

Supplementary Materials: Improving Health and Wealth by Introduction of an Affordable Bacterial Starter Culture for Probiotic Yoghurt Production in Uganda

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Table S1. Improving Health and Wealth by an intervention with an affordable starter for locally produced probiotic yoghurt in Uganda – Main partners.

Name	Type	Location	Main task in the project
Yoba for Life Foundation	Non-Governmental Organization	The Netherlands	Coordination, starter culture development, technical expertise on local yoghurt production in rural Africa and beyond
Heifer International	Non-Governmental Organization	Uganda (Headquarters: US)	Providing connections with farmers and dairy cooperatives
SNV (The Dutch Development Organization)	Non-Governmental Organization	Uganda (Headquarters: The Netherlands)	Support and advice, including providing funding to promote Yoba yoghurt at pre-primary schools in South-West Uganda
Uganda Industrial Research Institute (UIRI)	Research Institute	Uganda	Starter culture distribution, microbial analysis of yoghurt samples, technical advice to producers
Makerere University	Research Institute	Uganda	Research development of non-dairy probiotic products by using the Yoba probiotic starter culture
VU (Free University)	Research Institute	The Netherlands	Supporting PhD research in Uganda on probiotic yoghurt related topics
Dairy Development Authority (DDA)	Governmental institution	Uganda	Monitoring, technical advice and regulation of production units
CSK	Private sector company	The Netherlands	Starter culture production
Lactosan GmbH & Co	Private sector company	Austria	Drying of starter cultures
Netherlands Organization for Applied Scientific Research (TNO)	Research Institute	The Netherlands	Isolation of the <i>Lactobacillus rhamnosus</i> GG strain and genome analysis

Table S2. Average cost and profits per liter of probiotic yoghurt in Uganda as function of production volumes. Note: Sales price is set at 4.000 UGX per liter.

Raw material, transport and labor	Fixed/Variable Cost (F/V)	Price (UGX per unit)	Unit
Fresh Milk (wet season)	V	1000	Liter ^I
Sugar	V	5000	Kg ^{II}
Flavor	V	35.000	Liter ^{III}
Packaging material	V	40	Polythene bag ^{IV}
Yoba starter culture	F	2.500	One gram sachet ^V
Firewood	F	2.000	Bundle
Water (20L cans)	F	200	20 L ^{VI}
Labor	F	1.500	Hour
Distribution/Transport	F	4.000	-

^I Average value. Cost of milk can vary greatly per region (villages that have a contract with a milk processor buy at lower prices even down to 600 UGX, producers located in town usually buy at higher prices, e.g up to 1600 UGX) and is also influenced by wet and dry season (higher price in dry season due to lower supply). ^{II} Average value. Dosing at 5%. ^{III} Dosing at 0.1%. ^{IV} The estimated price of one package (polythene bag) is 40 UGX, the price per liter assumes that the yoghurt is packed in portions of 250 ml. ^V One gram can be used for up to 100 liter. ^{VI} Average value. Depending on the availability of water the price of one jerrycan of 20 L can range between 200 UGX and 500 UGX. ^{VII} Price generally used as wholesale price when the yoghurt is sold through external shops.

Table S3. Mechanisms behind the implementation of sustainable probiotic yoghurt production units and related effects. Inspired by the McKinsey Psychology of Change Management (Lawson E, Price C. The psychology of change management. McKinsey Q. 2003;30–41).

Targets for sustainable implementation
<ul style="list-style-type: none"> • Capacity building: Giving training and sharing knowledge on how to become an independent yoghurt producer. Observations made during the training facilitate continuous improvement for next trainings. • Reinforcing mechanisms: When production units are diverting from the prescribed production protocol, they are likely to obtain yoghurt of unacceptable quality which they are not able to market. • Understanding and conviction: Giving background information to yoghurt producers why adherence to the protocol and strict hygiene are important, how a well-managed business can be profitable, and why the yoghurt is beneficial to the health of the consumers. • Role models: Organizing central trainings and exchange visits in which production units learn from one another and become motivated to upgrade. Namatovu <i>et al.</i> (77) found that 84% of the Ugandan youth entrepreneurs have role models for their businesses.
Responses from the producers and yoghurt market in general
<ul style="list-style-type: none"> • Internal adoption: targeted groups have become sustainable active production units after the intervention. • Internal adaptation: Production units continue to invest in their yoghurt businesses beyond project support. • External response: The project attracts partners. • External expansion: Producers making yoghurt before the intervention join the project and start producing high-quality probiotic yoghurt.



Figure S1. Picture of the “Yoba Inside” brand added benefit mark and two examples of packaging design used by local producers.