POLICY BRIEF

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SOLAR POWERED TECHNOLOGIES FOR THE SMALLHOLDER DAIRY INDUSTRY IN MALAWI

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EXECUTIVE SUMMARY

Malawi has a high solar energy potential, which can be introduced into the country's smallholder dairy industry.

The overall objective of this project was to contribute towards improved milk production among smallholder dairy farmers in Malawi. This would be achieved through the introduction of two innovative solar-powered dairy production technologies (i) solar-powered milking machines and (ii) solar-powered water supply systems. These two technologies are neither available in the local market nor used in the smallholder dairy industry. The specific objectives of the project were to: (i) assess the suitability of the proposed solar-powered dairy production technologies for smallholder dairy production systems in Malawi, (ii) evaluate the quantity and quality of milk produced after the introduction of the techniques, (iii) assess the socio-economic and gender impacts of the technologies, and (iv) promote the uptake of the technologies among smallholder dairy farmers in Malawi.

With support from a public-private partnership (PPP) arrangement supported by the Science Granting Councils Initiative and the Malawi National Commission for Science and Technology (NCST), the project was implemented in collaboration with Orifice Irrigation and Water Supply Limited.

INTRODUCTION

The use of renewable energy technologies has the potential to increase the productivity of industries and businesses, which in turn can attract further investment and economic growth. The current energy situation in Malawi calls for the adoption and use of renewable energy to spur national development.

Malawi is an agro-based economy where agriculture accounts for 36% of the country's Gross Domestic Product (GDP), 90% of Malawi's export earnings and employs 70% of the active labour force. Despite this, only 25% of the generated electricity is used in the agricultural sector. Smallholder farmers who have no access to electricity dominate the dairy industry in Malawi. This challenge limits their ability to modernise their dairy farm activities (e.g., milking). They also do not have a steady and reliable supply of clean water for watering animals and to maintain adequate levels of sanitation of cows, kraals, and milking equipment. Fetching water for watering animals and cleaning kraals is the most time and energy-demanding activity on smallholder dairy farms in Malawi, and this activity is done almost exclusively by women.

The application of solar energy had not been extended to the smallholder dairy industry prior to the current applied research despite solar energy having been successfully introduced and adopted in other economic sectors.

APPROACHES AND RESULTS

A baseline study was conducted at the onset of the project to capture data on dairy production of farmers from the Chitsanzo Milk Bulking Group (MBG), in Dedza Malawi. Thereafter the process of designing a solar system to power the milking machine, water supply system, and provide household lighting (Figure 1) commenced.

The design of the solar energy powered systems was done in two stages: (a) development of design specifications of milking machines and (b) development of design specifications of the water pumping system.

The designed systems were installed at a dairy farm (Farm B) owned by a farming family belonging to Chitsanzo Milk Bulking Group in Dedza and another at Bunda College Animal Students' Farm (Farm A). A third farm (Farm C) without a solar-powered milking machine was used as a control. The solar-powered milking machine and the beneficiary family in Dedza are shown in Figure 2.

PERFORMANCE OF THE SOLAR-POWERED MILKING MACHINES

Field data collection on machine performance followed the design and installation of the water supply system and the solar-powered milking machine. Statistical analysis of data from the study showed that there were no significant differences between average milk yields per cow from machine milking and those from hand milking at Farm A (Figure 3).

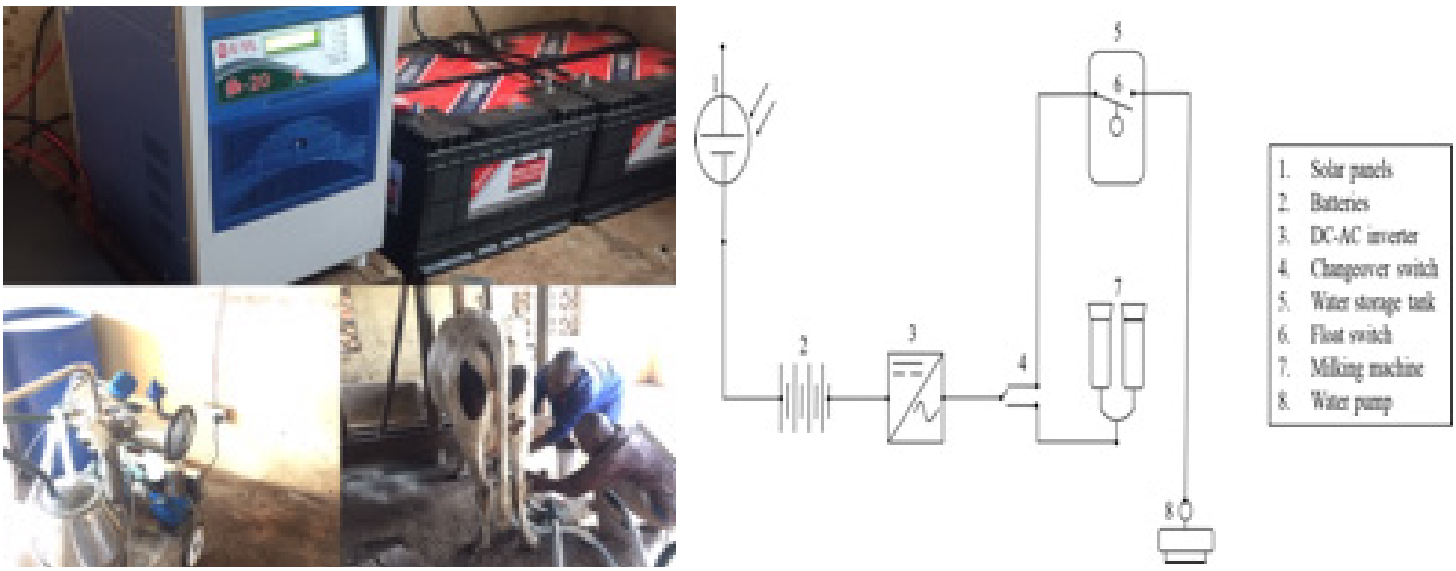


Figure 1: The design for solar technologies and solar equipment

Despite that, average milk yields for four out of the seven cows involved had slightly increased when machine milked while only three cows had slight declines.

The increase in average milk yields for the four cows in Figure 4 agrees with results from Farm B, where the farmer reported an approximately 20% increase in milk yield. At this farm, a cow provided an average milk yield of 10 litres when hand milked and 12 litres when machine milked.

On hand milking time, the farms with solar milking machines (SMM) had the lowest milking time per cow, while those that only used manual milking (MM) techniques had the highest. (Figure 4). The disparities in milking times may be attributed to different levels of expertise among milking personnel and the behavior of cows. Some cows were aggressive and, therefore, difficult to milk.

Machine milking at Farm A was relatively faster than hand milking, as can be observed from Figure 5. The Figure shows that machine milking resulted in time saving ranging from 32 to 58% across the seven cows earmarked for the study at this farm.

A similar phenomenon was observed from Farm B, where the time saved from machine milking wAs 51%. The results from the two farms imply that machine milking is a timesaving technique compared to hand milking.

The quality of milk obtained using the milking machines was excellent, as evidenced by the zero milk rejections experienced during the study period. Visual assessment of the milk by the bulking group farmers and the project team also indicated that the quality was good.

BENEFITS OF THE SOLAR-POWERED WATER PUMP

The study showed that the introduction of a solar-powered water pump at Farm B greatly reduced the amount of time spent fetching water for the dairy farm. This outcome was due to a reduction in the distance to the water source and in the time spent at the water source because the farm was initially using a communally owned borehole (hand pump).

The watering point for the dairy cattle was reduced from approximately 100 metres to less than 10 metres. Most farmers (81% of the respondents) at the milk bulking group previously used boreholes (apart from shallow wells and streams or rivers) as a source of water for their dairy farms. 84% of the borehole users reported that their farms were less than or about 0.5 km from the water source while16% reported an average distance of 1 km (Figure 6).

Figure 2: Solar powered milking machine

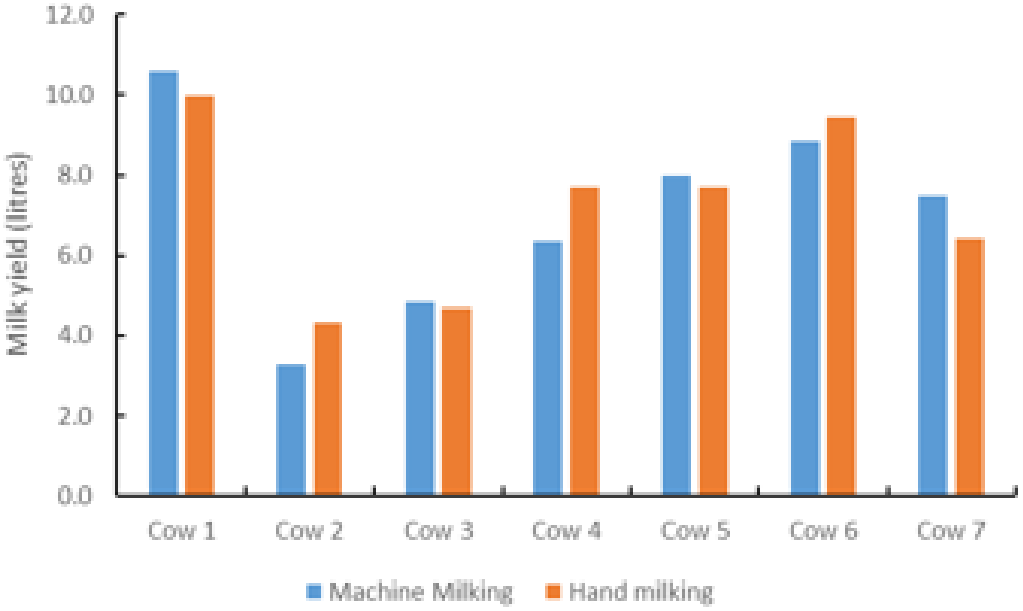


Figure 3: Comparison of milk yields under two milking techniques

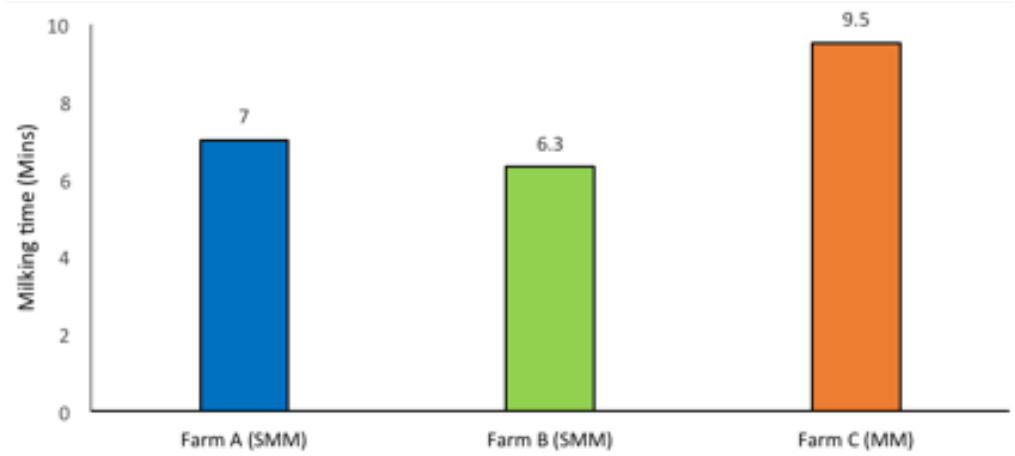


Figure 4: Average hand milking times per cow on three farms

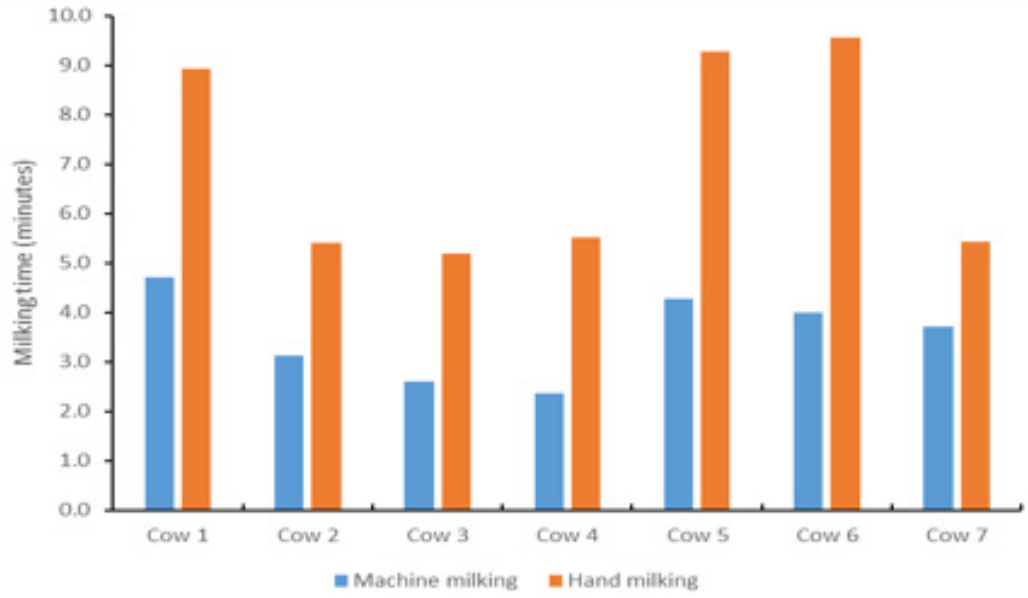


Figure 5: Comparison of milk yields under two milking techniques

Apart from the variations in the distances to the boreholes, the farmers also stated that they were communally owned. This resulted in congestion at the water sources, which increased the time spent by each user to fetch water. The average distance between the wells and the dairy farms was reported as 100m, while distances to streams or rivers ranged between 80 and 2000m. The introduction of the water pumps on the respective farms could significantly save time that could be used for other equally important economic activities.

It was also noted that most of the water fetching task was done by women so the introduction of water pumps could release them to take care of other dairy farm and domestic chores.

IMPLICATIONS OF THE SAVINGS ON GENDER

The study showed that women handled more dairy farming activities (52%) in Dedza compared to men (48%). It was further found that on Farm A, the females were assigned the role of fetching water while males gathered feeds and other activities. On Farm B, just like other dairy farms owned by the milk bulking group members, women were not only responsible for fetching water but also other farming activities and domestic chores. Thus, the introduction of water pumping systems on dairy farms could significantly create time for other activities.

The dairy farmers under the milk bulking group reported that men performed 83% of milking operations and 17% was by women. The low percentage of women participation in hand milking could be a clear indication that hand milking is gender insensitive. The farmers interviewed in the study reported that hand milking was labour-intensive and time-consuming, thereby affecting other farming and household operations.

The introduction of milking machines would probably increase the number of women carrying out milking operation as observed at Farm B, where the woman could be seen operating the milking machine. This implies that there would be no disruptions in milking if the man is unavailable or unwell. Furthermore, the introduction of the milking machine would reduce the amount of time spent on dairy farming activities by those women who are currently involved in hand milking. This would release the time saved to other equally important activities that the women do.

SOCIO-ECONOMIC IMPACT OF SOLAR-POWERED MILKING MACHINES AND WATER PUMPS

The time-saving benefit to be realised by the introduction of solar-powered milking machines and water pumps could improve the economic status of the dairy farmers nationally. The time saved could also be utilised in other farming activities and economic activities that members of the farming household could embark on. Introduction of solar-powered milking machines and water pumps will also ensure that milk production is not halted when men are unavailable because women can use the milking machines. This will ensure a steady economic standing by the farming family. Improvement in the economic status of the farming families would have a positive bearing in the fight against deforestation and other similar activities that degrade the environment.

Another benefit is that the farmers would be able to use the electricity for other purposes, such as to power televisions, charge cell phones,

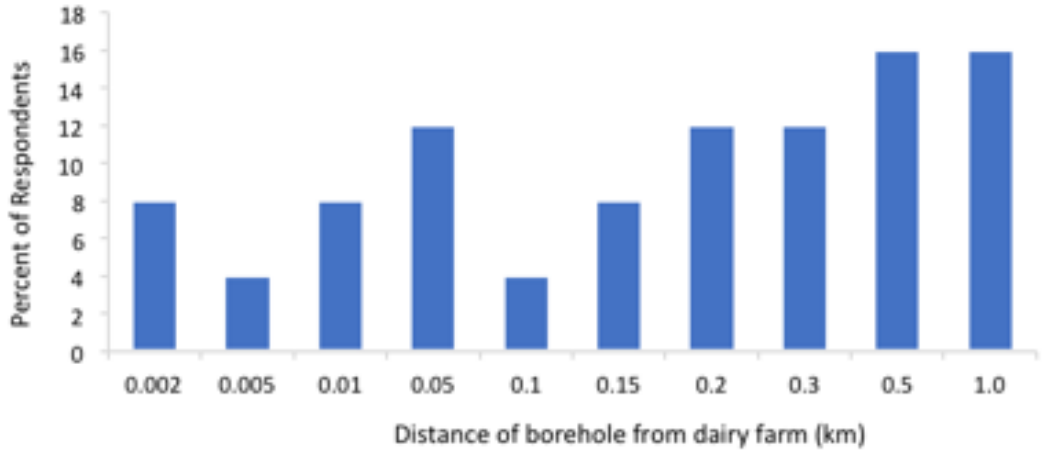


Figure 6: Estimated distances from the dairy farms to boreholes


Figure 7: Solar PV and the water storage tank

lighting, and other uses as evidenced by the beneficiary family of this project. Utilisation of solar energy will also help minimise the accumulation of greenhouse gases as a result of using firewood, charcoal, diesel, and petrol to provide heat and electricity. Another positive bearing on the economy is that the country would spend less on mitigation measures of environmental degradation and the impact of air pollution resulting from the burning of firewood, charcoal, and fossil fuels.

IMPLICATIONS AND RECOMMENDATIONS

The research project was aimed at increasing agricultural productivity on dairy farms. It also addressed the need to minimise environmental degradation caused by the use of paraffin lamps, firewood, and diesel or petrol generators for purposes of heating and lighting for the farmer and livestock.

The introduction of solar-powered systems on dairy farms would help reduce the time spent by farmers to milk and fetch water, relaying it to other economic activities.

The introduction of solar-powered systems to dairy farms has secondary benefits such as, the use of solar electricity for lighting instead of paraffin lamps, and the provision of electric power for televisions, charging phones, and other appliances. The beneficiary farms have experienced these benefits under the current project.

Decrease in milk rejection rates at the selling centres will also help to improve the economic status of the farming family. The use of machines prevents contamination of milk by dust, animal fur, and sweat from the operator because the milk is not exposed to the open environment as it goes directly into the milk container from the animal teat through a pipe. This is in contrast to hand milking, which exposes the milk to the open atmosphere, thus significantly affecting the quality due to exposure. The milk bulking group members and the project team visually assessed the two and confirmed that hand milking often resulted in impurities in milk. Another positive thing is that, after testing the chemical and physical properties of the milk, the bulking group gave the milk a clean bill of health.

The use of solar-powered groundwater pumps on a dairy farm also ensures a steady and easily accessible water supply. Milk production requires an abundant supply of clean water for hygiene and watering the cows so that they can produce enough milk. Dairy farmers usually travel long distances to fetch water that is often unsafe because it comes from unprotected open wells, ponds, and streams or rivers. These water bodies are exposed to the open environment and are easily contaminated by people, livestock, surface runoff, and dust.

The introduction of solar-powered systems at the dairy farm also reduces reliability on the national electricity grid because it cannot meet the demand for lighting and other uses on dairy farms.

The national grid electricity also faces frequent blackouts as a result of inadequate water in the Shire River, trash accumulation and siltation at the power plant. On the contrary, solar-powered electricity is not subject to these challenges; hence its availability is guaranteed all year round. The introduction of solar-powered systems to dairy farms also contributes towards the achievement of the Malawi Growth and Development Strategy (MGDS) III of increasing access to electricity in urban and rural areas. The MGDS III recognises energy

as the lifeblood of the economy as it serves as a crucial input into all critical social and economic services. Hence, the introduction of solar-powered technology into the dairy industry is a step in the right direction towards the achievement of this essential government development strategy.

RECOMMENDATIONS

The current prices of solar-powered equipment and other accessories could hinder the adoption of this innovation on dairy farms. In this regard, deliberate effort needs to be taken towards ensuring that the introduction of solar-powered technologies in the dairy industry is enhanced. Such efforts could include:

Fiscal and tax incentives

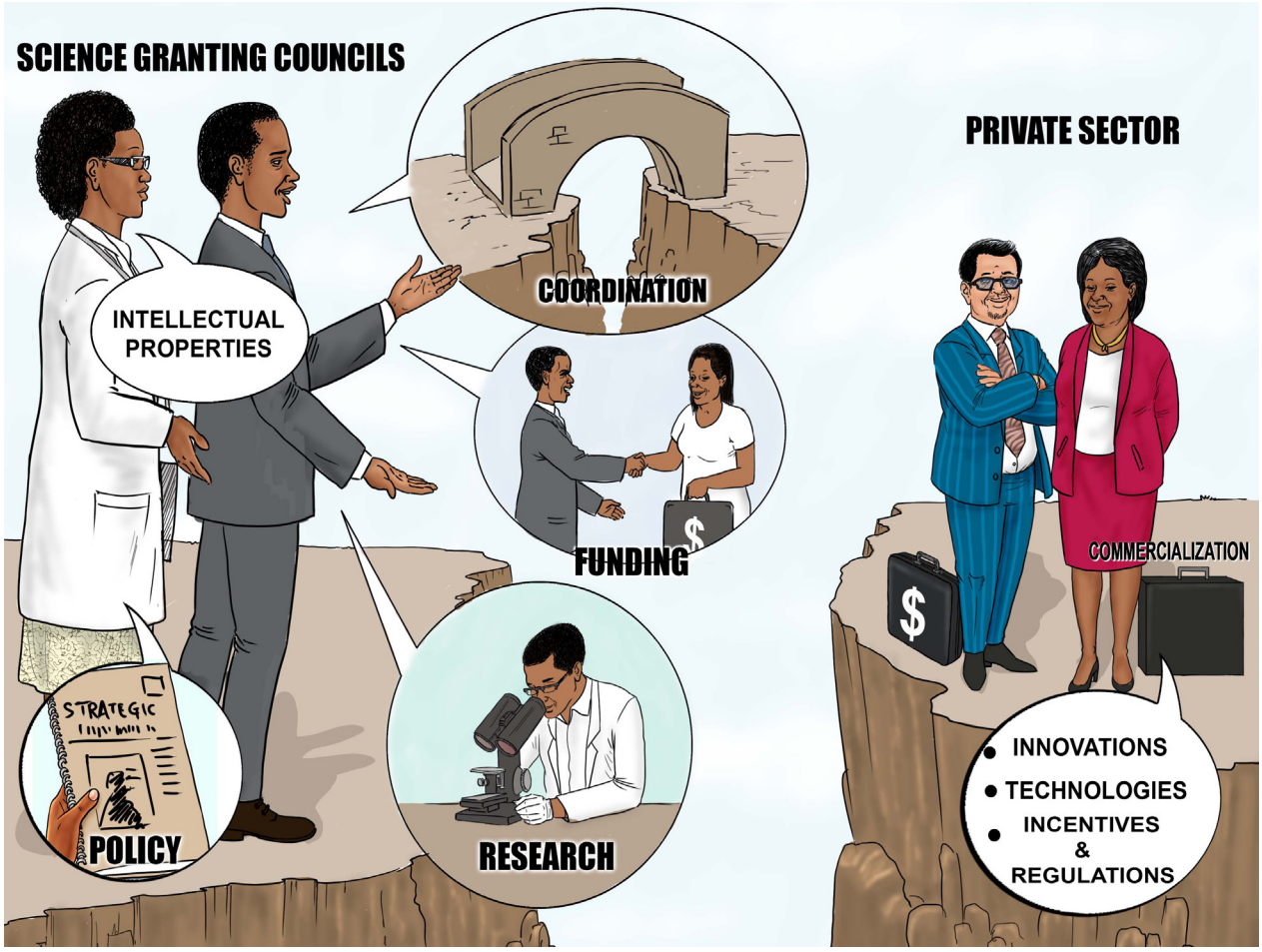
- Farmers should organise and mobilise themselves to lobby for the provision of subsidies or reduction/ removal of taxes on equipment needed for the installation of solar-powered systems on dairy farms. This would increase the adoption of the innovation because it could make the equipment more affordable to the smallholder dairy farmers.
- The Malawi Government needs to encourage adoption of solar-powered technologies on dairy farms by putting in place administrative and monetary policies (e.g., subsidies on solar-powered equipment and accessories installed on dairy farms) that would create an enabling environment for the adoption of such technologies.

Initiate revolving fund and loan schemes

- Introduction of revolving fund loan schemes to milk bulking groups whose farmers have shown interest in owning such systems. These schemes could be financed through the milk bulking groups who already have experience in managing loans for their members.
- For the proposed revolving fund loans to be attractive and achieve the intended purpose, the financing agency may need to charge affordable interest rates to avoid limiting access to the loans.
- Government and non-governmental organisations could facilitate the creation of revolving fund loan schemes. This can be done after thoroughly assessing and building the capacity of the milk-bulking group in managing revolving funds.

Role of government and other actors

- The government and non-governmental organisations need to take an active role towards enhancement of adoption of the solar-powered technology in the dairy industry to contribute towards the achievement of the MDGS III in the energy sector.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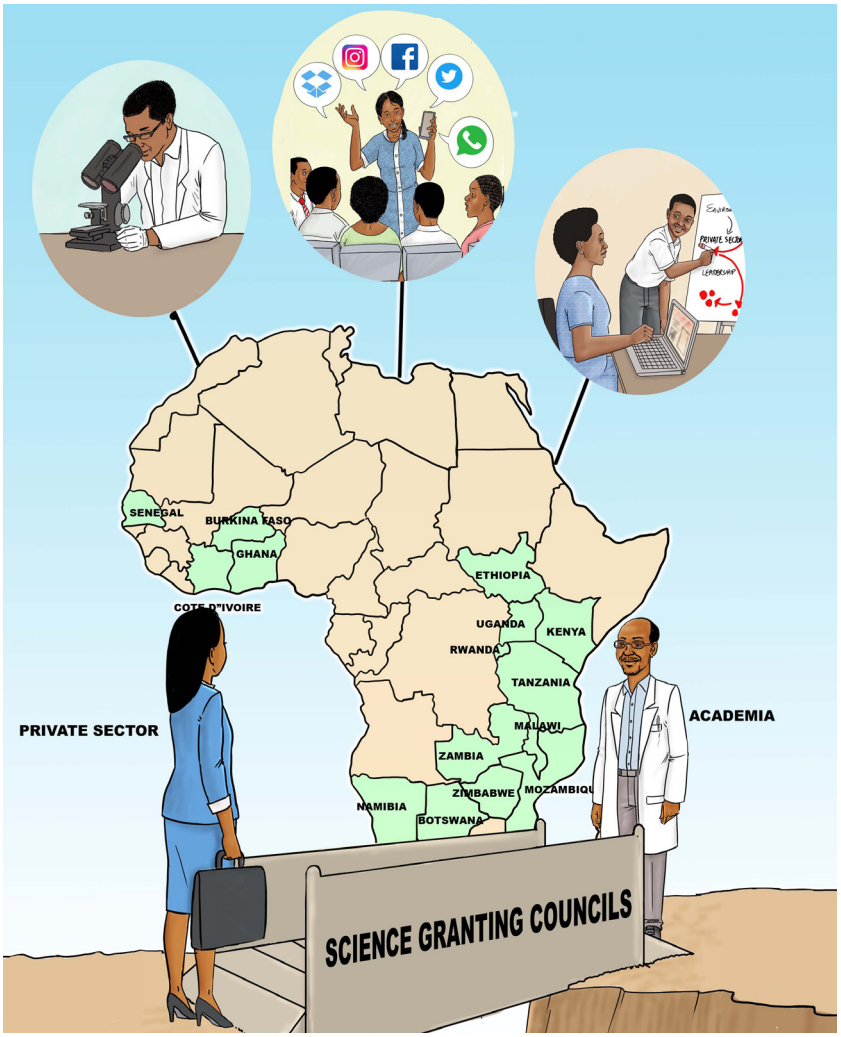
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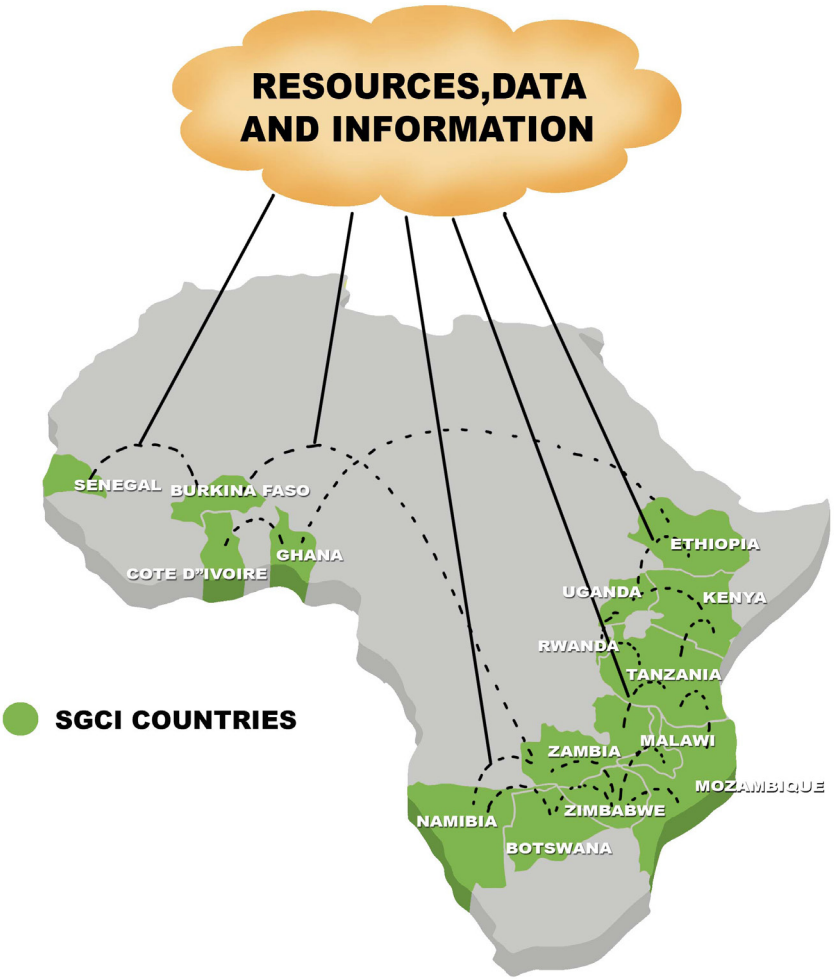

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