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ASSESSMENT OF SERICULTURE TECHNOLOGIES AND INNOVATIONS FOR ECONOMIC RECOVERY FROM COVID-19 PANDEMIC IN UGANDA.

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Abstract.

No country was left untouched with outbreak of COVID 19 pandemic. The first confirmed case in Uganda was reported on March 21, 2020. A total of 39,860 people were confirmed with the disease, 14,440 recovered and 327 died by February 9, 2021 in the same country. To reduce spread of the disease, a country lockdown was enacted with most of the economic activities shut down. The citizens lost job and businesses were disrupted due to breakdown of supply chain, demand reduced for goods and liquidity dried up both locally and globally. Economic gap was created with accumulated public debts amidst no hope for COVID-19 to end soon. The most worrying is the chances that more aggressive epidemics will break in future due to the continuous mutation of the disease causing agents. There is urgent need to innovate and use technologies that can sustain economic recovery in the face of pandemics. Sericulture played a big role in the livelihood of some of the community members in Uganda during COVID-19 lockdown. The cost benefit analysis for sericulture, a new technology in Uganda, was compared to other commercial agricultural activities done during COVID-19 lockdown of the country. Their viability for economic recovery was assessed based on the monthly returns per famer. Sericulture technology and innovation was found to be the most potential for sustainable economic recovery from COVID-19 pandemic and future epidemics in Uganda.

Key words:

Sericulture Technology and Innovations, economic recovery, COVID 19 pandemic Uganda.

Background.

No country was left untouched with outbreak of COVID 19 pandemic. The first confirmed case in Uganda was reported on March 21, 2020. By the time of writing this paper, a total of 39,860 people were confirmed with the disease, 433 active cases, 14,440 recoveries and 327 deaths registered (MOH ,9/2/2021). To reduce the spread of the disease, most of the economic activities of the country were shut down during the lock down of the country. Many Ugandans lost job and many businesses were disrupted due to breakdown of supply chain, reduced demand for goods and liquidity dry up both locally and globally.

The economic activities that went on uninterrupted during COVID 19 lock down were mainly agricultural activities that produced food for subsistence. Most people got involved in subsistence farming to produce staple food fruits and vegetables. The reason for continuity of these activities was that; social distancing was maintained, activity was done in open space and the participants remained active to boost their immunity. Some industries were allowed to operate especially those that produced essential goods like fuel, salt, soap, sanitizers, medicines and packed food to mention but few. Despite these activities, the economic crisis continued to deepen with 65 percent of the population affected, 9.1 percent loss in GDP (Younger et al., 2020). Demands for essential goods increased, liquid cash reduced and supply chain of goods were disrupted.

The government partially lifted the COVID 19 Country shutdown to allow some of the businesses to recover from the crisis created, though to no avail. The fact is, an unfilled economic gap was created, public debts accumulated and there is no hope for COVID 19 to end soon. There are also chances that more aggressive epidemics will break in future due to the continuous mutation of the disease causing agents. There is need to strategize for sustainability and resilience of economy of Uganda and the world at large in the face of the current and future pandemics.

Introduction of sericulture in Uganda has played a big role in the survival of some of the community members in the country during COVID-19 lockdown. The production and processing of silk from silkworm involves the art and science of rearing silkworms by feeding them on plant materials like leaves of mulberry, oak tree and other plants species. The mulberry tree *Morus alba L*. originated from China 4700 years ago (Heuze et al., 2019). In Uganda, the plant was introduced in 1971 when the Japanese gave mulberry seeds to help establish mulberry nursery for a start of experimental rearing of silkworm at Kawanda research Institute using eggs from Japan. The idea of sericulture and its viability in Uganda and Africa at large was pointed by Mr. Gray, a senior officer at UNDP by then in 1986 (Clet et al., 2020). His recommendation led to the formation of Uganda Silk Producers Association (USPA). Commercial cocoon production began in 1992 when two companies; Uganda Silk Industry limited (USIL) and Inuula Silk Estate limited (ISEL) imported good quality hybrid eggs from Japan, hatched and reared them in their own premises up to the third instar. The silk worms were distributed to the young silkworm farmers to be reared until cocoon production. Fresh cocoons were then collected by the companies and dried up to the time of exporting to the Japanese buyers (Clet et al., 2020).

In 1993 the Uganda Silk Sector Development Project (SSDP) was laid to support a pilot sericulture development and strengthen commercialization of sericulture in Uganda. A pilot sericulture project was operated from 1994 to 1999 and evaluated by European Union (EU) where it was fond that silk project is relevant in Uganda with cocoons produced throughout the year due to the good climatic conditions. Sericulture was also discovered to be promising with high returns for the rural poor (women and youth), enabling them earn monthly income compared to other crops. This prompted the Government to own sericulture project to enhance their agenda of ‘’Prosperity for all” under the ministry of Agriculture, Animal Industry and Fisheries. However, the project collapsed due to mismanagement of fund (Clet et al., 2020).

Despite the challenges of funding, the project had over 400 silk farmers trained in mulberry growing and silkworm rearing. 388 farmers had acquired both knowledge and skills in silk cocoon production (Clet et al., 2020). Cocoon production continued in over 12 districts in Uganda. In the same year 1999, trials on cocoon and silk processing were started on a small 10 multi-end silk reeling machine installed at Kawanda Research Institute. This venture was funded by International Centre of Insect Physiology and Ecology (lCIPE), International Fund for Agricultural Development (IFAD), African Development Foundation (ADF), and Government of Uganda. The success of the silk reeling trial led to establishment of the first silk industry at Rubare in greater Bushenyi District because most cocoon producers were from western Uganda under Bushenyi Silk Farmers Association.

From 2000 to 2016, sericulture suffered challenges of operational funding, policy crisis, technological gaps and lack of supplies for rearing due to the diminishing government priorities towards the activity. In the year 2020, a base line survey was done by Tropical Institute for Development and Innovations (TRIDI) under the title "Baseline assessment of socioeconomic impact of sericulture project on the casual worker livelihood ''. The results showed that 64.1% have increased monthly income level (Clet, 2020.) This also enabled them to meet their daily needs during COVID-19 pandemic lock in Uganda. The farmers that grew mulberry in their fields or reared the silkworm had more monthly returns as evidenced by the cost and benefit analysis of sericulture in the table 1.

Objectives.

The objective of this paper is to assess the potential of sericulture technology and innovations in helping communities in Uganda address the economic crisis in the face of COVID 19 pandemic and sustain economic recovery in future epidemic outbreak.

Problem statement.

The lock down of countries during COVID -19 pandemic made their citizens lose jobs. Many of the businesses were disrupted due to breakdown of supply chains, decreased demands for goods, dry up of liquid cash locally and globally. This led to creation of economic gap with accumulated public debts amidst no hope for COVID-19 to end soon. The most worrying is the chances that more aggressive epidemics will break in future due to the continuous mutation of the disease causing agents. There is urgency of the need to innovate and use technologies that can sustain economic recovery in the face of pandemics.

Methods used.

Archives and profiles of Tropical Institute of Development Innovations (TRIDI) were used to analyse the cost benefits of sericulture. Assorted articles on commercialization of selected cash crops, food crops and Apiculture were also used provided they were done during COVID-19 lockdown, and published in the year 2020. The literature in the archives, profiles and articles was reviewed with focus on potential for economic recovery from COVID 19 pandemic crisis in Uganda. Information from TRIDI was used because they run the project of sericulture commercialization in Uganda. Famers were also interviewed on ways of their livelihood during

the pandemic COVID -19 lockdown focused on their monthly income. The information from the farmers and National Planning Authority was used for selection of other commercial agricultural activities rolled in the whole country. The facts from literature and farmers were compared and conclusions drawn.

Result.

Cost and benefit analysis of Sericulture technology and innovations

Like any other investment, returns on investments are key considering all factors of production; especially land, labour, skills and capital (finance and materials). A small scale farmer needs at least one acre for production of enough mulberries to rear the entire 4-6 cycles in a year. Accessibility to roads, water source and electricity is a must for the success of the project. The activities also require skillful personnel from mulberry cultivation, silk worm rearing, cocoon handling, cocoon reeling up to garment production and design. Planting materials of mulberry tree cuttings are provided locally by Tropical Institute of Development Innovations (TRIDI) and farmers who are out growers. Free technical support and training services are also provided for farmers by TRIDI, Kawanda Research Centre and Iran Agro-Industrial Group at designed established centres.

Farmers interested in rearing are trained to construct rearing house using locally available materials like mud, poles, grass and or straw. The eggs or worms are provided for free by TRIDI or Kawanda Research Centre. The farmers already rearing are also encouraged to share with their fellow famers. The costs and benefits of sericulture depend chain value segments a farmer decides to take on as shown by tables 1, 2 and 3 respectively modified from the profile of commercialization of sericulture technologies and innovations.

Table1: Cost and Benefit analysis per acre of mulberry field in a year

S/No	Particulars	Quantity	Rate	Cost (UGX)	Return(UGX)
	Mulberry field				
1	Inputs (ploughing, cuttings weeding and pesticides			1,313,125	
	Mulberry products				
2	Mulberry cuttings (bags)	150	30,000		4,500,000
3	Mulberry leaves(kg)	16,000	200		3,200,000
	Total Costs and Returns			1,313,125	7,700,000
	Annual net returns				**6,386,875**

Monthly returns are USD142 (UGX 532,240). 1USD = UGX3750

Table 2: Costs and Returns in Cocoon production for rearing 300dfl (6boxes) per 6 cycles a year in established rearing house

S/No	Particulars	Quantity	Rate	Cost(UGX)	Return(UGX)
1	Cocoon production inputs (materials, silkworms, marketing)	01		5,825,000	

2	Maintenance costs (rearing house and equipments)	01		963,000	
3	Cocoon yield (kg)	1080	13,000		14,040,000
4	By-products				702,000
	Total annual cost and Gross returns			**6,788,000**	**14,742,000**
	Net returns per annum				**7,954,000**

Average rearing cycle per annum is 6-8 cycles. Average monthly returns are USD176 (UGX 662,833). 1USD = UGX3750.

Table 3: Annual Returns from raw silk production using automated silk reeling machine (40end) at rate of 20 working days per month

S/No	Particulars	Quantity (Kg)	Price(USD/Kg)	Cost (USD)	Returns (USD)
1	Machinery			186,667	
2	Cocoon procurement (buying, packaging, loading and transportation)			395,472	
3	Processing costs			16,000	
4	Maintenance of facility			7,467	
5	Marketing of raw silk			5,503	
6	Raw silk Sales	16000	50		800,000
7	Pupa	130	15		23,400
8	Waste silk	333.30	10		40,000
9	Defective Cocoon	433	5		25,980
	Total Costs and Gross returns			**611,109**	**889,380**
	Net returns per annum				**278,271**

Net returns per month are USD 23,189 (UGX 86,958,750). 1USD = UGX3750

Using the Bivoltine Cocoon, 1kg of silk Yarn is equivalent to 6kg of cocoons. Therefore, 1080kgs of cocoons harvested from 6cycles of silkworm rearing will give 180kgs of silk yarn (raw silk) per year using our innovations. At an average rate of USD 50/kg of yarn, one acre of mulberry will earn USD 9,000 equivalent to 33,750,000 per annum.

Using the automated reeling machine (40end), Uganda will produce approximately 67kgs of raw silk per day equivalent to 16MT annually at the rate of 250 working days per year.

With total investment of USD 120,000,000 0n 540 and 240 sets of reeling and re-reeling machine and equipments respectively, Uganda will produce approximately 9,000MT and 83,700,000 meters of raw silk and fabric production respectively from 50,000 acres of mulberry. This will earn Uganda USD 450,000,000 and USD 837,000,000 from production of raw silk and silk fabric annually. This is equivalent to 1.687 Trillion shillings and 3.138Trillion shillings per year from raw silk and fabric production respectively. The machines will create approximately 18.000 jobs (reelers, re-reelers, winders, twisters, marketers) with each earning UGX 2,400,000 annually.

Other selected commercial agricultural activities compared for intra and post COVID-19 economic recovery potential based on interviews of the farmers and National Planning Authority

were apiculture, Silk, poultry, livestock farming (cattle, goat, sheep and pig rearing), Coffee growing, tree planting, tea ,food crop (rice, millet, sorghum, maize, cassava, beans, peas, groundnuts), fruits, and sugar cane growing (NPA III).

According to National Development Plan III (NDP III) the years 2020/21-2024/25 are for sustainable industrialization to increase household income and reduce vulnerability through employment and wealth creation. This was aimed at enhancing agro-industrialization based on strategic commodities grown in the different defined agro-ecological zones of the country (NPA, 2019[c]).

The cost benefit analysis for all the selected commercial agricultural activities was not possible for the reason that; liquid cash dried up and supply chain was disrupted during COVID-19 lock down in the country. Most farmers were growing food crops for subsistence and to ensure food security, but not for sale despite Government appeal to buy food supply from locals as relief for those locked in urban centres. The cash crops harvested in the period of lockdown remained in the stores unsold and most got spoiled by pests and diseases leading to loss on the side of the farmers. There were no new plantations for cash crops established during the same period. The only eminent commercial agricultural activities during the lockdown were sericulture, apiculture, poultry, livestock farming, and to lesser extent food crop growing.

Apicultures

This is rearing of bees for production of honey and other bee products like bee wax, propolis, bee venom, pollen and royal jelly. This practice can be done for subsistence and or commercial purpose. According to Convention on Biological Diversity 2018, the honey bee is widely spread in the world, with 81million hives producing 1.6 million tons of honey in a year. The bees collect nector and pollen from flowers of the plants as their only source of food. Nector is their main source of carbohydrates for honey production while pollen provides other sources of nutrients essential for growth and development (Kun-Suk Woo, 2004).

A wide diversity of values is linked to bees and pollination beyond agriculture and food production. Bees and their habitats provide ecological, cultural, financial, health, human and social values. This endears beekeeping to be critical for economic recovery in the face of COVID-19 pandemic and future epidemic out breaks. It typically requires minimal investment, generates diverse products, can occur without land ownership or rent, and provide flexibility in timing and locations of activities. Products of bees are used by many indigenous people for different purposes, which include nourishment, traditional medicine, activities related to their spiritual and contemplative life and hand-crafting ( ). The products are also of high economic values with high returns once investments are made in it as reflect by their unit costs in the table below. According to bee keepers that were interviewed in June 2020 and Amulen at al., there are only three main bee products produce in Uganda namely honey, bee wax and propolis. Other bee products like pollen, bee venom and royal jelly are not harvested by bee keepers in Uganda causing them to have minimal annual or monthly returns compared to other economic activities.

Table 4: Average Annual returns of apiary with 22 beehives in 3.7ha of land as modified from Amulen et al., 2019

S/No	Particulars	Quantity (Kg)	Unit price (USD/kg)	Cost (USD)	Returns (USD)
1	Honey	22x17	4.80		374.00
2	Bee Wax	3.51	3.01		10.57
3	Propolis	0.19	4.00		0.76
4	Royal jelly	-	-	-	-
5	Bee venom	-	55.00	-	-
6	Pollen	-	-	-	-
7	Bee hives(log hive)	22	3.42	36.64	
8	Gum boot	2	4.00	8.00	
9	Bee suit	2	46.21	92.42	
10	Airtight Bucket	3	4.00	32.52	
11	Smoker	1	11		
12	Other costs(inspection, harvesting etc.			36.64	
13	**Total Costs and gross returns**			**206.22**	**385.33**
14	**Annual net returns.**				**179.11**

1litre of honey=1.4kg. 1 log hive produces 24litres (17kg) of pure honey. 1USD = 3750UGX. Monthly net return is USD 15 (UGX 56,250)

Other agricultural activities that engaged the rural famers during the COVID-19 lockdown were, Coffee growing, Sugarcane growing, tree planting (forestry), poultry and other livestock farming. All these activities need time to produce adequate returns. Most of them are seasonal and require large scale farming to make reasonable profits. Nonetheless, the cost and benefit analysis for these activities for the period of lockdown would still be unfriendly to the farmers.

Poultry

Amidst dry up of liquid cash in the community, small scale poultry keeping is possible for survival during COVID-19 lockdown. The best method used during such a time is the free ranch method. Each family rearing chicken in the rural keeps an average of 15 chickens per month. The excess are either sold or consumed by the family members. On average, a local chicken lays 10 eggs three times a year. With good shelter and medication the 10 eggs hatch into chicks and mature to chicken in six to eight months. At this rate this rate the average poultry farming output is 450 chicken per year.

Cost-Benefit analysis for 15 birds free ranch for a year in rural Uganda

S/No	Particulars	Quantity	Unit price (UGX)	Cost (UGX)	Returns (UGX))
1	Chicken	450	25,000		11,250,000

2	Eggs	450	500		225,000
3	Chicks	450	-	-	
4	labour	-		15,000	
5	Medicine	3	15,000	45,000	
6	feeds	-	-	-	
7	Others (shelter, shade,			10,000	
	Total Costs and gross returns			**70,000**	**11,475,000**
	Annual net returns.				**11,205,000**

1USD = 3750UGX; the monthly return is UGX 950,417 (USD 253)

Comparison of sericulture potential and other agricultural activities for intra and post COVID -19 rural economic recoveries in Uganda.

Comparatively, sericulture is rural friendly with high monthly net returns for farmers throughout the year unlike others (apiary, coffee, sugarcane, Forestry) that are seasonal with irregular monthly returns. Coffee plant takes long to give returns and sugarcane growing is selective in soil type hence not favouring all farmers. Forestry takes more than 50 years to get adequate returns. It is only good for long term investment. While mulberry takes three months to grow for a famer to start getting returns.

Sericulture products also have wide market in East Africa, Africa and world at large. This is boosted by the increased demand for raw silk and its products in world market caused by decline in silk production in the traditional silk producing countries like China, Japan and India. These countries and other western countries have inadequate land, labour and harsh climatic conditions which provide for only one season cocoon harvesting. Uganda has enough land, sufficient labour and good climatic conditions for sericulture. This clearly points Uganda to be the next leading silk and silk products exporting country in the world.

Conclusion(s)

Despite enactment of the COVID-19 lockdown in Uganda, all people who took to agricultural activities kept earning monthly and had living with minimal struggle. Those involved in sericulture had better monthly returns than apiary and any other business during the time of lockdown. This puts sericulture technologies and innovations far more viable than the other existing technologies in Uganda. However, a combination of them to make an integrated self-sustaining system of technologies and innovations will cause a synergistic boost in intra and post COVID-19 economic recovery

Recommendation(s)

Based on the cost and benefit analysis of activities in tables 1, 2, 3, and 4, including other related comparisons, the following are recommended for the government of Uganda to achieve a faster intra and post epidemic economic recovery.

More funding should be committed to sericulture in the rural communities. This will set a firm ground in the communities to boost commercialization of sericulture technologies and innovations for improved household income and increased GDP.

Curriculum and training in Sericulture technologies and innovations should be embraced into the mainstream education system of the country to raise human resource for sustainability of sericulture.

An integrated self-sustaining industries should be developed to add value to the variety of the local products from the community.

Apiculture should also be developed to supplement the returns of sericulture, oil and mineral mining as well as any other viable innovations that are not mentioned in this paper. This will help boost the economic recovery of Uganda from COVID-19 pandemic and future epidemics.

E-commerce should be embraced to enhance effective safe ordering and delivery of goods to consumers.

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