, such datasets are not yet easily available and constructing one would require substantial additional resources that were not available for this study. As a result, conclusions from this study are limited, impeding formulating concrete policy recommendations.

4 Conclusions

This working paper proposes a methodology for public expenditure review and analysis for climate change adaptation and mitigation in the agricultural sector. The study explains the methodological concepts, presents classification of the expenditures and illustrates how it contributes to policy analysis in the context of climate change adaptation and mitigation using a case study of Uganda.

PERCC is a tool that helps to understand the proportion of public expenditure in support of the agricultural sector development that have negative or positive effects on climate change adaptation and mitigation. PERCC aims at analysing the level and the composition of public expenditures that influence the adaptative capacity of the sector to climate change, and actions that increase or decrease GHG emissions in agriculture. It looks at all measures addressing climate change adaptation and mitigation in the sector, regardless of the source of financing, instrument used or perceived economic impacts. It analyses the way in which each of the expenditure measures is implemented and assesses the economic signals it sends to the sector.

The results allow for assessing whether the sector is stimulated in a way that allows achieving a country's climate change adaptation and mitigation objectives and form a basis for further evaluation of the effectiveness of individual measures in reaching these objectives such as project-level assessments to quantify the impacts on climate change. Moreover, complementing PERCC with standard public expenditures analysis could help governments understanding their performance in tackling the multiple challenges of improving livelihoods and ensuring food security, while building resilience to climatic shocks, increasing farmers' capacity to adapt to the changing climate and slowing down the pace of climate change.

The case study of Uganda reveals that most of the expenditures in support of the food and agriculture sector have both positive and negative effects on climate change adaptation and mitigation efforts. Further analysis demonstrates that the majority of these measures support increasing the adaptive capacity of the farming sector. They focus on agricultural research and training, extension services and technology transfers, variable inputs use, rural infrastructure, and are broadly consistent with the objectives set out in the NAP for the agricultural sector. The associated expenditures have been significantly increasing over the last ten years reaching almost USD 700 million in the 2017/2018 fiscal year. Yet, as the majority of these expenditures are funded by donors, mainstreaming all adaptation objectives requires securing future financial resources. Public expenditures can also stimulate GHGs emissions, contribute to emissions intensity reduction or increase carbon sequestration. Such measures in Uganda account for a lower share of agricultural expenditures. Most of these measures, however, were not sufficiently detailed to determine whether they increase or decrease emissions, which limited the conclusions.

The PERCC analysis conducted for Uganda demonstrates the usefulness of this work for evidence-based policymaking processes. PERCC contributes to enabling better policy design and helps identifying the priority areas for future investments to contribute to the achievement of climate change adaptation and mitigation targets in the agricultural sectors. As such, PERCC has a great potential in contributing to building key evidence for informed decision-making processes for a range of stakeholders, and particularly the policy makers and donor community. The analysis provides also insights that can usefully feed into building national level strategies and plans for building a climate-friendly, sustainable and productive agricultural sector.

Unfortunately, the current contents of the database for Uganda limit the potential of the analysis, as full descriptions of the expenditure measures are not available. In addition, a proper assessment of the direction of the relationship of expenditure measures and climate change adaptation and mitigation efforts of a country requires detailed contextual information on country characteristics, would need to be collected and combined with the information included in the expenditures dataset. Both aspects require substantial additional data collection efforts, which are extremely time consuming and very costly. This constitutes a major drawback of this work and renders it difficult to perform on a regular basis.

Further refinements of the presented methodology may enhance its usefulness and improve the results of the analysis. For example, a more thorough and disaggregated approach to livestock measures may distinguish between types of livestock – those with a much lower footprint, and measures within the subsector e.g. improved feed practices which reduce GHG emissions per cattle head, making the analysis more accurate.

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Annex 1. PERCC labelling assumptions

1. All measures that increase adaptive capacity of the sector to climate change are labelled as positively stimulating climate change adaptation. This includes provision of subsidised inputs such as seeds despite their known adverse effects on sustainability of agricultural sector. This is because only first order response of the sector to the policy measure in the context of climate change adaptation is considered.
2. Expenditures related to livestock subsector are all considered as increasing GHG emissions and hence negatively contributing to climate change mitigation. This is because only first order response to the policy measure is considered where any support linked to production in the livestock subsector is assumed to increase numbers of livestock and hence increase GHG emissions. Whether overall emissions will effectively increase depends on a particular measure in place and on other factors in the subsector including other measures that may be implemented helping better management of livestock. For example, veterinary services to the livestock sector are always considered mitigation negative, because treatment of animal diseases will tend to increase numbers of livestock. However, they may decrease emissions intensity because of enhanced animal health, especially if accompanied by better livestock management practices, resulting in overall decrease in emissions if decrease in emission intensity is stronger than the increase in numbers of livestock.
3. Expenditures on research are always considered as mitigation “not determined” because PERCC methodology does not allow establishing clear directional link between research in general and climate change mitigation. Such links could only be established if details on research activities were known for this study.
4. Expenditures on roads are considered mitigation “not determined”. This is because there are too many factors that influence the overall response of road construction activities on climate change mitigation, including the travel time before and after the investment, traffic intensity change or impact of the investment on the landscapes (e.g. clearing forest to build the road) that will all contribute to change in GHG emissions. Such information was not possible to obtain for this study.
5. All expenditures on education and health services are considered as benefiting climate change adaptation of the sector because they improve adaptive capacity of the beneficiaries.

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