

## STRATEGIES FOR INCREASED UTILISATION OF NEW PROPOLIS PRODUCTS IN UGANDA

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### EXECUTIVE SUMMARY

Propolis, a gum collected by bees to seal its hive has numerous medicinal values. It is one of the untapped high value bee products that is under exploited by Ugandan beekeepers despite its economic value.

This policy brief highlights the potential of the product prototypes developed under the bee propolis project to stimulate private sector investment and general market response. A cross sectional study of mixed methods research approach combining field surveys and laboratory analysis was conducted. A total of 112 beekeepers and 199 potential consumers were interviewed across four regions in Uganda. Four hundred kilograms of propolis were collected from four regions in Uganda and processed into powder and tea bags. The new product prototypes were then introduced to stakeholders after which perception and willingness to purchase was assessed.

This study reveals beekeepers have the potential to produce between 325 to 870 tons of crude propolis annually earning up to US\$1.3-3.5 million. This income is currently lost due to poor organisation.

### INTRODUCTION

Part of the limitation to high income generation by beekeepers lies in limited product diversity. Over 80% of Ugandan beekeepers harvest honey and beeswax but only 1% venture into commercialising propolis (Amulen, 2017). The rest (99%) do not attempt to harvest crude propolis from the beehives.

Propolis is a gum collected by honeybees from plants (Santos, 2012). This rather neglected product from Uganda has gained global interest from the scientific community due to growing evidence of their beneficial pharmacological properties (De Lima et al., 2016; Regueira et al., 2017; Santos et al., 2008). Propolis has been documented to have antioxidant, antiviral, antibacterial and immune boosting properties (Ahuja & Ahuja, 2011; De Lima et al., 2016; Viuda-Martos et al., 2008), leading to increased application of propolis products in the treatment of cough, wounds as well as immune boosting (Santos, 2012).

In Uganda, crudely prepared ethanol extracts in form of propolis tincture is the only product in the market. However, the processes involved in the preparation of such crude extract remains unstandardised, hence raising serious quality and public health concerns. Similarly, not every prospective buyer of propolis tincture consumes ethanol, thus affecting the market penetration and value of Uganda's propolis products.

Propolis and its related products have the potential to generate higher revenues compared to conventional products such

as honey. For example, a beekeeper can earn US\$34 per kg of propolis (data from this study) compared to US\$6 to US\$7 per kg revenue generated by honey (Aemera, 2014). One of the major constraints to increased utilisation of propolis and its products is limited knowledge on production, processing and market potential.

In a bid to stimulate private sector investment within the propolis value chain, this study sought to:

- Document the current production potential, processing and uses of propolis.
- Develop new propolis products.
- Assess the market potential and consumer attitudes towards the new products.

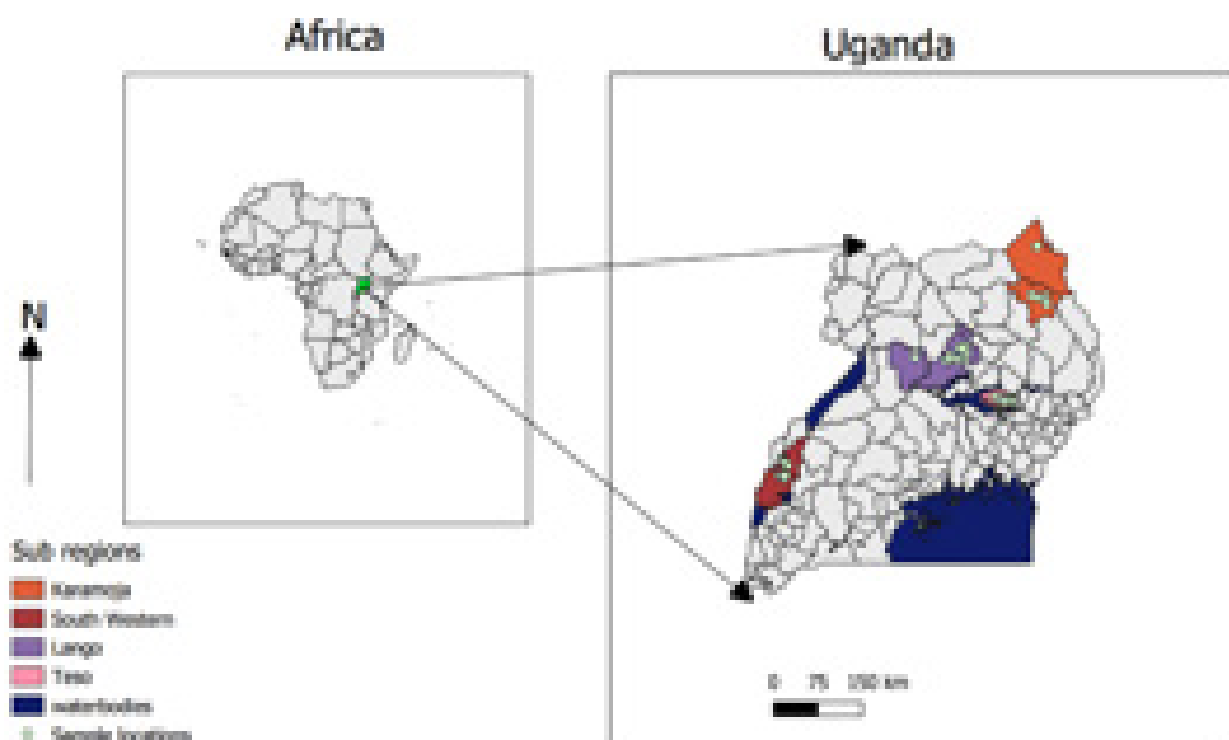
Overall this study presents two new propolis products in the Ugandan market with high demand and market potential. However, sustainable supply remains low, partly exacerbated by anthropogenic and environmental factors in beekeeper dominant areas of Uganda.

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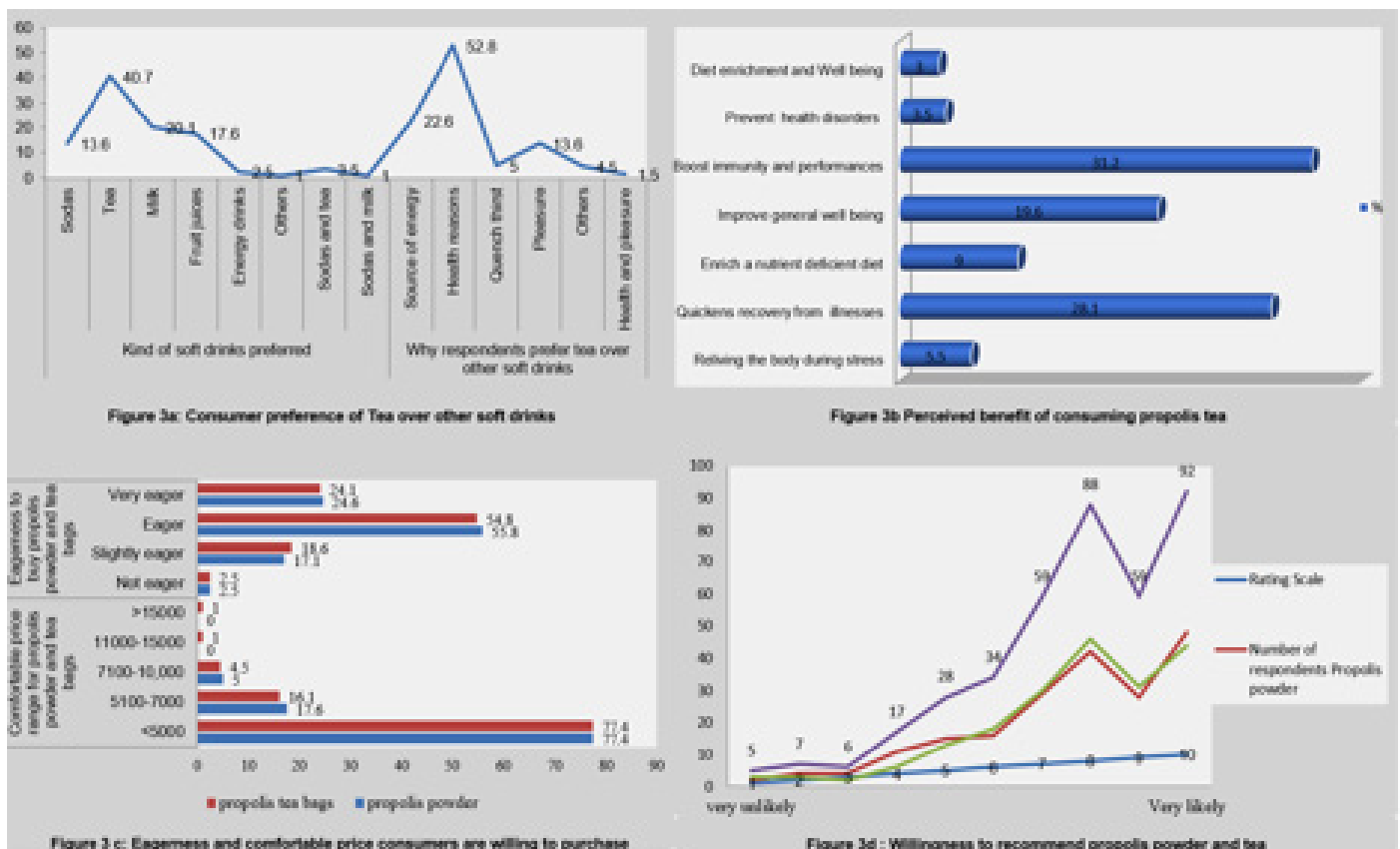
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**Figure 1:** Map of Uganda showing the location of beekeepers surveyed



**Figure 2:** Raw propolis in pot hive and developed products from propolis



**Figure 3:** Consumer preferences and willingness to utilise propolis powder and tea

## APPROACHES AND RESULTS

### Approaches

Mixed research methods were applied to capture data: Two field semi-structured questionnaire surveys and laboratory development of new product prototypes was done:

#### a) First Survey

One hundred and twelve (112) beekeepers across four regions of Uganda (Figure 1) i.e. Mid northern (Lira district) n= 43, Eastern (Soroti) n = 33, South western (Bunyangabo) n = 18 and North Eastern (Karamoja) n = 18 were interviewed. The list of beekeepers was obtained from the Uganda National Beekeepers Association (TUNADO) and the study participants were randomly selected. Information captured included production potential, processing and uses of propolis.

#### b) Second Survey

One hundred and ninety nine (199) potential consumers of propolis within Kampala City were interviewed. Participants were purposively selected

based on age groups, income levels and family sizes. Majority (61% n= 199) of the respondents were female because women are responsible for most domestic purchases of food items. Two clusters of monthly income levels were included i.e. low-income earners (36.2%) with a monthly income between US\$58-166 and high-income earners (31.2%) above US\$166. Other perceptions about the propolis tea and powder were captured during the honey week, an annual event for all bee stakeholders in Uganda organised by the project partner TUNADO.

#### c) Laboratory product prototype development

Four hundred (400) kg of raw propolis was purchased through the network of the private sector partner. Thereafter, the propolis powder and tea bag was developed at the Research Center for Tropical Diseases and Vector Control (RTC) Laboratory at Makerere University. The propolis processing steps were documented and knowledge shared with the members

of TUNADO. The data captured was analysed using statistical Package for the Social Sciences (SPSS) 22 and the results summarised into percentages and displayed in figures and texts. Pictures of the activities were also taken.

### Results

#### Estimated propolis production and revenue potential

The current level of production of propolis in the country is below the estimated potential. During collection of the raw material for product prototype development, the team took eight months to generate the 400kg by contacting all producers in the country. Yet, if all beekeepers are mobilised to collect propolis the country can produce between 325 to 870 tons of propolis annually. The current farm gate crude price of propolis is US\$4 per kg, meaning by not harvesting propolis beekeepers lose up to US\$1.3 to 3.5 million annually in revenue.



Figure 4 a) The masters' student Ms Immaculate Nakabugo and Laboratory Technician Mr. Joel Mukwaya explaining the products to His Excellency the President Yoweri Kaguta Museveni as a result the project team was invited to state house for to discuss further commercialization plans of the products to mitigate food insecurity and employment on 25th September 2019

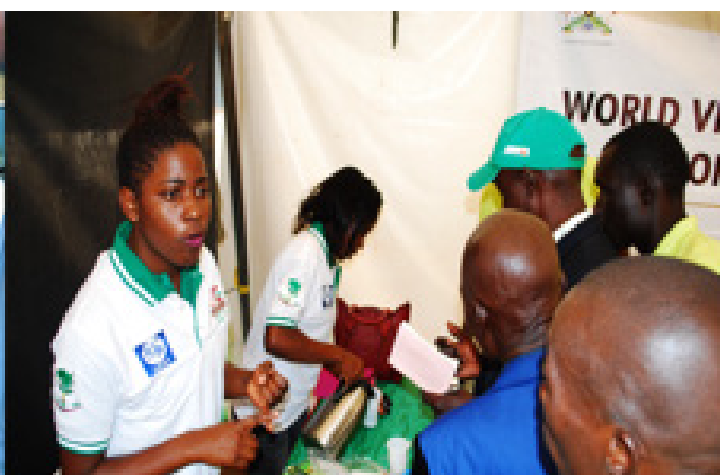


Figure 4 b) The masters' student Ms Immaculate Nakabugo explaining the product prototypes to farmers and the advantages these products may offer during the honey week from 18<sup>th</sup> to 31<sup>st</sup> August 2019.



Figure 4 c) Dr. Deborah Ruth Amulen (PI) on 31<sup>st</sup> August 2019 explaining the importance of propolis products to stakeholders in the beekeeping sector, an annual event of beekeepers, policy, extension workers, private investment and consumers.



Figure 4 d) Dr Deborah Ruth Amulen (PI) explaining the product to the Minister of State for Animal Industry (Joy Kabatsi in maroon sweater). In the picture the Chairman board TUMADO (Dr. Robert Kajobe –blue coat), Executive director TUMADO (Mr. Dickson Biryumunasho – maroon tie) and President Apimodia Regional Commission for Africa –(Mr David Mukwesera in grey coat)

**Figure 4a-d:** The project team sharing information about the products to policy, community and private sector stakeholders



Figure 5: Dr. Patrick Vudriko (Co-PI) and Dr. Deborah Ruth Amulen (PI) from the RTC Laboratory (Research Centre for Tropical Diseases and Vector Control) CDVAB briefing the university council chairperson Mrs Lornah Magara (stripped black and white coat) and her Deputy Hon. Daniel Fred Kidega (Black coat) about their research project that seeks to commercialize Bee Venom & propolis to improve the financial capacity of rural beekeepers. The council was exceedingly delighted about college Engagements with the public through such Research measures.

**Figure 4:** The project team and council chairpersons of Makerere University

Through value addition they can double these revenues. The above revenue estimates are based on available statistics. The total beehive population in Uganda is estimated to be between 747,220 (UBOS & MAAIF, 2009) to 2 million (Kilimo Trust, 2012). Most (87%) of the beehives owned by beekeepers are traditional (UBOS & MAAIF, 2009) meaning that there are between 650,000 to 1,740,000 local beehives. Propolis is used by honeybees to seal cracks, thus more propolis can be collected from local hives.

The most common method of collection is scrapping using knives from the hive. Our field propolis collection data showed each hive is capable of generating an average of 0.5 kg per local hive per season. For each 150g of raw propolis, 17g of pure propolis powder is recovered upon processing. The low yield (11.3%) of processed propolis is due to manual shaking but the quantity can be increased by using automated mechanical agitator.

#### ***Types of propolis based products and uses before the project intervention***

A survey of 112 beekeepers across the country revealed raw propolis and tincture as the only product on the market before development of propolis powder and tea bag developed through the propolis project (Figure 2e and f). Most of the people (42%) used propolis tincture to treat coughs, 'flu' (common cold) (31%) and to boost immunity (28%). For the first time, this project has documented two colours of propolis powder, the red and dark (Figure 2b and c).

Evidence from other countries like Brazil that have documented two colours of propolis, has indicated that composition and medicinal properties vary by colour (Regueira et al., 2017). This means that the situation could be similar in the Ugandan case. The red propolis was mainly from Karamoja. The processed powder (Fig. 2b-e) can

be used as a raw material for a wide range of food, medicinal and cosmetic products. For example, it can be infused with tea and packaged in tea bags (Fig.2f) or sold as tined propolis infused in tea granules. In the propolis tea bag prototype, 200g of tea is infused with 5g of propolis. Further research on chemical composition and pharmacological benefit of the two types of Ugandan propolis is recommended.

#### ***Market potential and consumer attitudes towards the new products***

A market survey revealed that most respondents perceived tea as a healthy drink (52.8%) while others drink it as a source of energy (26%) (Figure 3a). This perception towards tea by the respondent makes it easy to predict that propolis infused tea bags can be easily marketed. All consumers were willing to utilise propolis powder and tea bag, with majority eager to try the products (Figure 3c). This was made easy due to perceived immune boosting and healing properties of propolis (Figure 3b). For instance, all consumers were more likely to recommend the product to another consumer (Figure 3d). The challenge was that consumers were only willing to buy a tea bag at US\$2, which is lower than the profit margin meaning that the investor may have to find mechanisms to lower production costs to increase their return to investment.

#### ***Policy engagement and capacity building***

Information on the potential of the new products prototypes was widely disseminated and feedback on the potential of these prototypes in addressing national development needs were sought from the public, private and community. The results showed that there is potential and great interest among stakeholders for new opportunities to emerge and for the project team to further explore and develop more high value products from honeybees. For example; On 25th September 2019 the project team participated in an

exhibition entitled '*Enhancing of youth involvement in agriculture to mitigate increasing food insecurity and unemployment in Uganda exhibition*' organised by Makerere University.

They got an opportunity to explain the new product prototypes to the Chief Guest who was H.E. Yoweri Kaguta Museveni, the President of the Republic of Uganda. The team was later invited to State House to explain further how this high value yet underexploited products could be integrated into the National Development Agenda. H.E the President was particularly excited that scientists had identified a product that would otherwise be abandoned to make high value products that contribute to income and youth employment (Figure 4a).

As a result of sharing the great milestones from this project with the Minister of State for Animal Industry, TUNADO Board and Executive, as well as the international beekeeping governing body representative for Africa (President Apimodia-Africa), The PI- Dr. Deborah Ruth Amulen has been elected President Regional Working Group for honey and hive products value addition for Africa to share the experiences with other African countries on how to stimulate private sector investment through research (Figure 4d).

Finally, this project has contributed towards the visibility of the RTC laboratory among top Makerere University Management, that were impressed by the role of the team in increasing university engagement with the private sector (Figure 5).

Through this project we have been able to directly train 20 beekeepers on hygienic propolis harvesting and storage. We have also shared information on possible business opportunities for over 1,000 stakeholders through exhibitions and direct involvement. The project has also trained a master's student to



increase the capacity of the laboratory technicians at RTC laboratory to generate the new product prototypes. During fieldwork, one undergraduate student was engaged in field sample collection, hence increasing their confidence in working with bees.

## **IMPLICATIONS AND RECOMMENDATIONS**

### ***a) High demand low supply***

The demand for propolis is expected to increase exponentially due to diverse application of pure propolis in varied product lines such as tea infusion, pro-biotic ice cream, cosmetics, and pharmaceutical preparations. There is need to mobilise producers through increased awareness to produce more quality raw propolis to feed the emerging cottage industries. Beekeepers need to be continuously trained on proper collection and storage if they are to increase the volume of propolis produced at farm level to meet future demand.

### ***b) Equipment***

During this study, we noticed that yield per hive for crude propolis could be increased if specialised equipment for harvesting propolis from traditional hives was designed. Currently, available equipment is designed for the Langstroth machine (Bankova et al., 2016) a European situation, yet 80% of beekeepers use Kenya top bars and log or pot hives. Therefore, we propose innovation of a new beehive that blends attributes of both traditional and modern hives. This new beehive technology will enable a bee farmer to harvest more propolis, while simultaneously maximising honey production at the same time.

### ***c) Processing***

Processing of propolis is equally challenging, we have observed that the yield of pure powder is dependent on the particle size where smaller particles yield more powder and level of manual agitation. This means that the current technology cannot

support processing of large volumes of propolis. This presents opportunity to innovate and design a specialised industrial cottage crashing and semi-automated agitation and solvent evaporation (industrial rotatory evaporator) equipment for crashing and shaking large volumes of raw propolis respectively. This innovation will significantly increase the yield and the monetary value of raw propolis per kilogram.

At the laboratory, there is need to build capacity through specialised equipment for product development such as, composition analysis (high pressure liquid chromatography machine), granulating among others. This is expensive equipment but essential in future development of proposed products.

For private sector investors, the innovated equipment needs to be affordable and easy to manage for them to adopt and integrate it into their current businesses.

### ***d) Standards***

Propolis tea bags and powders are new products in the Ugandan market and East Africa, meaning that licensing could take longer than expected since the Uganda National Bureau of Standards (UNBS) does not have standards. There is need for the team to partner with the Uganda National Bureau of Standards to develop the necessary standards against which the private processors will be evaluated while benchmarking standards developed for similar products elsewhere like Brazil (Regueira et al., 2017).

### ***e) Further research***

This initial study has generated more questions that need further investigation in research and product development. For example, we now know that Uganda has the red and black propolis, however, the composition and pharmacological benefits of the two types and their plant sources remain unknown.

Aspects that are key for product information and conservation of the plants that produce these types.

In Brazil it has already been revealed that there is variation in pharmacological activity of red and black propolis (Regueira et al., 2017) as to whether the same scenarios exist for Uganda is yet to be documented. Aspects on the shelf life of the developed products, safety aspects including risks of heavy metal contamination or pesticides due to increased environmental contamination also need to be investigated to ensure consumer safety.

Last but not least, there is also need to investigate if these products have applications in livestock health especially poultry and piggery, which tend to use a lot of antimicrobials hence contributing to global agenda of minimising antibiotic resistance resulting from heavy use in management of common ailments in these livestock. Such research will create more avenues for commercialisation of the new product.

### ***f) Intellectual property***

The team has not concluded on the intellectual properties of the products because the memorandum of understanding between Makerere University and its partners was still under review by the University Legal Team, a process that takes time. The research team also received support from the Ugandan National Council of Science and Technology, an opportunity that they plan to fast track. Delay in utilising this opportunity arose from long discussions among partners, on how to benefit from the intellectual property. The University Legal Team is helping on this aspect but they need financial, technical and capacity building support on how to conclude this output and protect future outputs.

### g) Private sector investment and commercialisation

The team has appreciated the importance of joint research initiative between academicians and private sector as it develops impactful research that addresses local needs.

Lesson from this project is that the outcomes are readily accepted by communities and all parties involved learn. The remaining challenge is the training of individuals on product processing, establishment of a product development mini-factory to continue incubating and upscale research innovations while offering opportunities for employments and income generation.

### CONCLUSION

This study has established that by not exploiting propolis the beekeepers are losing between US\$1.3 to 3.5 million from crude propolis sales with potential for higher incomes after value addition to new product prototypes.

Second, within the current hive investments there is potential to increase production of propolis from 400kgs to 870tons annually through mobilisation of beekeepers. Marketing of propolis locally may not be a challenge since demand for the products prototypes exists beyond the versatile applications of propolis in human and animal health aspects that can be explored through further research.

Therefore, to maximise these new opportunities and increase beekeepers' income and improve human health, we propose that the following aspects be addressed:

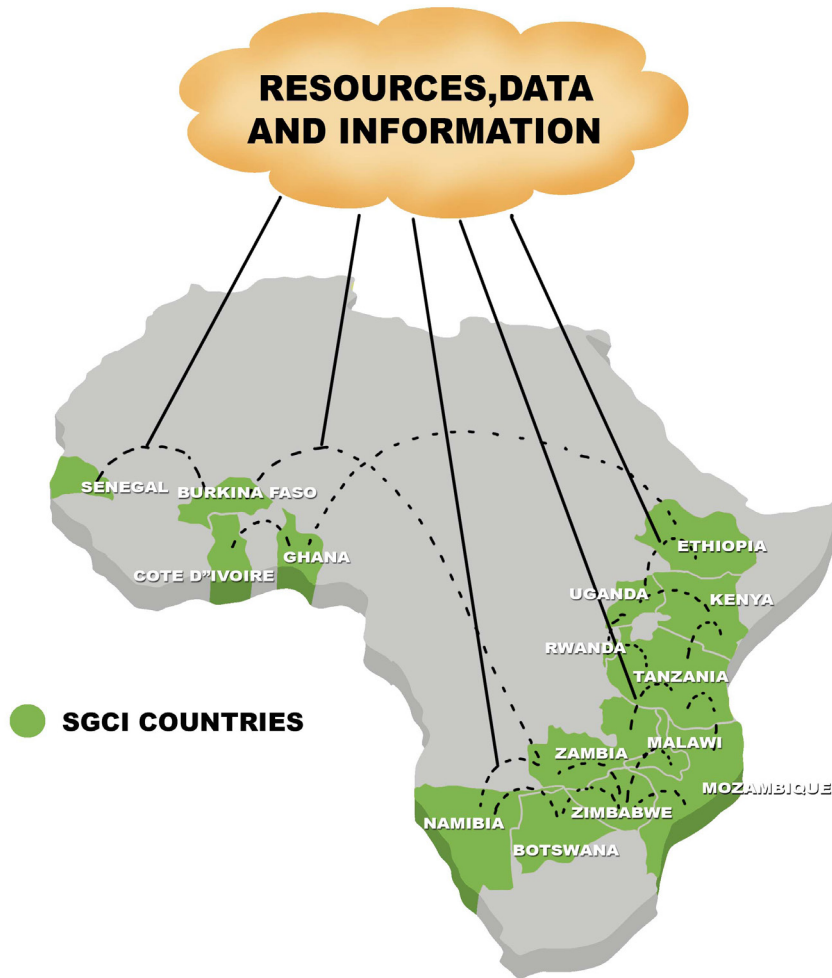
- Increase supply of raw material
- Address equipment roadblocks
- Develop standards
- Conduct further research
- Build team capacity in intellectual property management as patents and similar opportunities arise
- Invest in a mini-processing factory for small medium entrepreneur incubation

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