Note

Effective implementation of agriculture-related actions of the EAC Nationally Determined Contributions:

Technology as a means of implementation

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Summary

This note will focus on EAC countries' needs in term of agriculture-related actions contained in their NDCs. It will present how technology can be a mean to effectively implement the agriculture-related actions of their NDCs, and what are the options to leverage them. This paper will be concluded with some recommendations to climate negotiators and policy makers at both national and international levels, in order to enhance technology transfer and development of the EAC agricultural sector.

Introduction

Est African Community (EAC) countries are particularly vulnerable to climate change. Their economic activity is mainly based on natural resources exploitation. As biodiversity and ecosystem can be disturbed by climate change, it hence has direct effects on agriculture[1]. Thus, the major part of Nationally Determined Contributions (NDCs) submitted by EAC countries is related to agriculture. They aim to adapt and mitigate climate change through actions that can implement a sustainable and resilient agriculture.

Most of the agriculture-related actions of NDCs require specific technology in order to implement them. Since countries may not have the technical resources, they need assistance to enhance technology transfer and development mechanism.

This note aims to expose EAC countries needs in term of agriculture-related actions contained in their NDCs, how technology can be a mean to effectively implement these NDCs and what are the options to leverage technology.

What is planned under the EAC NDC in terms of agriculture?

Some similar actions under EAC countries' NDCs

The major part of agriculture-related actions of NDCs are similar among EAC countries. The main measures considered by all countries are: (i) irrigation, control of animal and plant pests and diseases, as well as improved animal and crops breeds as adaptation contributions; (ii) soil conservation and land husbandry, agro forestry and organics waste composting as adaption and mitigation measures[2].

Climate Smart Agriculture

All EAC countries aims to develop a Climate Smart Agriculture (CSA) through their NDCs. CSA is promoted by the Food and Agriculture Organization (FAO), with the objectives of increasing agricultural productivity, building resilience of smallholders to climate change, and reducing GHG emissions. For instance, in Uganda, developing such methods could lead to a potential emission reduction of 2,7 million tons of carbon dioxide per year in 2030[3].

Irrigation

Improving irrigation is an important issue in the EAC NDCs in order to adapt to climate change and prevent farmers from suffering climate shocks. It can improve food security, by increasing and ensuring production. It can also be a mitigate action. Efficient use of irrigation water reduces nitrogen losses including nitrous oxide emissions[4]. To do so, Rwanda for instance aims to develop district irrigation master plans with a focus on small-scale schemes. Burundi' NDCs plan to enhance water resources control and management by developing small and large scale irrigation as well as

[1] http://www.un.org/africarenewal/fr/magazine/%C3%A9dition-sp%C3%A9ciale-agriculture-2014/l%E2%80%99afrique-face-au-changement-climatique

[2] Katushabe (2016) Taking Stock of INDCs: Potential Trade Impacts for East Africa

[3] UNFCCC (2015e) Uganda's Intended Nationally Determined Contribution (INDC)

[4] UNFCCC (2015c) Intended Nationally Determined Contribution (INDC) for the Republic of Rwanda

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improving their efficiency to reduce water consumption.

Agroforestry

All EAC countries NDCs recommend using agroforestry. Rwanda, for instance, specifies that "*100% of the households involved in agriculture production will be implementing agro forestry sustainable food production by 2030*"[5]. This approach can reach the purpose of sustainability, by diversifying crops and lead to soil conservation while ensuring agricultural production.

Organic waste composting

It is mentioned in all EAC NDCs that using organic fertilisers can be implemented as an adaptation and mitigation measure. It allows farmers to manage organic waste and by using them in agriculture, annihilate the adverse impacts that inorganic fertilisers have in climate change.

Specific national actions of the EAC NDCs

Developing agricultural services

Burundi, Tanzania and Uganda focus on developing agricultural services to face climate change. Particularly, developing climate information and early warning systems6. Burundi aims to improve weather forecasts, and "*Use information networks to identify areas ravaged by disease and/or with major water and pastureland resources*"[7]. For instance, Tanzania aims to develop crop insurance to protect smallholders from shocks. This country also aims to strengthen the capacity of agricultural research institutions to conduct basic and applied research.

Developing access to market

Rwanda, Burundi and Uganda focus on developing access to market for smallholders. For Rwanda, and Uganda, by adding value to agricultural products through processing. Uganda aims to provide micro-finances resources to smallholders (agro-producers and agro-processors). For Burundi, it involves the transformation of subsistence farming into profitable market agriculture, managed by professionals.

Technology transfer and development mechanisms to effectively implement agriculture-related actions of the NDC

Actions contained in the NDCs would be implemented, only if EAC countries have the required resources. Kenya clearly stipulates in its NDCs, that there are conditional objectives: they will be implemented only if they receive enough financial support from the international community.

Most important, they also need to develop and/or obtain necessary technology for most part of NDCs actions. The poor performance of agriculture sector can be explained partly by a lack of technology and development mechanisms. In the region, the level of Research & Development (R&D) remains insufficient and services and training on specific

[5] Ibid

[6] UNFCCC (2015e) Uganda's Intended Nationally Determined Contribution (INDC)

[7] UNFCCC (2015a) Republic of Burundi: Intended Nationally Determined Contribution (INDC)

technology needed still inadequate[8].

Technology and skills' needs on Climate smart agriculture

To develop a climate smart agriculture (CSA), EAC countries will need to access and develop a wide range of skills and technologies. A CSA is based on a sustainable management of natural resources (land, water, soil and biodiversity). All agricultural sectors must be improved in the region, which consists of sustainable agroforestry, integrated pest management and ecosystem approaches to fisheries and aquaculture. In order to go into that direction, EAC countries will need to strengthen infrastructures, improve institutions' capacities and shape coherent legal frameworks and policies. Moreover, they will need investment to develop or import the technologies required: weather forecasting, early warning systems and risk insurance. Uganda and Kenya have already set up a national CSA program.

Technology and skills' needs on water management

A water efficient agriculture is necessary in order to face challenges from climate change, as water supply can be reduced by droughts. But it goes further than this approach. It is the cornerstone of adaptation to climate change. Burundi and Rwanda put a focus on this technology need. For instance, Burundi aims at enhancing use of water in order to improve its access. Therefore, the country needs to develop management and control systems to increase hydro-agricultural developments, to develop rain-fed crops and to put into place small and large scale efficient irrigation. By doing this, the government wants to promote intensified water-efficient agriculture.

It can be interesting to notice that since all countries aim to develop CSA through their NDCs, they will all need to develop good irrigation systems. CSA aims to enhance capture of water, storage and use for agriculture.

Technology and skills' needs on fertilizers

Improving the use of fertilizers can lead to reduce leaching and nutrient loss 9. For instance, the use of biodigestor could help developing a more sustainable agriculture as well as developing a better management of fertilizers. Burundi included the use of renewable energy in its NDCs, and thanks to biodigestor development, waste could be used as an energy. Indeed, manure is converted by biodigestors into biogas (which can be used to cook) and produce a nutrient-rich fertilizer. For Rwanda, "*the use of organic fertilisers by composting has many environmental benefits whereby it provides an excellent way to manage the huge volume of organic waste and utilise it in a productive manner*"[10]. To have further effectiveness, the fertiliser can be enriched with nutrients (Nitrogen phosphorus). For instance, the production of such fertilizer can be produced locally by conversing atmospheric nitrogen gas into chemical fertilizers. Thus, this technique adds valuable organic matter to soils.

Technology and skills' needs on

[8] http://www.eac.int/sectors/agriculture-and-food-security/constraints

[9] https://ccafs.cgiar.org/blog/kenya-integrates-climate-smart-agriculture-its-intended-nationally-determined-contribution#.WN4dT6KkLIU

[10] UNFCCC (2015c) Intended Nationally Determined Contribution (INDC) for the Republic of Rwanda

crops improvement

Some NDCs focus on developing biotechnology for crops' improvement in order to adapt crops to climate change. For instance, Uganda aims to develop upland rice cultivation: "*This is the promotion of a variety of rice that does not need flooded fields. In the case of Uganda, flooded rice fields are mainly utilising wetlands. Current efforts are already being put in the upland rice promotion activities*"[11]. Rwanda also aims to develop biotechnology. The techniques needed to develop biotechnology and allow EAC countries to improve their crops 'resilience consist in tissue culture (i.e. "*cultivation of plant cells or tissues on specifically formulated nutrient media*"[12]), molecular marker-assisted breeding and genetic engineering.

Technology and skills' needs on agroforestry

Agroforestry consists in integrating the production of trees and other crops or animals in the same land area. It can improve the resilience of agriculture production and therefore improve food security. At the same time, it can increase the socio-economic resilience of smallholders as it gives access to more ecosystem services, and improve household income. What is required to implement agroforestry consists in training on forestry, agronomic technologies, post-harvest storage and marketing for products[13]. Capacity building is necessary to allow smallholders to implement agroforestry activities: establishing community nurseries, plant growing, installation of plantations and rejuvenation of regional forests.

Potential challenges and constraints in leveraging technology transfer and development mechanisms

EAC countries face many challenges leveraging the necessary technology development and transfer mechanisms to be able to effectively implement agriculture actions of their NDCs. Three main constraints are presented below:

Financing the implementation

The most significant constraint is the cost of developing such technologies: i) to invest in equipment; ii) to provide adequate training to farmers to implement technology and to maintain it; iii) to develop Research and Development (R&D) centres.

For instance, Burundi estimated its costs for the promotion of R&D and technology transfers to 25,787 dollars[14] for agriculture sector. Some adaptation actions were already planned in previous national action plans, but have not been implemented so far because of a lack of financial support. Tanzania evaluated its financial resources needs at about 500 million US$ for adaptation contributions. For instance, the implementation of improved gravity system for irrigation will bring the annual cost from 16US$/ha to 43 US$/ha[15]. The costs for agroforestry implementation are estimated

11 Uganda (2006) Consultancy services for technology needs assessment for mitigation of GHG Emissions in Uganda

12 Republic of Rwanda (2012). Technology needs assessment and technology action plans for climate change mitigation and adaptation

13 UNFCCC (2015d) United Republic of Tanzania: Intended Nationally Determined Contributions (INDCs)

14 UNFCCC (2015a) Republic of Burundi: Intended Nationally Determined Contribution (INDC)

15 UNFCCC (2015d) United Republic of Tanzania: Intended Nationally Determined Contributions (INDCs)

in the range of 4m-5m US$/year.

Implementation of NDCS in Kenya is based on both domestic and international support. The country estimates financial needs to 40 billion US$ to implement mitigation and adaptation contributions.

Uganda will also rely on domestic resources but they will only cover 30 % of total costs for the next 15 years. For an estimation of a total amount of 2.9 billion US$, it represents 1,2% of its GDP[16]. Thus, implementation of all Uganda NDCs is conditional on the support of international community. This support could be provided directly from climate finance instruments, but can also be provided by international market mechanisms. Compared to traditional development partners, international climate funds contributed very little to adaptation in Uganda. It is estimated at 160000US$ from 2008 to 2012 (mostly for mitigation actions) whereas 59 million US$ have been spent by traditional development partners (in partnership with the government) to implement adaption projects.

Ensuring a conducive institutional and legal environment

First, governments must be able to monitor the effectiveness and efficiency of the implementation of the NDCs. Policies need to be aligned with NDCs recommendation. However, it is not always the case, some governments can sometimes orient their policy in a way that does not meet NDCs goals, for instance by promoting monoculture instead of agroforestry. In addition to financial issues mentioned above, many policies are not supported by financial plans. Without straight policies providing guidelines financial allocations, NDCs have less chances to be fully implemented.

Second, as technologies are mainly implemented by private actors, the role of government to create the adequate environment is essential. It allows entrepreneurs to have access to required information, to develop networks, and thus, to spread technology in all areas of the country. For now, in EAC countries, incentives may be not sufficient to attract private actors to invest in agriculture-related technology. Regulatory environment must be suitable for private investments in agricultural R&D.

Building knowledge and capacity of all stakeholders

Inadequate information and insufficient knowledge-building can lead to a lack of awareness of all stakeholders on how urgent is the need to adapt agricultural practices to climate change. Smallholders may not understand what is the value addition of implementing this *x* technology or elaborating this *y* mechanism. For instance, concerning CSA implementation, FAO noticed the misunderstanding of stakeholders, i.e. farmers, policy makers, media and general public about these issues. This can lead to a reject of NDCs projects, especially among rural households[17].

To implement technology and develop new mechanisms, all stakeholders must be involved, in particular private firms that can enhance use of technology and impulse their implementation. Indeed, cooperation needs to be promoted. For

16 UNFCCC (2015e) Uganda's Intended Nationally Determined Contribution (INDC)

17 Njeru et al. (2016) Eastern Africa Climate-Smart Agriculture Scoping Study: Ethiopia, Kenya and Uganda

instance, in Tanzania, to implement agroforestry, recommendations are to set up new or strengthen existing cooperatives to improve negotiating power of smallholders, as well as improve their access to credit. To increase this private actors' involvement, they should get a better understanding or capacities to manage and negotiate on these issues[18]. This recommendation can be extended to other technologies development. Concerning CSA, projects are, so far, mainly implemented in a fragmented manner. This prevent from an extension of practices and rise of awareness. FAO recommends strengthening the coordination of CSA implementation[19]. The fact of involving stakeholders to implement projects will also prevent them from being inadequate to local needs and constraints. Too many projects are still implemented because of a previous success elsewhere. If not adapted to local environment, population and preferences, projects can be rejected: "Development, testing and sharing of climate-smart technologies should be done in partnership with the farmers themselves so as to enhance adoption and sustainability"[20]

Options and opportunities for EAC countries when leveraging the necessary technologies to implement agriculture actions of the NDCs

International support: Taking advantage of existing mechanisms/bodies

International institutions recognise the need of support for technology transfer in order to implement adaption actions in developing countries. The Article 10 of Paris Agreement specifies: "*technology transfer could be used to develop agricultural sector if targeted for this purpose*".

To promote technology transfer, the Technology Mechanism has been established in 2010, within the UNFCCC. It is composed by two bodies: (i) the Technology Executive Committee aims to promote cooperation between countries, in particular between developing countries but also through triangular cooperation. (ii) the Climate Technology Centre and Network aims to support countries by advising them on policies, by elaborating regulatory frameworks, developing technology solutions and capacity building.

To leverage this option, EAC countries need to develop their skills to be able to defend their interest and to advocate within these bodies on their needs in term of agricultural technology. Indeed, the TM having complicated process and few funds, EAC countries must "*identify specific programmatic areas in which the mechanism can work in partnership with national authorities*" Thus, by participating in designing TM's programs, experts from EAC countries could orient them in a way that suit projects of technology transfer in their countries[21].

National actions: Developing a

[18] Gagnon-Lebrun (2004) International energy technology collaboration and climate change mitigation. Case Study 2: Cooperation in Agriculture :R&D on High-Yielding Crop Varieties

[19] Njeru et al. (2016) Eastern Africa Climate-Smart Agriculture Scoping Study: Ethiopia, Kenya and Uganda

[20] Njeru et al. (2016) Eastern Africa Climate-Smart Agriculture Scoping Study: Ethiopia, Kenya and Uganda

[21] http://www.ictsd.org/bridges-news/bridges-africa/news/making-the-un-climate-change-technology-mechanism-work-for-africa.

suitable environment and create incentives

Effective and holistic involvement of stakeholders

To ensure effective transfer of technology, it is essential to develop a cooperative environment between stakeholders. Multi-stakeholder platforms may ensure that every smallholder/stakeholder can have access to technology and knowledge they need to develop a CSA[22]. Governmental bodies, industry associations, smallholder farmers, research centres, laboratories … must be involved in a multi-stakeholder approach when implementing a project aiming at developing technology. This is also a way to maintain long term effects after the project duration.

Institutional coordination is crucial for CSA programs, for instance. Horizontal and vertical integration are required to implement these programs in an effective way. To do so, government must set up a framework providing "*high level guidance*"[23] and must determine which sectors are crucial and must be improved. A coordination framework could improve cooperation between ministries and local governments, develop public/private partnerships, as well as include civil society and development partners.

Better institutional environment

The institutional environment should be adapted to enhance technology development in developing countries. In fact, technological effort of firms is directly influenced by the national environment. Therefore, several determinants should be enhanced like implementing more incentive structures. Macroeconomic policies should be adapted to investment, i.e. developing incentive fiscal and monetary policies, but also ensure availability of foreign exchange, as well as paying attention to exchange rates, interest rates and growth rate. Trade regime and competition policies need to be set up in order to attract foreign investors, but also to allow domestic investors to be competitive at an international level and to reach international markets.

In the same spirit, to enhance private domestic actors to invest in and to develop agriculture sector, governments should implement technology-oriented policies in order to promote the coordination of research activities, and to provide education and training on specific technologies for agriculture.

Finally, government must ensure that technologies will be benefiting to most of the population. Indeed, in order to ensure investments that make sense, technology transferred must be cost-effective, and should also alleviate poverty as well as ensure food security[24]. For instance, in Rwanda technology transfer are requested to meet the three dimensions of sustainable development. Apart from being cost-effective and contribute to adapt and mitigate climate change, technology must contribute to socio-economic development (for instance, the number of beneficiaries must be sufficient to justify the expense for technology transfer).

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22 Sullivan et al. (2012) Climate Smart Agriculture: More Than Technologies Are Needed to Move Smallholder Farmers Toward Resilient and Sustainable Livelihoods

23 Njeru et al. (2016) Eastern Africa Climate-Smart Agriculture Scoping Study: Ethiopia, Kenya and Uganda

24 UNFCCC (2015c) Intended Nationally Determined Contribution (INDC) for the Republic of Rwanda

Case study: Technology Transfer Project in Ghana

Some projects have been implemented to transfer technology in agriculture sector. For instance, the Agricultural Technology Transfer Project in Ghana supported by USAID[25]. This project aims to develop technology and capacity building in two areas: seed and soil fertility. It uses a multi-stakeholders approach and focuses on public-private partnerships. Improving institutions can help seed companies by providing them with technical assistance. Building institutions' capacity will allow them to elaborate a framework for quality and labelling standards. Furthermore, a research component aims to develop research to identify new technology, as well as enhance equipment and facilities. This project involves all actors: smallholders, companies, government bodies, research centres and laboratories.

Capacity building to innovate

Through the CSA program of Uganda, innovation takes a large part. For now, the EAC countries' capacity to develop research on climate smart technologies is still limited. They perform inadequate research that provide ineffective technologies to farmers. Research must be well-oriented to adapt technology to smallholder farmers.

Focus on Irrigation

As Asian countries have developed irrigation technologies, it makes sense to learn lessons from these developments and using these countries to transfer the required technology[26]. It is particularly suited for smallholders.

Concerning irrigation, Asian countries already set up a lot of technologies to use and pump efficiently water. These technologies consist mainly in implementing low-cost pumps to irrigate and could be transferred to EAC countries. For instance, World Bank supported a project to implement solar-powered irrigation pumps in Bangladesh in 2015[27].

In order to avoid this dependence to developed countries and international financial institutions, developing countries should make a wise choice when asking for support. Better to develop capacity to innovate, and to develop their own R&D institutions than directly import foreign technology. Governments should focus on create this incentive institutional environment mentioned above to lead to the improvement of R&D institutions in their country, and therefore increase their domestic empowerment in terms of technology development. For instance, irrigation equipment should be locally manufactured and traded. But it can be difficult for local manufacturers to implement such technology because of complex design28. With strong institutions and policies, governments could use international development aid to provide necessary training to build capacity of manufacturers and allow them to create and implement needed equipment for NDCs implementation.

Case of irrigation technology development in India

In India, the agriculture productivity has been increased thanks to the rehabilitation of the traditional gravity systems. Starting by developing

25 https://www.wur.nl/en/project/ifdc_att_ghana.htm

26 http://www.fao.org/docrep/W7314E/w7314e0f.htm

27 http://blogs.worldbank.org/endpovertyinsouthasia/solar-irrigation-pumps-new-way-agriculture-bangladesh

28 http://www.fao.org/docrep/W7314E/w7314e0f.htm

small gravity systems, technology transfer, enhanced by research, led to put into place large scale reservoirs. Fostered by rural electrification, this technology of pumping water allowed food production to be improved, contributing to regional development. Investment in equipment have been supplemented by research activities on irrigation technology and water management, including the soil and climatic factors. Thus, hundred research stations belonging to agricultural universities allowed the irrigation technology to be transferred to farmers.

General recommendations

Most part of agriculture-related NDCs require technology to be implemented. EAC countries need help and support to do so. This note provided examples of such means to enhance technology transfer and development mechanisms.

Policy makers and UNFCCC negotiators are recommended to remind these main principles when leveraging the necessary technology development:

At national level:

- Enhancing institutional environment is essential to lead to technology transfer and capacity building of smallholders.
- Involving all stakeholders and creating incentives for private actors can enhance national R&D.
- Encouraging public/private partnerships can provide financial support, develop infrastructure and equipment in order to spread technology and capacity building
- Develop R&D in order to develop its own technology. Using funding for this purpose in order to take empowerment in this issue.
- Implementation of technology should be supplemented by adequate training in order to maintain it and disseminate it. It must be chosen not to cost more to smallholders who could not maintain costly technologies.

At international level:

- It can be easier to leverage funds from traditional development partners in order to implement adaptation actions.
- Building capacities of UNFCCC negotiators in order to allow them to advocate their needs on agricultural technology through the Technology Mechanism, as well as participating in designing TM program.

Appendix

Nationally Determined Contributions in EACs countries

BURUNDI	KENYA	RWANDA	TANZANIA	UGANDA
ADAPTATION				
Increase in agricultural production and productivity and development of sustainable production systems	Enhance the resilience of the agriculture, livestock and fisheries value chains: Climate smart agriculture and livestock development	1. Sustainable intensification of agriculture	Up-scaling the level of improvement of agricultural land and water management.	Expanding extension services
Capacity-building in the agricultural sector to transform subsistence farming into profitable market agriculture		Agroecology techniques: agroforestry, kitchen gardens, nutrient recycling, and water conservation	Increasing yields through inter alia climate smart agriculture	Expanding climate information and early warning systems
Introduction of smart agriculture		Resource recovery and reuse through organic waste composting and wastewater irrigation	Protecting smallholder farmers against climate related shocks, including through crop insurance	Expanding Climate Smart Agriculture (CSA)
		Using fertiliser enriched compost	Strengthening the capacity of Agricultural research institutions to conduct basic and applied research	Expanding diversification of crops and livestock
		Sustainable pest management techniques to control plant parasites and pathogens	Strengthening knowledge, extension services and agricultural infrastructures to target climate actions.	Expanding value addition, post-harvest handling and storage and access to markets, including micro-finances
		Soil conservation and land husbandry		Expanding rangeland management
		Irrigation and water management		Expanding small scale water infrastructure
		Agricultural diversity in local and export markets: Add value to agricultural products		Expanding research on climate resilient crops and animal breeds
MITIGATION				

Gradual replacement of 100% of mineral fertilizers with organic fertilizer by 2030	Climate Smart Agriculture			- Climate Smart Agriculture techniques for cropping - Livestock breeding research and manure management practices

Technology needed (from technology assessment)

BURUNDI	KENYA	RWANDA	TANZANIA	UGANDA
Development of access to water while enhancing the efficiency of its use = Water resources control and management: - Develop, rehabilitate and manage hydroagricultural developments - Produce developments for rain-fed crops - Develop small and large scale irrigation and improve its efficiency in order to reduce water consumption	Solar Dryers	Agro forestry	Agroforestry	Organic Farming: The approach is to utilise aerobic digestion of vegetation matter into organic manure to restore and improve soil resources as against use of inorganic fertilisers.
Promotion of intensified water-efficient agriculture = Intensification and diversification of agricultural production: - Intensify and diversify agricultural production by simplifying access to inputs (fertilizer, subsistence crop seeds, drought-resistant fodder and crop protection products) and to agricultural equipment - Develop an agro-ecological approach (soil fertility management practices, use of manure and compost, development of agroforestry, and water and soil conservation)	Biodigestor	Drip irrigation		Upland Rice Cultivation: This is the promotion of a variety of rice that does not need flooded fields.
Security for livestock farming and support for the association of agriculture and livestock: - Enable the diversification of activities (breeding of multiple species of animals, combination of agriculture and livestock, sale of harvest transport services, fodder crops, etc.) - Facilitate the genetic diversity of different animals		Radical terracing		Forestry Subsector 1. Afforestation 2. Forestry Conservation
Support for the exploitation of fishing resources: Develop the exploitation of fishing resources while conserving resources (stocking bodies of water with fish, development of rain-fed fish farming and application of zones closed to grazing)		Rain water harvesting		
Support for facilities that use renewable energy sources Improvement of the population's well-being: Improve agricultural and livestock production activities (drainage, conservation, drying and cold chain) including the use of renewable energy sources (hydraulic, solar and wind)		Seed and grain storage		

Key measure: Communications on climate risks and adaptation scenarios = Knowledge of spatial and temporal changes to the environment: - Track weather forecasts and the climate - Prevent and fight bio-aggressors - Use information networks to identify areas ravaged by disease and/or with major water and pastureland resources		Biotechnology of crops for climate change adaptation		
		Integrated fertilizers and pesticide management		

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The PACT EAC2 project is undertaken with funding support from the Swedish International Development Cooperation Agency (Sida).