Institution: Brunel University London		
Unit of Assessment: 17 Business and Management Studies		
Title of case study: Supply chain analysis: driving improvements in farming and growth of education in Uganda		
Period when the underpinning research was undertaken: 2015 - 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Dr Manoj Dora	Reader – Operations Management	10/2015 - present
Period when the claimed impact occurred: 2016 - 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact (indicative maximum 100 words)

Dr Dora's research has resulted in vast economic, social, ecological, and educational improvements in Rwenzori, Western Uganda, and established a new sustainable partnership between Mountains of the Moon University (MMU) and the farming industry. Following the adoption of his research, the regional dairy sector capacity increased by 75%, and MMU received a full institutional accreditation "Charter" by the Uganda National Council for Higher Education (UNCHE). This has led to a substantial increase in the University's endowment, which now stands at GBP1,300,000, and acceptance of 400 extra students due to additional bursaries worth GBP250,000 being offered. MMU subsequently expanded and, as a result, the cost of surrounding land increased by 1,000%. This all directly benefitted the economy and livelihoods of people living in the Rwenzori region.

2. Underpinning research (indicative maximum 500 words)

Dr Dora specialises in applying lean farming principles in the food supply chain to make it more efficient and sustainable. He was awarded a project on *Strengthening agribusiness value chain through community engagement in Uganda* worth EUR2,900,000, equivalent to GBP2,609,420 (11-2020), in 2013 when he was at the University of Ghent, Belgium and continued the research programme when he joined Brunel in 2015. The 10-year long project (2012-2022), funded by the VLIRUOS Institutional University Cooperation, focuses on capacity building and institutional strengthening in areas of relevance to farming communities in Uganda, providing a pilot for future farming solutions.

When Dr Dora joined Brunel in 2015, he conducted further research on the lean farming component of the project to provide effective solutions for a simplified farming process in Uganda. He applied the 'lean thinking' approach—originally derived from Toyota's model to cut waste and later adapted to develop sustainable global food supply chains—to the Ugandan farmers' economic system. He developed a Lean Tool Box and Readiness Index and then worked collaboratively with farmers, cooperatives, food processors and suppliers to implement a low-cost management system for Ugandan farmers in order to optimise their resource management and productivity.

Dr Dora has contributed to identifying the bottlenecks in the food supply chain management in Uganda (especially the small holders' farmers) and developed a new collaboration framework and management tools to improve their productivity. His research identified hotspots susceptible

to losses and waste along the food supply chain (Primary production, processing, storage, food service and/or consumption) (Ref. 1). Results further revealed discarding and nutrient loss, most especially at the processing level, as the main forms of loss/waste in food, which were adapted to 4 out of 7 lean manufacturing wastes (i.e. defect, unnecessary inventory, overproduction and inappropriate processing). In order to ensure successful application of lean practices aimed at minimizing food or nutrient losses and wastes, multi-stakeholder collaboration along the entire food supply chain is indispensable.

Additionally, his research provided practical solutions for using mobile phones in farming communities beyond just normal communication. Dr Dora conducted a study which looked at the applicability of the technology acceptance model (TAM) to the use of mobile phones in farming communities in Sub-Saharan Africa. Using samples from 300 dairy farmers in Uganda, the research presented in the study contributed to the scholarship on mobile phone adoption in the agricultural sector in Sub-Saharan Africa and promoted the practical benefits the use of mobile phones can have on the agricultural sector. The majority of farmers only use their mobile phones for personal communication but Dora et al. identified that a change in mind-set can have a significant impact on their welfare when they learn how to use their phone to market their produce or exchange information on price. The research results therefore revealed the investment and business opportunities that arise when farmers move beyond familiar processes and instead adopt new socio-economic thinking with technology. In addition, a mobile application “cow analytics” has been developed to help farmers to manage farms and make informed decisions (Ref. 2).

Working closely with 528 farmers, 1 co-operative and 2 food processors in 8 districts of the Rwenzori region (which has a population of approximately 3,000,000), Dr Dora applied lean manufacturing as a waste management approach and the theory of organisational readiness to change to assess value chain actors’ readiness to adopt measures against losses and wastes. His findings indicate that farmers are unfamiliar with the term nutrition sensitive agriculture, yet they actually know or do what the concept entails.

In addition, he found that unmarketable dairy products were often discarded but sometimes donated to charity. Path analysis revealed that change valence and resource availability positively influence change commitment and efficacy, respectively, to adopt lean measures against losses and wastes. Multi-actor approach only had a positive effect on change commitment but not on efficacy. In summary, value chain actors were optimistic about adopting approaches to reduce food and nutrient losses or wastes as part of nutrition sensitive agriculture. Consequently, external players such as governments, academia and humanitarian agencies need to create sustainable partnerships with the food industry to implement such initiatives (Ref. 4).

3. References to the research (indicative maximum of six references)

Manoj Dora (CI) VLIRUOS Institutional University Cooperation, 2012-2022, *Strengthening agribusiness value chain through community engagement in Uganda*, EUR2,900,000.

Ref 1: De Steur H, Wesan J, Dora M, Pearce D, Gellynck X. (2016) ‘Applying Value Stream Mapping to reduce food losses and wastes in supply chains: a systematic review ‘Waste Management https://doi.org/10.1016/j.wasman.2016.08.0255

Ref 2: Kabbiri, R., Dora, M., Kumar, V., Elepu, G. and Gellynck, X. (2017) 'Mobile phone adoption in agri-food sector: Are farmers in Sub-Saharan Africa connected?'.

Technological Forecasting and Social Change, 131. pp. 253 - 261. ISSN: 0040-1625 **(ABS 3*)** https://doi.org/10.1016/j.techfore.2017.12.0100

Ref 3: Odongo W, Dora M, Molnar A, Ongeng D, Gellynck X (2017) "Role of power in supply chain performance: evidence from agribusiness SMEs in Uganda", Journal of Agribusiness in Developing and Emerging Economies, Vol. 7 Issue: 3, pp.339-35 https://doi.org/10.1108/JADEE-09-2016-00666

Ref 4: Wesana J, De Steur H, Dora M, Mutenyo E, Muyama L, Gellynck X, (2018) "Towards nutrition sensitive agriculture. Actor readiness to reduce food and nutrient losses or wastes along the dairy value chain in Uganda," Journal of Cleaner Production (ABS 2*) https://doi.org/10.1016/j.jclepro.2018.02.021

Ref 5: Pearce, D., Dora, M., Wesana, J. and Gellynck, X. (2018) 'Determining factors driving sustainable performance through the application of lean management practices in horticultural primary production'. Journal of Cleaner Production, 203. pp. 400 - 417. ISSN: 0959-6526 **(ABS 2*)** https://doi.org/10.1016/j.jclepro.2018.08.170

Ref 6: 2019 Dora, M., Wesana, J., Gellynck, X. et al. "Importance of sustainable operations in food loss: evidence from the Belgian food processing industry," Annals of Operations Research **(ABS 3*)** https://doi.org/10.1007/s10479-019-03134-0

4. Details of the impact (indicative maximum 750 words)

The Rwenzori region has vast natural resources comprised of fertile volcanic soils, ample and reliable rainfall, huge tourism potential, water bodies and rich forest cover. Despite its potential and progress, Rwenzori region is still below the national average on a number of social economic indicators. Agriculture is the major economic activity with the majority of the population practising subsistence agriculture. It is estimated that approximately 80% of the region's population entirely depend on agriculture. Smallholder agriculture production is hampered by challenges related to marketing, lack of agricultural financing, slow adoption of agricultural technologies and practices, and an increasing nutritional challenge among children. The primary reason of food insecurity in this region is mismanagement of resources and lack of knowledge on best farming practices.

The Food Supply Management System designed by Dr Dora has benefited not only the farmers in the region who have implemented the system but also its wider community – Rwenzori region – economically by establishing a new sustainable partnership model between an academic institution and an industry.

Increasing Dairy Production and productivity, and improving efficiency

The Food Supply Management System is now successfully integrated with traditional farming in Uganda and has been replicated by farming communities in South Africa and has generated progressive economic, social, and ecological results across communities. Further, the project established and mobilised a dairy stakeholder Platform in 8 districts of the Rwenzori region bringing together 528 famers for an integrated dairy supply chain between 2013 and 2018. As a result, the programme has (E1):

- Increased milk production and productivity from 10l of milk per day per cow to 22l [120% increase];
- Enhanced the dairy market access through the creation of 10 milk collection centres and the installation 10 milk coolers;

- Increased the value of the milk by 72% through processing and marketing milk products such as cheeses, bottled milk, yogurt, ice cream and butter;
- Increased the regional dairy sector capacity by 75% by mobilizing 528 dairy farmers [both small, medium and large scale];
- Created 6 dairy farmers platforms in the region. Platforms are formed in 6 different areas of Rwenzori region to cater the local needs of the farmers. Each platform includes 70 to 80 farmers.

This immediate and direct improvement has led to expanding the scope of Dr Dora's research to benefit a wider society in the Rwenzori region.

Building a Sustainable Partnership between a University and an Industrial Sector

Dr Dora's research has directly benefited MMU and its community by providing a sustainable partnership model for a community-owned University to strategically build and use its academic capacity to tackle community issues. MMU, established in 2004, is solely run by the tribal communities, and serves a regional population of approximately 3,700,000 people which expands at a rate of 4.8% per annum (E2).

The project responds to the needs of the community and is designed to enable MMU, local farmers and residents to solve the problems of the community. For instance, despite the abundance of natural resources and good weather condition, the agricultural productivity of the region is low compared to other parts of the country. Specifically, farmers in dairy sector have low productivity which results in low income and quality of life.

On average, a cow in the region produces approximately 4.4l of milk per day (1606l per annum). The major factors that are responsible for this low milk production include poor breeds of dairy cows, pests and diseases, poor nutrition and poor management. High cost of inputs, inadequate financial services and low uptake of improved production technologies also contribute to the low milk production in the district. The main concerns of farmers are lack of training on standard dairy farming practices, quality, food safety, transport, and market access. To address these challenges, a modern test farm which facilitates research and development on a variety of subjects such as animal feed, breeding, health, farm management, milking and cooling has been set up. The community-based skills training and research on integrated dairy chain and Management Systems includes:

- Farming practices using lean principles
- Pasture management
- Supplementary feeding
- Feeds rationing and formulation
- Milk handling practices

Long-term sustainability, building infrastructure through knowledge transfer

- Training programmes were designed as interventions for the farmers
- Better feeding
- Better knowledge of the market
- Better knowledge to increase milk production

Dr Dora's distinct involvement in the project drew from his research expertise in supply chain analysis and improved the quality of training for dairy farming in the agricultural sector of the Rwenzori region in Uganda. Each year, 3 training programmes have been organised on the above topics. As a result of Dr Dora's research contribution, MMU has been able to train over 500 farmers. The training resulted in 40 to 50% increase in milk production for most of the farmers.

In addition, to drive knowledge exchange between MMU and the farming sector, each UG student is assigned a farmer. Farmers share real-life problems and students research for solutions, benefiting each other. This is a unique and the only model in the world where each student assigned to a farmer to facilitate knowledge exchange.

This capacity building project has helped MMU to get a full institutional accreditation "Charter" by the Uganda National Council for Higher Education (UNCHE). Having achieved the charter status in 2018, MMU is one of the few chartered universities that are eligible for Government funding schemes. As a result, MMU saw a substantial increase in public funding and now receives approximately GBP1,3000,000 which creates a range of opportunities the University could not access previously. MMU is now able to offer 871 student bursaries and 63 government loan schemes worth more than GBP250,000. This has allowed MMU to start accepting students who previously have been unable to attend University due to financial constraints. MMU has since been able to accept 520 more students and saw an increase of over 400 students in 2019, the year after the Charter. The extra funding also allowed MMU to improve its infrastructure which contributed to an additional increase in student numbers (E2).

Contributing to the regional and national economy

In Uganda, over 80% of the population is involved in small scale agriculture conducting mainly subsistence mixed crop and livestock farming on small land holdings (approximately 3 hectares of land on average). Agriculture contributes 31% to the GDP and the dairy sector is the second to cereal products contributing over 50% to the GDP of the total output from the livestock subsector. Small-scale farmers dominate Uganda's dairy production, owning over 90% of the cattle population in the country. Out of the 96% of the poorer citizens who live in rural areas, approximately 60% keep indigenous cattle.

MMU's significant expansion opportunities have contributed to the development of the local economy. In 2017, the University started to expand and moved their offices from Fort Portal to the town of Saka, acquiring 200 acres of land in the process to establish a Dairy Technology and Innovation Centre. Because of the expansion, Saka has seen a rapid increase in investors establishing hotels, student hostels, restaurants and accommodation to meet the growing needs. The new student accommodation block can house over 1,000 students. Moreover, since 2017, there are 10 additional hostels in Saka and the cost of land has increased by 1,000% because of the presence of MMU: a 15x30m plot of land, which was worth approximately GBP630 in 2005 now stands at approximately GBP6,300 (E2).

5. Sources to corroborate the impact (indicative maximum of 10 references)

E1 Vice-chancellor, Mountains of the Moon University, Fort Portal, Uganda, 2019

E2 Vice-chancellor, Mountains of the Moon University, Fort Portal, Uganda, 2020