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adelphi

Case study

Assessment of Climate Change Adaptation Measures in micro-, small- and medium-sized enterprises

Consultation on development of climate change adaptation strategies for companies

COOPAC, Rwanda

This case study has been developed by adelphi commissioned by GIZ global programme 'Strengthening the Capacity of the Private Sector to Adapt to Climate Change' on behalf of the BMZ.

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Part A: Introduction and Background

This case study has been developed as part of a GIZ global programme 'Strengthening the Capacity of the Private Sector to Adapt to Climate Change'. The study **analyses the vulnerability of a coffee processing company in Gisenyi, Rwanda to climate change impacts**. Based on this assessment, **adaptation measures are identified** to allow the company to adapt to these climate change impacts. The study is based on an actual assessment of the company.

For the assessment the **Climate Expert methodology** was applied. This methodology has been developed by GIZ and adelphi and is a step-by-step approach for identifying climate change risks and opportunities for companies, ranking them, identifying suitable adaptation measures and prioritising them. Information on materials on the Climate Expert approach can be obtained free-of-charge from www.climate-expert.in.

The assessment on which this case study is based was conducted in July 2015. A team of international experts (GIZ and adelphi) visited the company, COOPAC, in Gisenyi, Rwanda. From COOPAC, the Production Manager Mr. Ernest Kubwimana Ntaganzwa participated. During the half-day visit, an extensive interview was conducted, the production facilities were examined, and climate change risks and opportunities as well as corresponding adaptation measures were discussed.

COOPAC coffee washing station at Lake Kivu (adelphi, 2015)

COOPAC is a **coffee processing company** founded in 2001 in Gisenyi, Rubavu district in the Western Province of Rwanda. COOPAC purchases coffee berries from its associated farmers and processes the major part into green coffee which is exported. A small part of the green coffee produced is roasted and sold in the local market. COOPAC **covers almost the entire coffee value chain** – from purchasing the coffee berries, to pulping, fermenting, washing, hulling and roasting the coffee. COOPAC also produces its own fertilizer from coffee pulp, lime, molasses and microorganisms; this fertilizer together with seedlings and natural pesticides is given for free to its associated farmers.

COOPAC roasting station (adelphi, 2015)

The company started as a cooperative and became a private company in 2011. With 8,000 associated farmers, the company currently produces around 1,200 tonnes of green coffee per year. **COOPAC produces Rainforest-Alliance-certified, fair-trade, and organic coffee**. Most of the green coffee produced is exported to the USA; Switzerland, the UK; Germany, Netherlands, France and Japan. With **800 employees** during the harvesting season (55 employees during off-season), the company can be considered **medium-sized**.

After the associated farmers harvest the berries they are delivered to COOPAC coffee washing stations where they are further processed: the berries are weighted, manually selected and sent to a washing process that expands and softens them. Then, through a mechanical process the pulp is separated from the coffee cherries. Dry- and wet-fermentation processes are followed by soaking and drying. In the COOPAC central processing plant the berries are hulled, sorted and packaged. After this step they are prepared for export as green coffee. A small portion is roasted and ground, and sold on the local market.

Most important inputs for the production processes are fertilizers, organic pesticides, coffee berries, labour, electricity, and water.

The **process of coffee washing is very water and energy intensive**. Washing stations consume up to 10,000 litres per day for processing of 2 tonnes of coffee. The water is sourced from wells and small streams. Waste water is currently being directed to ponds where it is cleaned through a natural filtration process.

The electricity consumption for operating a pump in a coffee washing station is ca. 650 kWh per month leading to costs of ca. RWF 85.000. The company has diesel generators at their washing stations to produce power for the grinding / pulping machines. These generators consume between 7 and 12 litres of fuel per day if the machinery is in operation. At one coffee washing station, the company installed solar panels to generate electricity for lighting.

Green coffee from COOPAC (adelphi 2015)

Company Facts:	
Location	Gisenyi, Rubavu, Western Province, Rwanda.
Products	Fair-trade, Rainforest-Alliance, and certified organic coffee, mainly Arabica coffee (Bourbon, Pope, Jackson)
Employees	800 (in the harvesting season) and 55 (off-season)
Supply chain	Downstream supply chain: 8,000 coffee producers, 6,000 from the Western Province in Rubavu and Rutsian District and 2,000 in the Northern Province End-user market: • Green coffee: USA, Belgium, Switzerland, UK, Germany, Netherlands, France, Japan • Roasted coffee: Rwanda
Technology level	Medium: machine-supported processes
Inputs	Coffee cherries, water, electricity, fertilizer, organic pesticides, labour
Past climate change	Shifting seasons resulting in decreasing yield from coffee trees; intense rainfall events affecting the drying process, floods affect the washing process; droughts affecting the quality of the coffee, the availability of water for the washing process as well as the probability of pests; landslides affecting transportation of the product; and heat waves affecting the moisture content (quality) of the coffee beans.
Future climate change	Increased number and intensity of floods and landslides due to heavy rain events; increased number and more intense droughts

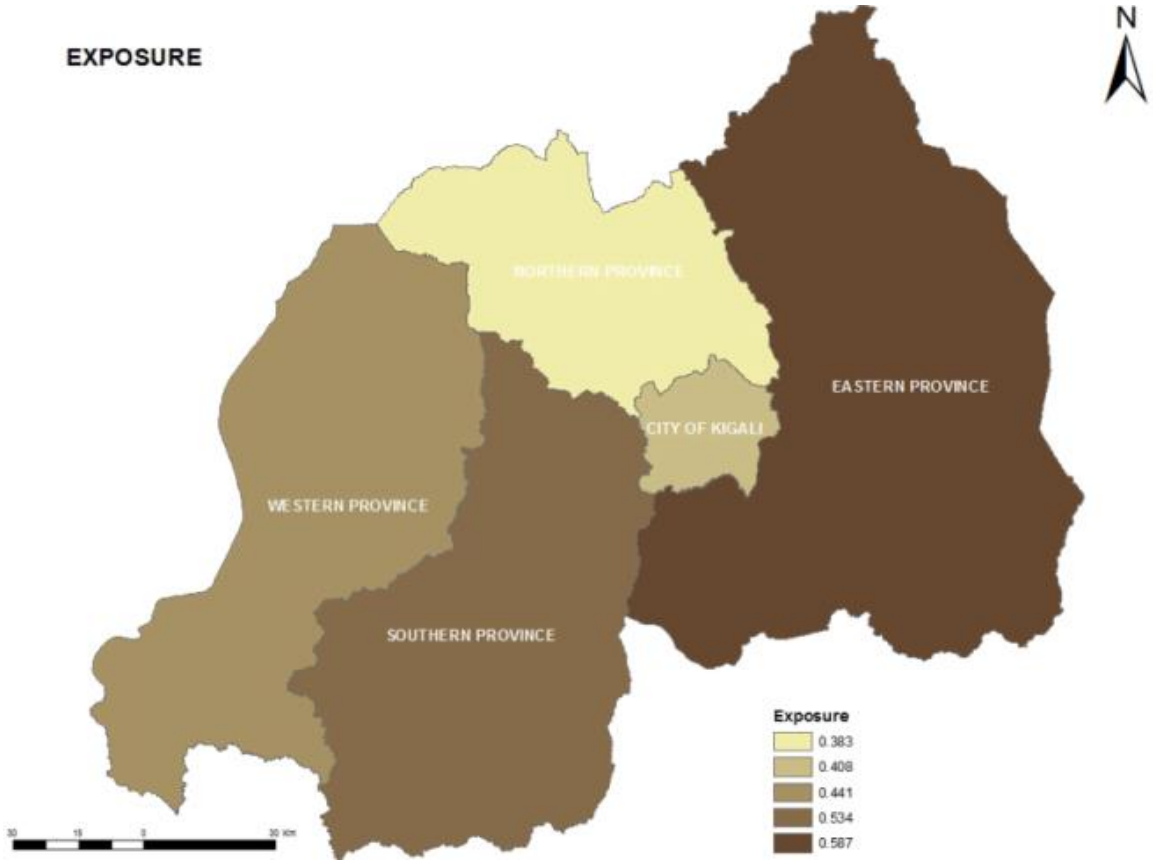
This case study begins with an analysis of how Rwanda is affected by climate change (**Part B: Climate Change Impacts in Rwanda**). The following section describes how the company is affected by climate change, structured according to different impact areas following the climate expert. Relevant climate change related risks are analysed (**Part C: Climate Change Impacts**). Following this logic, possible adaptation measures that have been identified are suggested in the subsequent section (**Part D: Climate Change Adaptation**). In the last section (**Part E: Conclusion**), most significant climate change related risks and respective suitable adaptation measures for implementation are summed up.

Part B: Climate Change Impacts in Rwanda

Climatic changes, anomalies and weather extremes are already a reality in Rwanda today. The country has experienced irregular climate patterns in the past that include greater variability in rainfall intensities and frequencies, unusually heavy rains in the North and more severe droughts in the East and South (REMA, 2009). The decade between 1991 and 2001 has been the driest on average since 1961 (ibid). The recorded annual average temperatures of four weather stations across Rwanda reveal a clearly increasing trend of +0.35°C per decade for the period between 1971 and 2010 (MINIRENA, 2011). Heat waves have also become more severe. The maximum temperature recorded between 2001 and 2010 was as high as 35.4°C compared to 32.8°C in the preceding decade (Rwanda Meteorological Center quoted in Rwanda Focus, 2012).

Projections estimate that large parts of the country, including the Western Province, will experience an **increase in precipitation** with **more intense rainfall particularly during rainy seasons**, which will **increase the intensity and frequency of floods and landslides**. The Southern, Northern and Western provinces present the main "flood and landslide risk zones" (MINITERE, 2006, cited in REMA, 2009). "In September 2008 the heavy rains and winds adversely affected 8 among 12 sectors of Rubavu district: Gisenyi, Rubavu, Rugerero, Nyamyumba, Nyundo, Cyanzarwe, Nyakiriba and Kanama." (ibid). On the other hand, extended **droughts are expected to become more frequent** in the country (NAPA-Rwanda, 2006; IIED, 2013). Average temperatures are expected to increase up to 2.5°C by 2050 and up to 4°C by 2080.

The region where the company is located belongs to the Western Kivu-sea climate zone. Average annual rainfall in this area amounts to 1.100 mm. Not all of the general country trends described above are relevant for the location of the COOPAC. According to a vulnerability baseline report by REMA the Western province is especially exposed to climate impacts from a change in the amount of rainfall, a shift in seasons - especially the beginning of the rainy seasons - and wind and thunder events (REMA, 2015). The Western province is less exposed to a change in temperature, heat waves, flooding and drought (ibid.). The general exposure of climate change of the Western province ranks third among all five provinces in Rwanda (ibid.).



Map of exposure to climate change (REMA, 2015)

The exposure in the map above is composed of the following individual impacts (REMA 2015). The numbers represent the position of the impact on an index from 0 to 1 - 0 being absolutely no exposure to the impact and 1 being complete exposure to the impact. The individual impacts are not weighted.

	Change in temperature	Change in rainfall amount	Shift in rainfall start date	Drought episode	Flooding events	Wind events	Heat	Thunder
Western Province	0.38	0.64	0.575	0.32	0.26	0.53	0.265	0.555

It should be considered that despite the availability of some climatic information, country-specific climate data for Rwanda is scarce and some studies contradict each other regarding estimates of overall changes in precipitation. Besides temperature recordings, trends of precipitation changes are difficult to observe due to spatial variability and inter-annual rainfall variability.

COOPAC has experienced several impacts of climate change on the production processes. **The company is most severely affected by the change of seasons**. In the past, there have been two harvesting (and thus flowering) seasons: a long one from February until June, and a short one from September to October. Currently, there is only one long harvesting season from December to the end of May / beginning of June. The change in seasons has come along with **longer and more intense droughts** affecting the quality of coffee. In the past, **heavy rain events** have also led to flooding of areas where COOPAC's facilities are located. As coffee is extremely sensitive to changes in temperature, water supply and humidity level the effects of climate change on the main input for COOPAC's are not to be underestimated to ensure business continuity.

Part C: How the company is affected by climate change

As mentioned in the introduction, the consultant team assessed the expected impacts of climate change on the company through a multi-step process. Before engaging personally with the company, information on past and future climate change trends was obtained through desk research.

Based on the information collected beforehand, the discussion with the company personnel as well as the visit to the company's facilities, several risk as well as opportunities for the companies arising from climate change could be identified. Following the Climate Expert approach, these risks and opportunities are attributed to seven impact areas that represent the entire spectrum of business activity. It includes direct impact areas such as the company's location, its production processes, logistics and stock as well as its employees. It also includes more indirect areas such as nearby communities, the markets which it caters to, and financial resources or policies affecting its business activities. Impacts on all of these areas can significantly affect a company's business activity and are therefore considered in this analysis.

Buildings and location

The company owns eight washing stations. In 2013, **heavy rain** caused **flooding of a coffee washing station** where 15 tables with coffee beans were affected and the beans were washed away. During a thunderstorm **strong winds blew away the roof of one of the drying sheds**.

Processes

The change of seasons is the climate change impact most strongly affecting the processes of COOPAC. As mentioned above, it has occurred that **instead of two rainy seasons per year there was only one longer rainy season** with the effect that coffee trees are only flowering once. Before, a coffee tree produced 5-6 kilograms per season, now it produces only 3-4 kilograms - this leads to a general loss of production.

Heavy rains may affect the drying process of the coffee. Usually, it takes 20 days

to dry the coffee cherries. In case of heavy rain and high humidity, the drying process may last up to 50 days. Due to this prolonged drying time, labour costs also rise as workers are required to oversee the drying process. Heavy rains also affect the quality of the water that is used for washing the cherries. More sediment in the water resulting from heavy rain may affect the washing process and lead to a lower product quality after washing.

Droughts affect the quality of the coffee beans. Coffee in the rainy season contains more moisture and has thus a better quality. **Drought reduces the moisture content and thereby lowers the quality**. Additionally, **water availability is reduced during droughts and washing may be suspended for one or more days** until enough water is available. Coffee cherries could be transported to another washing station where water is available. This, however, leads to higher costs and a loss of quality of the coffee. Finally, **droughts also increase the likelihood of pests occurring**. Pests affecting the coffee in the area are the coffee berry borer and the Antestiopsis bug. The generally **lower quality of coffee harvested during drought periods also leads to a higher demand for labour** as more cherries need to be sorted out – this increases the cost of production.

Logistics and stock

Heavy rains and resulting landslides have led to disruption of road connections in the past. In 2013 a landslide occurred that blocked the road from Gisenyi to Kigali. Due to this situation COOPAC could not ship the green coffee to the National Agricultural Exports Board (NAEB) as planned. As the delay did not affect the quality or cash flow of COOPAC significantly, it is not considered a major problem. More problematic is the disruption of roads between coffee farmers and coffee washing stations. The harvested coffee cherries need to be processed within a certain time period, otherwise they loose quality.

Heat waves or high temperatures affect the production process. **Heat waves can lead to a reduction of the moisture content in the stored coffee beans**. Usually, the moisture content is 12.5 %. With high temperatures the moisture content can drop to 10 % thereby negatively affecting product quality.

Employees / community

Heavy rain events in the area where COOPAC is located have an effect on the attendance of workers. During heavy rain not all workers show up for their shift which leads to a slowdown of production. **Heat stress of workers during heat waves does not have a significant impact on production.**

Government / regulation

COOPAC is not aware about any specific regulations relating to climate change that will affect its processes in the short term. In general, COOPAC management is aware about the possibility that regulation may be enacted affecting, for example, water or electricity consumption.

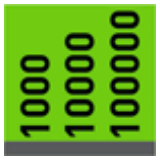
Market

Relatively **strong price fluctuations of coffee, reflecting varying harvest yields and quality in the region, have been observed** in the past. With increasing climate change effects across East Africa and the world, the company expects even more frequent and strong price fluctuations in the future.

As consumers become more aware that not only fair wages or ecological agri-practices are relevant criteria for sustainable coffee but also climate resilience, the **demand for "climate-proof" coffee may increase**.

As the topic of climate change adaptation becomes more prominent, there may be a **growing demand for expertise on climate-resilient coffee growing and processing as well as products enabling the same**. Examples of products could be pest-resistant coffee crops, organic fertilizer, water filters, etc.

Finance



In the recent past, **COOPAC has had problems to receive loans required for the harvesting season**. The company had to approach banks earlier than the years before **due to the shifting seasons**. Before, loans could be taken from the banks once the first contracts with buyers of coffee had been made - that used to be in January or February. This was just in time to get the financial resources required for the harvesting season. Now, with the harvesting season starting in December, COOPAC did not have any contracts yet and, therefore, had problems receiving loans from the banks.

Part D: Climate Change Adaptation

Following the assessment of COOPAC's exposure to climate change risks as well as opportunities for the company arising from climate change, adaptation measures to mitigate the risks and realise the opportunities are identified.

Buildings and location

For tackling the risk of flooding of coffee washing stations as well as other premises of COOPAC, the company should **develop a proper flood management system** and **install drainage systems or dams** where necessary. **Roofs and other potentially loose parts of buildings should be securely attached**.

Processes

COOPAC is planning to **install a fuel-powered dryer** which would make it partly independent of sun-drying. It should be ensured that the driers operate with renewable / biomass-based fuel.

COOPAC could **install larger water storage tanks** that would allow the company to become more independent from dirty water or a lack of water. In addition, a **water filter or sedimentation tanks could be installed** to remove sediments from the water.

Planting shade trees is an effective measure to reduce air temperatures and thus combat the effects of droughts and heat waves. COOPAC already has its own reforestation programme that is currently implemented in cooperation with GIZ and the Private Sector Federation (PSF) yet does by far not cover all associated farmers.

A possible solution for decreasing water demand would be the **investment into more water efficient machinery**. So far, no measures to increase water efficiency have been taken by the company as there is no urgent necessity from the company's point of view.

COOPAC also considers the **construction of a new wastewater treatment plant**. A water recycling system may be an option for reducing water consumption.

For combatting pests that are more likely to occur during droughts and under changing climatic conditions COOPAC should continue supplying the farmers with organic pesticides and **experiment with new organic pesticides to ensure the continuous effectiveness of the pesticides**. In addition, COOPAC could **test how new coffee plant varieties can cope with pests and diseases**. If more resistant crop varieties are identified these could be distributed among the famers.

Logistics and stock

For the occurrence of landslides resulting from heavy rain, the company can prepare by **developing emergency plans for the most frequented and/or most vulnerable routes**. Such an emergency plan would contain alternative routes for potentially blocked routes. In addition, off-road vehicles could be made available that could pass / by-pass the blocked roads. Where absolutely no passing of vehicles is possible workers could be asked to manually transport the goods from one side of the roadblock to the other. This may be relevant in case of transporting the harvested cherries to the washing station. Delays in processing the cherries will lead to a deterioration of quality.

For maintaining the moisture content of the stored coffee beans, COOPAC could **install a building insulation and an air humidifier**. By regularly monitoring the moisture content of the coffee beans, COOPAC could decide at what time to switch on the air humidifier.

Employees / community

Creating financial incentives for workers to attend work in cases of heavy rain would be an option to ensure the continuity of the production process. Another option would be to **organise the transport of workers** from central points in residential areas to ensure production continuity and avoid material destruction.

Government / regulation

Currently, no specific policy limiting the business activities of COOPAC due to climate change is in place. Nonetheless, COOPAC should **closely monitor regulatory developments and other government initiatives**. This will allow the company to prepare for regulatory change or governmental programmes that enforce or support climate change adaptation early on.

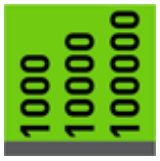
Markets

For not being affected by a sudden drop in coffee prices, COOPAC could **hedge against coffee price fluctuations or obtain an insurance**.

COOPAC could benefit from a potential increase in demand for coffee with the label "climate-proof" or "climate resilient". As customers especially in Europe or the Unites States are very sensitive about the production of coffee, coffee with the attribute "climate-proof" or "climate resilient" could be sold with a premium. **If COOPAC develops an adaptation strategy and adaptation measures it could actively use these for marketing purposes**.

If the benefits of proactive climate change adaptation become visible also to other coffee growers and processors, there may be an increasing demand for expertise on the development of adaptation measures and strategies as well as the products required for the implementation of the measures. **COOPAC as early-mover could use its expertise on adaptation to advise other coffee growers and processors on adaptation strategy development. Additionally, it could sell them some of its products such as organic fertilizer and pesticides, new coffee varieties, etc.**

Finance



The risk of not accessing finance that is required for the harvesting season can be mitigated by a suitable communication strategy. In cooperation with the coffee association CEPAR, COOPAC together with other companies could **inform bank branches about the implications of the shift in seasons for the harvesting period and the need for finance**. COOPAC should make loan officers understand that the previously fixed time period in which finance is required no longer exists due to climate change effects. Based on this loan officers will not attribute the loan request to an improper business management but will be more flexible in the loan sanctioning.

As a parallel strategy, CEPAR, COOPAC and other companies could also **liaise with buyers of coffee**. If these customers were also more flexible in signing contracts or pre-contracts, the problems with banks could be avoided.

Part E: Conclusion

Given the past as well as expected climate change impacts in Gisenyi as well as the specific location of COOPAC and its production processes, the most relevant climate risk for the company is the shift of seasons.

The assessment following the Climate Expert approach has helped the company assess its vulnerability to climate change in a structured manner. The combination of desk research, detailed interview, site visit and discussion of options has resulted in a comprehensive of overview of climate risks and opportunities that COOPAC faces.

In the table below, the main risks as well as the corresponding adaptation measures are summarised:

Climate change risk / opportunity *(climate change impact)*	**Adaptation measure**
Flooding of coffee washing stations and damage of roofs (*heavy rain / thunderstorm*)	Develop flood management system, install drainage system and dams Secure loose building parts
Lower yield of coffee trees (*shift in seasons / droughts*)	Plant shade trees in the coffee plantations
Lower coffee quality due to lower moisture content (*droughts / heat waves*)	Install building insulation Install air humidifier
Disruption in coffee washing process due to low water quality (sediments) (*heavy rain*) or unavailability of water (*drought*)	Install larger water storage tanks Install a filter and/or sedimentation tank to remove sediments from the water
Higher labour costs due to additional sorting requirement (*drought*) or longer drying process (*heavy rain*)	Plant shade trees in the coffee plantation to reduce decrease in quality (see above) Install a fuel-fired dryer making the company independent of sun-drying; renewable /biomass-based fuels should be preferred
Increase in pest occurrence *(droughts / change in temperature / shift in season*)	Apply organic pesticides Plant new pest-resistant coffee plant varieties
Workers not attending their shift (*heavy rain*)	Set-up a financial incentive scheme for workers to show up to work during heavy rains Organise the transport of workers to the company premises during heavy rains
Road connection disrupted due to landslides (*heavy rain*)	Develop an emergency plan with alternative routes, off-road vehicles, manual worker support in case of landslides
Regulation relating to climate change effects restricting business activities (*various*)	Closely monitor regulatory developments and other government initiatives
More demand for “climate-proof” coffee (*various*)	Market coffee as “climate-proof” showing the adaptation strategy developed and the adaptation actions undertaken
More demand from other coffee growers or coffee-processors for climate-proofing expertise and products	Market expertise and products to produce climate-resilient coffee to the coffee industry in Rwanda
Price fluctuation of coffee (*various*)	Hedging or insurance against price fluctuations
Difficult access to financing for the harvesting season (*shift in seasons*)	Inform financial institutions about the effects of changing seasons and convince them to become more flexible regarding the time at which loans are sanctioned

Climate change risk / opportunity *(climate change impact)*	Adaptation measure
	Liaise with coffee buyers and convince them to become more flexible regarding the time when to sign (pre-)contracts for the purchase of coffee

COOPAC should first engage in the implementation of options categorized as no-regret options. Such options yield benefits even in the absence of strong climate change impacts. For example, investing in energy or water efficiency measures will lead to cost savings that the company can benefit from even if water and energy prices do not increase. Generally, such options should be favoured that are no- or low-cost options. No-regret options from the above list are:

- Secure loose building parts
- Develop flood management system
- Plant shade trees
- Apply organic pesticides
- Plant new pest-resistant coffee plant varieties
- Organise the transport of workers to the company premises during heavy rains
- Develop an emergency plan with alternative routes, off-road vehicles, manual worker support in case of landslides
- Closely monitor regulatory developments and other government initiatives
- Hedging or insurance against price fluctuations

Particularly for high-cost options it is advisable to conduct a cost-benefit or cost-effectiveness analysis to assess under which conditions these measures make sense economically. The Climate Expert contains a section on economic assessments which could be used for calculating the economic figures. High-cost options from the above list are:

- Install drainage system and dams
- Install building insulation
- Install air humidifier
- Install larger water storage tanks
- Install a filter and/or sedimentation tank to remove sediments from the water
- Install a fuel-fired dryer

As mentioned above, COOPAC should consider financing sources that are particularly dedicated to adaptation measures. Funding from such sources may come with preferential conditions or partly even as grant financing.

The team of the GIZ global programme ‘Strengthening the Capacity of the Private Sector to Adapt to Climate Change’ will be following up with COOPAC on the implementation of the measures with the goal to support the implementation of some of the measures suggested above. Given that some of the measures are actually implemented the company this case study will be complemented to share the experience of the implementation process.

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