SCIENTIFIC INNOVATION & TECHNOLOGY RESEARCH
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Development of Nutrient-Energy Dense Ready-To-Use-Therapeutic Foods (RUTF) in Sierra Leone Using Local Agro-Produce

1. EXECUTIVE SUMMARY

This section provides a succinct high-level summary of the proposed project. The summary should be in plain English, avoiding the use of jargon and acronyms. Please note that this summary will be published in the SGCI Virtual Hub and partner institutions websites. The summary should be short but detailed enough to stand alone. It must not be more than one page long.

Globally, an estimated 14.3 million children aged 6-59 months suffered from severe acute malnutrition in 2019. Child under-nutrition is a major global health problem, contributing to child morbidity and mortality, impaired intellectual development, sub-optimal adult work capacity and increased risk of diseases in adulthood. Malnourished children, particularly those with severe acute malnutrition, have a higher risk of death from common childhood illnesses, with 45% of deaths in children aged less than 5 years attributed to malnutrition. Most children aged 6 months or older with severe acute malnutrition can be safely treated in their communities without requiring admission to a health facility or a therapeutic feeding Centre. However, this community-based approach involves timely detection of severe acute malnutrition in the community, assessment of appetite, and treating those without medical complications with ready-to-use therapeutic foods (RUTF), combined with basic orally-administered medication to treat infections. Community-based management of children with uncomplicated severe acute malnutrition requires safe, palatable foods with high energy content and adequate amounts of protein, vitamins and minerals, such as RUTF.

RUTF is widely recognized as a life-saving food supply that treats severe wasting in children under 5 years old. Ready-to-use therapeutic foods (RUTF) are high-energy/energy-dense and nutrient-rich foods that require no preparation. They are specifically designed to treat acute malnutrition (SAM) in children aged 6 to 59 months without medical complications but with appetite. RUTF comes as energy-dense, micronutrient paste made using peanuts, sugar, milk powder, oil, vitamins, and minerals, or as a powder product. UNICEF has been procuring almost 80% of the world's RUTF. It has a similar nutrient composition to F-100 therapeutic milk, which is used to treat SAM in hospital settings. However, existing ready-to-use therapeutic (RUTFs) products are quite expensive, and have had limited acceptance and effectiveness by all parties. Therefore, our project aims at developing powdered and paste prototype RUTF products from locally-produced ingredients in Sierra Leone using modified or adaptable processing techniques.

The proposed project will be implemented in three phases over 21 months with activities ranging from product formulation and optimization to consumer studies and publishing our data. Product prototypes or composite mixes will be subjected to nutritional and physico-chemical analysis as well as to safety and storage stability analysis on all composite mix product prototypes. Products will further be subjected to sensory and consumer testing to select the best composite mix and determine acceptability. All data will be analyzed using uni-variate and multi-variate statistical analysis (SAS version 8.2 or higher) with a specific categorical model for Sensory and Consumer study.

Partnerships will be established to holistically implement this project within the stipulated time frame. From designing the project to publishing its data, partnerships will be established to also ensure the aforementioned goal and objectives are achieved. The project will be governed and monitored by all implementing partners in their respective roles and in cross responsibilities. Anticipated outputs of such a project not only contributes to food security through increased crop production of key ingredients but also to reduction in economic cost of importing RUTFs whilst enhancing availability and accessibility at affordable cost that is anticipated in turn to contribute to the reduction of widespread malnutrition in Sierra Leone.

Knowledge acquired from this project will be shared and disseminated via publication, conference meetings and with key stakeholders for expanded research including clinical trials and other end uses or application. Individual and organizational capacities are expected to be enhanced in terms of knowledge, skills and experience acquisition; in terms of resource strengthening is food processing and production and analytical capabilities. SciInnovtec Research and working partners are well positioned to undertake this type of research with their collective resource capabilities, facilities and expertise.

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2. BACKGROUND AND RATIONALE

Describe the problem that is to be investigated and the questions that will guide the research process. Provide a brief overview of the body of knowledge related to the problem and indicate the knowledge gaps that the proposed research will fill. To show the importance of the problem, this section should discuss: how the research relates to the country's development priorities; the scientific importance of the problem; the urgency and magnitude of the problem and how the research results will contribute to its solution; the special importance of the project for the private sector; and the need to build up research capacity in the proposed area of research.

Introduction

There is a longstanding recognition that under-nutrition is not only an individual problem but a national and global problem with strong ramifications for economic development in many low and middle income countries, and Sierra Leone is no exception. As the saying goes "you are what you eat". Sierra Leone has the fourth highest child under-five mortality rate in the world at 111 per 1,000 live births[1]. Many children in the country die before reaching their 5th birthday and die simply from highly preventable and treatable causes such as malaria, pneumonia and diarrhoea. Under-nutrition is the underlying cause in over one-third of under-five deaths and diseases, and nearly one-third (31 per cent) of children under-five suffer from stunting while five per cent are acutely malnourished (moderate and severe).[2] *According to the causal framework of malnutrition, one of the immediate causes of malnutrition in Sierra Leone is poor dietary intake especially amongst nutritionally vulnerable groups* such as mothers, infants and young children. Only 10% of children aged six to 23 months received the minimum acceptable diet, 43 per cent receive complementary foods the minimum number of times or more, and 24 per cent receive what is considered to be a diverse diet[*Ibid-2*]. Amongst women aged 15 - 49 years, only 68 per cent receive what is considered a minimum diverse diet[*Ibid-2*]. There has been a slight improvement in breastfeeding rates between 2010 and 2017 with strong advocacy for early initiation of breastfeeding that has increased from 45% to 55**%,** and exclusive breastfeeding rates rose from 32% to 52%[*Ibid-2*]

Micronutrient deficiencies are of crucial public health concern in Sierra Leone. High prevalence of Anaemia is identified among women and children. Anaemia among women of reproductive age stands at 46.0 per cent, while Anaemia in pregnant women, and children under-5 stands at 70 per cent and 76.3 per cent respectively. In addition, 17.4 per cent of children 6 - 59 months are deficient in Vitamin A[3]. Over the past decades, various products and approaches for the prevention and treatment of childhood under-nutrition have been developed and tested[5,6,7]. Special nutritious foods have also been used to treat under-nutrition, and children with moderate acute to severe acute malnutrition (MAM & SAM) have over the last twenty (20) years used dried milk formula such as F75 and F100[8], BP-5 or BP-100 that required in-hospital stay because the formula had to be made by qualified medical personnel due to the risk of using contaminated water and adequate dosage. The major RUTF on the market is the French brand 'Plumpy Nut' a peanut based product produced by Nuttiest. The company also produces various types of meals including emergency-based meals. The use of some of these energy-dense ready-to-use-therapeutic food (RUTF) has revolutionized the treatment of children with moderate and severe acute malnutrition with and without medical complications as it has made treatment possible and safer at the community level without the need for qualified medical personnel through the distribution of 'ready-to-use' food products that can be consumed without any preparation[7,9].

The WHO/UNICEF have developed protocols for the composition of ready-to-use-therapeutic foods (RUTF's), and their use in the treatment of severe acute malnutrition (SAM) which has demonstrated their effectiveness[10-14]. However, no standardized approach exists for the formulation of ready-to-use therapeutic/supplementary foods (RUTF/RUSF's) or for approaches to prevention of undernutrition[10,15]. With high cost of importation, and for sustained supply of RUTF's, the WHO and various researchers have recommended the development of new therapeutic and supplementary foods that are more affordable, acceptable, accessible, effective, and comparable with existing products in terms of their potential for preventing growth faltering and undernutrition[7,10,12,15-20]. In 2012, a linear programming tool was developed to help formulate locally sourced RUTFs that could meet international specifications[21,22,23]. Locally produced RUTFs were tested in Ethiopia, Ghana, Pakistan and India and gave overall good results in terms of acceptability (tested on severely malnourished children without clinical complication) and cost (40% cheaper than Plumpy-nut). Other countries including Cambodia, Uganda, Malawi etc., are now producing comparable local RUTF and RUSF that is contributing to treatment of moderate and severe acute malnutrition, and in turn to reduction in the overall malnutrition prevalence. Ghana recently introduced a local RUTF that is now successfully being commercialized by the private sector.

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[1] United Nations Children's Fund. (2017). *Levels and Trends in Child Mortality Report 2017: Estimates Developed by UN Inter-agency Group for Child Mortality Estimation*. New York: UNICEF.

[2] Sierra Leone National Nutrition Survey 2017, MoHS

[3] Sierra Leone National Micronutrient Survey, 2013

A local formulation of food sprinkle containing peanut flour, palm oil, milk powder, sugar and vitamin mix was developed by the University of Parma in Italy for the treatment of moderately malnourished children in Sierra Leone[24]. The sprinkles were used in combination with commercial RUSF and showed slight improvement in treated children with this product. Currently there is an initiative called the Project Peanut Butter (PPB) in Sierra Leone that is funded by USAID that is producing RUTF using mostly imported ingredients and some local ones. One of PPB's product is a ready to use supplementary food (RUSF) for pregnant and malnourished women[25]. This group has also stalled in production due to not meeting UNICEF, WFP, WHO standards. Apart from PPB, no locally produced ready-to-use-therapeutic (RUTF) and ready-to-use-supplementary (RUSF) foods have been developed or reported for Sierra Leone. Hence, now more than ever, there is a need to develop in country local RUTF and RUSF to contribute to curbing malnutrition and preventing growth faltering amongst the 6-59 months old children in Sierra Leone.

Problem and Rational for RUTF Development and Nutritional Food Composition Profiling

1. **Country status** – Despite some gains in made, Sierra Leone still has high prevalence of under-nutrition, as well as moderate and severe acute malnutrition amongst children under five years of age.
2. **Donor cost** - imported RUTF's are purchased and used in the treatment of Moderate and Severe Acute (MAM & SAM) malnourished children. UNICEF and other donors provide support to the Food and Nutrition Directorate (DFN) under the Ministry of Health and Sanitation (MoHS) and pays for majority of the imported RUTF products and in-patient treatment of SAM. The WFP spends thousands of dollars to procure RUTF from the United States each year and often the corrupt bureaucratic process involved at the customs office holds back aid supplies for lengthy periods causing food stuffs to perish in transit. Irish Aid, Helen Keller International etc., are strong nutrition donor organizations supporting the purchase of imported and the locally made Project Peanut Butter – RUTF and complimentary supply from the Bennimix company in Sierra Leone.
3. **Priority Level** - To date there is no institution or research agency focused on conducting Food and Nutrition research to contribute to solutions in giving directions to solving the countries Food and Nutrition security problems. The Nutrition Directorate under the MoHS gets 90% of its support from donor agencies and limited support from the government. The Ministry of Agriculture does not prioritize Nutrition in their framework and critical information on food and nutrition is really just limited. There is no agency for regulation of food safety or food laws; no standard food testing laboratory which is critical to processing, analysis and quality assurance of developed products like a RUTF. From independence to date only few quantitative research work (less than 10%) has been done related to Food and Nutrition issues in Sierra Leone. Every other work and issues strongly focus on qualitative field research without reference to scientific quantitative research and solutions.

At present, every country is reeling back from the economic, financial, social, and health effects of Covid-19 that was globally and immeasurably felt around the world. Low to middle income and war-torn countries dependent on higher / upper income countries were affected and hit hard and across the socioeconomic strata from the vulnerable to upper income earners and businesses. Sierra Leone has one of the highest rates of under-nutrition in the world amongst its under-five population. Post Covid-19 impact and now the Russia – Ukraine, and climate change effects are all exacerbating the situation and the high cost of imported RUTF and quality RUSF's does not meet the demand for therapeutic food supply. With an already struggling economy, decrease in importation of goods and restricted donor funding will see a re-surge in MAM and SAM in the country.

In view of the above, there is a strong need to develop these products using local indigenous crops/ingredients in Sierra Leone from economic, health and nutritional perspectives. The production of RUTF and RUSF by scientific standard with local ingredients common to the palate, will be more acceptable to mothers and children, less expensive for donors and government to purchase, and will be sustainably accessible, available and affordable in country. This approach of ONLY local ingredients has never been used or tested in Sierra Leone apart from mom and pop home-made mixes, donor imported products and one commercial complementary product (Bennimix) on the market in very limited quantities and does not meet UNICEF, WHO, and WFP standard composition (energy-nutrient density) for RUTF[27].

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3. PROJECT GOAL AND SPECIFIC OBJECTIVES

The overall goal should state the development goal being pursued by the research. The specific objectives should indicate the specific types of knowledge (or other outputs) to be produced/realized, the audiences to be reached, the forms of capacity to be reinforced, and the partnerships to be established. These are the objectives against which the success of the project will be judged.

Goal: As stated above, the goal of this project is to research, develop/formulate nutrient-energy dense RUTF product prototypes using 100% locally available ingredients that will make RUTF to be more available/accessible, affordable, and acceptable for the vulnerable group and most importantly in the treatment of MAM and SAM, and in the prevention of growth faltering in children in Sierra Leone.

Objectives:
To develop ready-to-use therapeutic product prototypes, assess the nutritional, physic-chemical, sensory properties and consumer acceptability of products as well as analyse the cost of such value added local produce.

Specific objectives of the project are:

1. Utilize modified process in a POWDER & PASTE product in the development of RUTF using 100% local ingredients/produce
2. To determine physicochemical properties, microbial safety, sensory, and preliminary safety of the prototypes
3. To determine the nutritional composition of products in meeting the energy density and daily nutrient intake for MAM, SAM and growth faltering children of 6 - 59months.
4. Determine safety, storage shelf life and stability of products under local conditions.
5. Perform cost analysis in comparison to current RUTF's on the market in Sierra Leone.
6. Perform mini consumer study on the prototypes with mothers
7. Develop strategic value and supply chain of raw ingredients to meet production demand.

Partnerships will be established to holistically implement this project within the stipulated time frame. From designing the project to publishing its data, partnerships will be established to also ensure the aforementioned goal and objectives are achieved.

4. PROJECT METHODOLOGY/ APPROACH

Explain how each specific objective will be achieved in sufficient detail to enable an independent scientific assessment of the proposal. This section should show how the research questions will be answered in the most rigorous way possible. You must be clear about the activities envisaged to achieve each objective. The methodology (which should be justified) should discuss the following details as appropriate:
• Conceptual and theoretical framework. Define the frame of reference that will guide the research (for more on this see section on innovation systems).
• User participation. Indicate whether (and if so, how) the ultimate users of the research findings (in this case, the private sector) were involved in the design of the project and how they will participate in the execution of the project or implementation of the results.
• Data collection. Indicate the approaches and methods that will be used to collect data as well as how the research instruments will be developed. If the research includes studies on human populations, indicate how ethical questions relating to confidentiality will be achieved (see below). Where applicable, details must be provided with regard to the collection and handling of biological samples, and all laboratory procedures and protocols must be stipulated.
• Data analysis. Describe the methods of data analysis and modeling to be used, if any. This should include any statistical processes/ software's (if necessary) as well as how the data will be secured, accessed, shared, stored and archived.

Methodology - Project Approach and Output
Scientific approaches to product development through sensory and consumer testing will guide the development of an acceptable product prototype. Applicable and modified industry processing methods will guide product development for safety, and the UNICEF guidelines for acceptable RUTF will guide the end product to meet target needs. With sufficient funding, this type of project can only be done in phases with sometimes multiple funding sources. Giving the funding amount in the Food Security and Agriculture area, this project will cover phases 1 and 2 and part of phase 3 over a 21 months period. We will continue to seek for extramural funding to carry out full blown activities in phases 3 and 4.

Phase I - will comprise three key things a) scientific development of RUTF prototypes, b) nutritional profiling of key indigenous crops and product prototypes, c) storage stability and safety of product prototypes under varying conditions by end users.

Phase 2 - Will comprise a) conducting of sensory acceptability testing of product prototype, b) bench marking survey of prototypes against existing products in country, c) mapping / establishing of supply chain for large quantity production of key ingredients for the Sierra Leone market

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Phase 3 - A preliminary consumer study will be carried out but data may not be sufficient to make any decision from it. However, it will provide additional guidance or direction on prototype selection. This will not involve any benchmarking of prototypes against available imported market products. With additional extramural funding, a full-blown consumer testing of prototypes from sensory testing for acceptability of products will involve bench marking of selected prototype against existing or competitive products in country. Cost analysis of formulated prototypes in comparison to current products in use will be assessed.

**** It must be noted that with these type of research, a final phase (**Phase 4 with additional funding)** involves clinical efficacy testing of such products which is essential to determine the in vivo / biological-health benefits with the applicable target group. Hence, testing with Moderate and Severe Acute Malnourished children, as well as with growth faltering children in Sierra Leone over a 6-8 months period will be later required.,

Data Collection (Phases 1 & 2 only)

Experimental Design for RUTF & RUSF Formulation and Processing: Product prototype will be formulated as 'composite mix' using a number of produce/ingredients at various ratios. Independent variables are formulation type (Powder and Paste formulations) comprising two levels each a) starch base (Rice or Orange fleshed Sweet Potatoes) and b) premix inclusion or no inclusion. Focus is on class of ingredients that includes Carbohydrates, Fat, Proteins, Mineral and Vitamin sources that will make up each composite mix. The prototypes will be subjected to Vitamin and Mineral Premix or no premix to determine if products meet RUTF nutritional standards as set by UNICEF. Since there are a number of possible formulation combinations, a fractional 2x2x2 factorial design will be used for this study with three independent experimental replications to be carried out.

Analysis:

Proximate Analysis and Physical Properties: Crude protein concentrations will be determined using the Pierce BCA (bicinchoninic acid) Protein Assay procedure; free amino acid nitrogen content by titration method; moisture/dry matter content, water activity (Aw) for powder formulation, fat (using methylene chloride) and brix value / total solids will be determined using the CEM microwave machine. Color (L*a*b*) will be measured using the Minolta CM-508d Spectrophotometer. Viscosity in centipoise (cP) will be measured using a Brookfield's DV II+ viscometer. Protein Separation will be performed as a measure of quality and homogeneity of samples and as a precise measure of the amount of protein suspended in moist products. Apparent Colloidal Stability, defined as the maintenance of a homogeneous liquid system, will be determined. Other analysis will include n-6 fatty acids, n-3 fatty acids, essential minerals, vitamins, amino acids profile etc., contaminant (selected heavy metals if any).

Microbial Safety and Storage Stability. Analysis will include afflatoxin, total plate count, faecal coliforms (MPN – most probable number), yeast - mould and *E.coli* on prototypes will be evaluated and reported as Log colony-forming unit (Log CFU/ml) per millilitre. Preliminary shelf life will be determined based on microbial safety data. Although no preservatives will be added to these products, analysis will be done for common and naturally occurring contaminants that is required to be done in all packaged baby / children's food.

Sensory Testing - The sensory evaluations of the products will be carried out with 40-50 mothers in the western area of Sierra Leone. These mothers will be trained on sensory evaluation techniques prior to evaluating products. Bottled water will be used to cleanse their palates before analyzing each. The sensory attributes for evaluation shall include appearance, color, finger texture, taste, odor / aroma & flavor, mouthfeel, smoothness, consistency, and general acceptability. Best applicable scales for the sensory attributes will be used to evaluate products. Example - Appearance will be evaluated on a 9 point hedonic scale where 1 reflects low/poor and 9 high/appealing. This stage in the product development enables us select the best prototype(s), optimize product and production process before proceeding into consumer testing for product acceptability and purchase intent by target consumers or stakeholders.

Consumer Acceptance - About 100-120 consumers (mothers) will evaluate two paste and two powder (total four (4)) RUTF prototypes following the Balanced Complete Block Design for overall appearance, color, overall aroma/odor, specific noticeable aroma, taste, flavor, sweetness, mouth feel / viscosity and overall liking on a 9 point hedonic scale (1=extremely dislike and 9=extremely like). Acceptability and purchase intent will be determined on a yes/no scale. Binary logit model and McNemar Tests will be used to explore consumer decision making for the products.

Justification of Approach/Methods Used: We will be using accepted and standardized methods with modifications to develop and analyze our RUTF product samples. The PIs and partners are experienced across the spectra of this project from experimental design, product development, sensory and consumer analysis (Janette Saidu - SciInnovTec Research; Prof. Witoon Prinyawiwatkul - external supervision, Louisiana State University, USA), to physico-chemical analysis (Janette Saidu - SciInnovTec Research; Chemistry department at FBC-USL, Dr. Mohammed Sheriff - Esters of Nature Company, and Eurofin commercial lab - UK), microbial safety (Eurofin - commercial lab, UK), Clinical efficacy studies (Janette Saidu - SciInnovTec Research; and DFN-MoHS) and thermal processing/equipment handling (SciInnovTec Research), Value and supply chain establishment (Debar group ltd).

User Participation Approach

It is hoped that our preliminary studies will exhibit promising results, hence we anticipate to successfully produce RUTF prototypes as proposed. The results from this study will be used as preliminary information for future research proposals on RUTF production in Sierra Leone to secure extramural funding for consumer studies, clinical trials and semi-industry scale processing for the clinical testing.

Data Analysis & Publication

Statistical Analyses. All data will be analyzed using uni-variate and multi-variate statistical analysis (SAS version 8.2 or higher) with a specific categorical model for Sensory and Consumer study. Difference between samples and between processing treatments will be analyzed and means separated by Duncan's multiple range test. Multivariate normality will be checked prior to data analysis. The team anticipates publishing results of the project which is very critical for information sharing and future funding applications. Based on the experimental design, one or two publications may emanate from this project.

5. ANTICIPATED OUTPUTS AND OUTCOMES

Define the major outputs (e.g., publications, policy briefs, books, technologies, protocols, guidelines, etc.) expected from the research (please be specific.). Based on these outputs, define the outcomes expected. Outcomes are defined as changes in actions, behaviors, and relationships of the users and target audiences. What is likely to change as a result of research findings, to whom, when and where? Describe whether the project findings are likely to influence policy and at what levels (national, regional?) How will the project engage with policy and decision actors at these levels?

Outputs:

As a not-for-profit Research Organization and with our human resource capabilities, it is anticipated that our efforts into this project will deliver:

- Affordable, consumable standard product prototype for the treatment of moderately acute and severely acute malnourished children, or for supporting growth and development in children.
- Similar to the beverage production sector (Sierra Juice, SL Brewery industry) that has sustainable supply chain of some locally produced ingredient/crops for their drinks, RUTF crop value and supply chain will be established that ensures sustainable supply of raw ingredient, and will be expected to expand over time to meet demand for sustained production of RUTF products.
- Report from this project will be published in either Food Science or Nutrition or Health journals

Expected Outcomes:

With this approach, it is hoped and envisaged that by the end of this project some impact will be seen broadly in Agriculture, Food & Nutrition, Health, and Economic Cost Reduction.

1. Agriculture - Reliance on local produce to sustain production of products enhances country level crop production; enhances food security as specific crop production levels increase, and affordable products developed in country; establishes acceptable produce quality and food safety standards in the food-crop production, manufacturing and value-chain path.
    - Establishment of sustainable supply chain of raw ingredient with even a small group of farmers whilst providing continual training sessions to produce safe and high-grade crops. Training in some aspects of agriculture, nutrition and processing will ensure that accurate information is transmitted to consumers and end users
    - Local ingredient and end product profiles will also contribute to cataloged information for external services such as export in which food safety data is critical. i.e., information on biological, chemical and physical hazard contamination etc.
    - Start of perhaps the establishment of National food standards in the agricultural, manufacturing and processing, and emerging markets sector.

2. Food and Health - though multi-faceted in nature, but product uptake is expected to have continued reduction in the prevalence of malnutrition across the country. The development of local RUTF will significantly contribute to the gradual reduction in malnutrition and under-nutrition incidence and prevalence in the country by 5-10% or more annually. In hospital admission will decrease over time as mothers get pushed more toward high nutrition intake for themselves and their children. Hopefully, this will contribute to the government of Sierra Leone meeting related MDG goals on mother and child nutrition and health.
3. Economic Cost - The burden of importation of RUTF by donor partners like UNICEF, WFP, Irish Aid, WHO, and others will be drastically reduced by half or more that will enable resources to cater for other priorities.

6. KNOWLEDGE UTILIZATION AND DISSEMINATION PLAN

Describe how the research findings will be disseminated or used. Who are the target audience/beneficiaries? How will the findings be used to influence policy and practice? What media engagements plans are envisaged? Is open access (OA) part of your university's/institute's policy? Relate the specific dissemination method/approach to the target audience and briefly explain the rationale for the choice of the approach.

Open access and information sharing is a focal policy of SciInnovTec Research particularly for sponsored research projects. Dissemination is not limited to the end of a project. Therefore, data and information captured from the project will be published in appropriate peer-reviewed nutrition/food science/health journals. It is hoped that the government of Sierra Leone (GoSL), the Ministry of Health and Sanitation specifically, and donor partners will utilize the research results for policy development, stakeholder engagements, community engagements, in training, advocacy messages to mothers etc. Conference/Workshops/Meetings/Event engagements are best suited for knowledge utilization and dissemination as it provides both one-on-one engagement and group engagements with a range of stakeholders that informs, share findings or exchange knowledge-experience-skills (KES), engages in valuable discussions, raise awareness work done or serves as advocacy platform, build partnerships or establish networks, causes decisions to be made, brings on board possible investors, and get feedback where necessary.

7. PROJECT GOVERNANCE

Briefly explain how the project will be governed. Describe whether the project plans to incorporate advisors to provide overall oversight. What is the composition of the research team, their qualifications and specific roles in the proposed project? Is any partnership planned with other universities/ research institutes in your country (if the focus is national); or in other countries (if the focus is regional)? How will the private sector and other beneficiaries be involved in the design/ management/ execution of the project? What is the role of the university's/institute's management (if any) and how might this governance structure influence the success of the programme?

The project will be governed by the applying entity (SciInnovTec Research) with cordial overall oversight (not partnership) by an external expatriate at Louisiana State University, USA. SciInnovTec Research does have what we refer to as strategic partnerships core mandate for externally funded projects and are critical for every project implemented in terms of governance and this is no exception. Our team strategy convenes and supports multi-sectorial or multi-stakeholder partnerships be it at local/national level as well as at sub-national, sub-regional, regional and global levels aimed at concerted efforts and accelerate progress towards scientific research, innovations and technology developments. Our strategic partnerships allow us to share responsibilities, optimize resources, and maximize results. Each project is unique and determines the team's primary partners for strategic project development, implementation, governance, monitoring and evaluation thereof. Hence, partnership and governance can be clustered as:

- ✓ Academics
- ✓ Government
- ✓ NGOs and CSOs
- ✓ Private sector (Production / manufacturing Industry)
- ✓ A combination of the above

Research team composition, qualifications, sector involvement and roles is provided in appendix 1 below. Partnership focus is based on project needs, available expertise within which sectors. In country partnership will involve the Chemistry Department at Fourah Bay College of the University of Sierra Leone; The Debar group which is a private agricultural company. External partnership if agreed upon may involve the School of Nutrition and Food Sciences at Louisiana State University, and Esters of Nature, a private company both in the USA. The role of each entity is dependent on the infrastructural system for partnerships designed and used for such collaboration. With some entities, and depending on the nature of a project, the emanating sector (private, government, NGO, industry etc.) of the project, the management may not play any direct role in the partnership, but approves the partnership and oversees the financial disbursement on their side. A memorandum of understanding (MoU) will be signed with each partner around this project to enable each side to adhere to set timelines, and complete their tasks. Non-adherence to the MoU beyond a 30 days limit period will result in dissolving the partnership at no cost to the host project entity

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8. SUITABILITY OF THE HOST INSTUTUION

Describe the suitability of your institution in coordinating this project by highlighting the specific factors that make it uniquely qualified. Provide an overview of the technical infrastructure, human capacity, and other resource endowments that demonstrate the existing capacity to undertake the proposed research. Explain the institution's previous/ current activities, outreach and impact in the proposed area. Describe any existing or anticipated links with the private sector and other actors in the country/national system. Briefly demonstrate how this project will fit into the overall design of the university's/institute's overall research strategy

SciInnovTec Research (Scientific Innovation & Technology Research) is a non-profit entity suitably positioned for the proposed project in Sierra Leone. The overall supervisor (Prof. Witoon Prinyawiwatkul), and the principal investigator or lead researcher (Dr. Janette Saidu) are both renown Food Scientist with vast experience in the areas of product development, sensory consumer research, and nutrition research. Though a start-up entity, but the research center boasts of a small staff, a start-up facility comprising of office space, kitchen for small scale processing, equipment, laboratory space for analytical equipment. Most important is the requisite knowledge, experience and skills in the key areas of the proposed project

9. CAPACITY BUILDING

Describe how the project plans to contribute towards both individual and organizational capacity building. How might post-graduate students (MSc. and PhD) be involved in the project? What other training activities are envisaged under the project? Are their plans to enhance the capacity of project partners (and if so, in what areas)?

Capacity building as we all know is the process of developing and strengthening skills, instincts, abilities, processes, and resources that individuals, organizations or communities need to survive, adapt, and thrive in a fast-changing world. It is an essential ingredient in sustainable development, and goes beyond performing tasks to changing mindsets, behavior, and attitudes[1]. It is a transformation that is generated and sustained over time from within. With the RUTF project there will be both direct and indirect, tangible and intangible, and opportunity development. It is expected that individual staff or team members will acquire new skills from proposal writing to charting unknown territories like sensory and consumer testing. The project will the opportunity for our student workers to be involved in the project execution process that will build their academic knowledge and skills.

Institutional capacity will be strengthened both in essential resources (key processing equipment), learnings from project challenges and acquiring skills in maneuvering around such challenges in the Sierra Leone context. Project partners or assisting individuals will gain knowledge around working on such a project, its challenges, and experience every step of the way. Our strategic partnership will allow us share responsibilities, optimize resources, and maximize results.

10. MONITORING AND EVALUATION STRATEGY

Describe the monitoring and evaluation strategy approach that the research team will use for monitoring and evaluation of the research project.

Internal monitoring of the project hinges on its proposed activities and timeline ensuring that the project is on track with its goal and objectives. The PI and lead entity and overall supervising member will be monitoring and evaluating the project closely based on the performance indicator matrix in appendix 2. Monitoring and evaluation strategy will involve expense checks and balances, data quality collection etc.

11. GENDER, ETHICS AND SUSTAINABILITY

Describe how ethical approval will be obtained, if applicable. All projects that include human subjects must ensure that their privacy, dignity, and integrity are protected. Projects that will collect corporate or personal information must detail how informed consent will be obtained and confidentiality maintained. Carefully describe the links of the proposed project to ongoing projects within the institution (regardless of whether these projects are undertaken by the PI). If the project builds on other funded projects then provide accurate and verifiable information about the funding sources and whether the proposed activities are new. Explain how the project will be sustained beyond the project support. Are any donor partnerships anticipated, and if so, which ones? Provide details of any ongoing discussions with other funders, if applicable. Identify the key risks that may arise during the implementation of the proposed research and how each will be addressed. For each potential risk, outline the key assumptions and a mitigation plan.

Consumer studies with mothers will require ethical clearance from the Ministry of Health and Sanitation (MoHS). The principal applicant entity (SciInnovTec) will apply for ethical clearance from the Ministry of Health and Sanitation at least two/three months prior to the execution of that section of the study (Phase three). This phase of the project is about mother's perception of products being developed for their children and no preservatives are added to the products. Hence, the products will be considered safe since they will be heat treated, and their privacy, dignity and integrity will not be infringed upon. Every consumer study comes with informed consent (IC) and this is no exception. Informed Consent will be obtained from the mothers after explaining to them the purpose of the tests and procedure of testing. A copy of the consent will be provided to the MoHS for approval along with the request for ethical clearance.

This project is not linked to any other project or built on other funded projects nor is it funded by other funding grants. The projects being done in phases will be considered complete when data is collected, analyzed and published. Therefore, sustainability will only be considered with any off-shoot recommendations. At present, no donor partnerships are anticipated. However, we will continue to seek for extramural grants to fund the remaining phase(s) of this project

Obviously, and like every other project or activity, identifying and analyzing risk is an important part of the project planning process but having a clear sense of the project risks you face, helps prevent or prepare for upcoming risks. Risk mitigation matrix is detailed in Appendix 4 below.

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12. PROPOSED PROJECT ACTIVITIES & TIMELINE - Chart of key activities and timelines)

No.	Phase 1 Project Activities	Responsible Team	Year 1				Year 2			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.	**Activity 1.1 - Formulation of RUTF and Process Optimization with locally available ingredients** ✓ Determining formulation process and food Ingredient selection ✓ Ingredient Analysis ✓ Sensory tests of formulation selection ✓ Optimize formulation and profile analyze	Food Scientist-Product Developer. (SciInnovTec Res & LSU) FBC-Chemistry Dept Debar Group	**X**	**X**	**X**	**X**	**X**			
2.	**Activity 1:2 - Quality Evaluation and Product Analysis of RUTFs** ✓ Heavy metals - arsenic, lead, cadmium, mercury ✓ Toxins - Rice base after tainted with lead, cadmium. (These affect brain function).	External Analytical Laboratory on Food Safety					**X**	**X**	**X**	
3.	**Activity 1.3 - Storage/Shelf Life and Safety Tests** ✓ Six (6) months storage study under varying conditions (home use storage test, counter storage, airtight bin storage)	Food Scientist & Product Developer (SciInnovTec Research) (Commercial Labs for analysis				**X**	**X**	**X**	**X**	**X**
4.	**Activity 2.1 - Sensory Acceptance study with mothers (n-120)** ✓ Sensory testing of product ✓ In-vitro digestibility study	Food Scientist / Sensory Consumer Scientist (SciInnovTec Research; LSU				**X**	**X**	**X**	**X**	
5.	**Activity 2.2 - Cost Analysis of RUTF prototypes in comparison to Existing ones**	SciInnovTec Research							**X**	
6.	**Activity 2.3 - Development of crop value and supply chain with farmers producing crops utilized in the product prototype** ✓ Meet with farmers or producers and identify potentially sustainable suppliers ✓ Develop a supply chain system ✓ Training and Introduction of ingredient standards	Agronomist / Agriculturist (Debar Group Ltd) in conjunction with SciInnovTec Research				**X**	**X**			
7.	**Activity 3 – Mini Consumer Study** ✓ 100 – 120 mothers	SciInnovTec Research, LSU, MoHS (Food scientist, Nutritionists etc)						**X**	**X**	
8.	**Activity 4 - Data Analysis**	SciInnovTec & LSU				**X**	**X**	**X**	**X**	
9.	**Activity 5 - Project Report Write-up and Submission**	SciInnovTec Research						**X**	**X**	**X**
10.	**Activity 6 - Manuscript preparation for publication**	SciInnovtec Research							**X**	**X**

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Appendix 1: SciInnovTec Research Performance Indicator Matrix (M&E)

No.	Performance Objectives	Key Inputs	Key Outputs	Overall Outcomes
1.	Utilize modified process in two production path (POWDER & PASTE) to develop RUTF and RUSF using 100% local ingredients/produce	- *Utilize two different processing path - 1) to achieve a Paste product, 2) to get a ready to eat powder product*	- Number of stable composite mixes in each category	Number of prototype product produced
2.	To determine physico-chemical properties, microbial safety, sensory assessment, and preliminary storage and safety of the prototypes	- *Number of ingredients and product samples subjected to analysis for general physico-chemical properties, microbial safety information* - *Train mothers for sensory assessment testing* - *Assess product safety*	- Data on ingredients used in the development of products, and composite mix products - 50 trained mothers specifically for RUTFs, data of mother's assessment of products - Data on product safety	Data established on ingredients and products developed Established group of women for product sensory testing studies
3.	To determine the nutrient composition of products in meeting the energy density and daily nutrient intake for MAM, SAM and growth faltering children of 6 - 59months.	- *Number of products subjected to analysis products for RUTF specification for energy-density and daily nutrient uptake*	- Data of products analyzed and degree of specification or standard met	Established information on locally produced RUTF quality in comparison to expected UNICEF / WHO standards
4.	Determine safety and stability of products under local conditions.	- *Number of products subjected to post production safety and product stability testing*	- Data on products subjected to post production safety and product stability testing	Established information on locally produced RUTF safety
5.	Conduct cost analysis of RUTF prototypes in comparison to existing products	- *cost value of ingredient, processing, and other factors in production*	- Data on prototypes and market products	Established cost analysis information on product
6.	Establish strategic value and supply chain (VSC) of raw ingredients to meet production demand	- *Identification of farmers for the value and supply chain (VSC) development* - *Mini workshop with identified farmers on production, storage, crop quality and ingredient standards etc.*	- Number of farmer participants in the RUTF value and supply chain - Understanding of RUTF crop needs in the VSC	Developed VSC specifically for RUTF production in Sierra Leone. Identified farmers in the VSC only for RUTF
7.	Mini Consumer study with 100-120 mothers	*Preparation of field study* *Training of field staff* *Selection of study sample*	Assessment of prototype Data collected on formulated prototypes	Processed data with information of consumer perception of prototypes

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Appendix 2: Risk Assessment in RUTF Project Implementation

No.	Key Areas	Potential Risk	Assumptions	Mitigation plan
1.	Processing and development of RUTF using 100% local ingredients/produce	-Getting the needed produce in sufficient quantities -Low/poor quality grade or infected produce - Order and purchase of critical equipment - Equipment breakdown can cause delays and push timelines back	-Problem getting consistent reliable needed quantities - Farmers or sellers will sell anything with no attention to the quality - Supplier delays that can push project timeline back	-Have legal binding supply agreement in place with suppliers -Ensure produce check at point of purchase before packaging and put critical emphasis on quality. - Clearly communicate to supplier urgency on equipment need that is time bound - ensure maintenance and care of equipment
2.	Sensory Training and Testing	- occasional low turn up or drop out of panel members during testing sessions	-availability of panel members can be affected by any number of issues including personal, work, family, traveling etc.	-always train more panelist than needed so any dropping out or missing two consecutive sensory sessions can be replaced
3.	Analysis - physico-chemical properties, microbial safety, sensory assessment, and preliminary storage and safety of the prototypes	- Delays in analysis, stalls data analysis and needed report for next phase	- Sample load for analysis prior to ours can cause delays - lab accidents, equipment breakdown for any number of reasons can affect sample analysis - Other unexpected or unknown lab issues can cause critical delays	- Have alternate lab notified for analysis - Clearly communicate from onset time bound nature of projects, establish or agree on deadlines for results output that impacts payment
4.	Analysis - Nutritional composition of products in meeting the energy density and daily nutrient intake for MAM, SAM and growth faltering children of 6 - 59months.	- Delays in analysis, stalls data analysis and needed report for next phase	- Same as in no. 2 above	- Same as in no. 2 above
5.	-Determine safety and stability of products under local conditions.	- Delays in analysis, stalls data analysis and needed report for next phase	- Same as in no. 2 above	- Same as in no. 2 above
6.	-Conduct consumer acceptability and perception study of product prototypes with target group.	-Delays in getting ethical clearance can stall execution of study and data analysis for report development -Having sufficient product for testing impacts study	- declined if all conditions are not met or proper documentation not done -Low quantity availability due to seasonal effects; -Transportation of produce to processing center	-Submit ethical clearance request with proper documentation at least 3-4 months in advance of anticipated study execution date -Purchase sufficient quantities and store - Establish farmer or supplier contact in year 1 to ensure supply in year 2
7.	-Establish strategic value and supply chain (VSC) of raw ingredients to meet production demand	- Low farmer participation if purpose and expectations are unclear	-Possible problems if farmer lead/head is not transparent about the project and process -Affects farmer participation or getting farmers together -Unwillingness to sell produce at a standard prize	-Clearly express the purpose of the project, the need for farmers participation and impact, with emphasis to meet with all participants from the onset

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Appendix 3: Project Budget:

*****This project budget is based on current and projected costs in country and globally as at present time of submission. With inflation and rising costs globally, some items may be affected in a few months, hence a 5% contingency was factored into the budget.

RUTF Project Budget

Phase 1				
No.	**Item Description**	**Qnty**	**Unit Cost ($)**	**Total ($$)**
1. Formulation and Process Optimization (Multi-produce/ingredients)				
a.	Native/Rough Rice (50 kg bags)	4	50	200
b.	Plantains (50kg bags)	2	75	150
d.	Soybeans (50kg bags)	2	60	120
e.	Groundnuts (50kg bags)	2	75	150
f.	Benniseeds (50kg bags)	2	100	200
g.	Coconut Oil (5 gal)	2	45	90
h.	Sugar (50kg bags)	1	60	60
i.	Multi-Vitamin Premix (25kg)	1	1000	1000
Subtotal				**1,970**
2. Formulation & Processing Equipment and Transportation				
a.	Hobert Bench top mixer & slicer	1	2,500	2,500
b.	Steamer	1	1,500	1,500
c.	Stone grinder	1	1,800	1,800
d.	Wet grinder	1	1,120	1,120
e.	Air forced oven dryer (med Size)	1	4,800	4,800
f.	Miscellaneous materials	1	1,500	1,500
Subtotal				**13,220**
3. Quality Evaluation				
a.	Ingredient Analysis (8 samples)	8	200	1,600
b.	Composite mix - product Analysis (8 samples)	10	200	2,000
c.	Storage Analysis (30-36 samples)	32	150	4,800
d.	Safety Analysis (24 samples)	16	150	2,400
Subtotal				**10,800**
Total (Phase 1)				**25,990**

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Phase 2				
4. Sensory Testing				
a.	Sensory Training (Stipends for 50 women volunteers)	50	40	2,000
b.	Sensory Training Materials (Assorted)	*	*	1,200
c.	Sensory Testing study of Products	*	*	1,000
5. Supply and Value Chain Development & Cost Analysis				
a.	Field travel and meetings			1,000
b.	Workshop for lead farmers (10-12) on basic produce storage, required quality, standards + Food & Transport			1,000
6. Stipend				
a.	2 graduate students (12mths / 264 - 276 days spread over 21 months @50/mth*3*12)	2	1200	2,400
7. Manuscript & Publication				
a.	Journal fees	1	3000	3,000
Total (Phase 2)				**11,600**
Phase 3				
No.	**Item Description**	**Qnty**	**Unit Cost ($)**	**Total ($$)**
8. Mini Consumer Study with 100-120 Mothers				
1	Consumer study materials (Assorted)	1	1,500	1,500
2	Consumer study stipend for volunteer mothers to assess products	120	15	1,800
3	Consumer testing Field Equipment	10	200	2,000
Total (Phase 3)				**5,300**
All - Phase 1-3 Total				**42,890.0**
5% Contingency				**2,144.5**
Grand Total (Phases 1-3)				**45,034.5**

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Appendix 4: Project Team / Organizational Partners

SciInnovTec Research (Scientific Innovation and Technology Research)

Brief Profile / Background

Established in 2019, SciInnovTec (Scientific Innovation and Technology Research) is a female owned and led non-profit research entity aimed at contributing to national and economic development through strong strategic, rigorous scientific research initiatives in Sierra Leone. The entity has a small staff and partners or collaborates in joint venture activities. We are located on Lightfoot Boston Street in Freetown, Sierra Leone. Our core activities are in value-addition research, innovative and technology initiatives adaptable to Sierra Leone and the world at large.

Our Values

Our values define our mentality. It's who we are and how we work. These include Research & Development, Independence, Strategic Initiative, Collaboration, Continuous Improvement

Our Vision

Our mission defines us. It's what we do and that is promoting development through science, innovation, research and education.

Our Mission

To be the leading and recognized scientific research center in Sierra Leone through our outstanding quality of research, contribution to scientific innovations, and commitment to professional and public education initiatives. Our vision defines our path. It's what we aspire to be. Our mission is how we want to get there through innovative science and technology development research activities. We aspire to achieve this by continuously applying science, utilizing standard systems and technologies, improving our performance, and respecting our values.

Our Philosophy

Our philosophy is to attain our mission through the work of the Center's dedicated staff of researchers, technical support personnel, and generous funding or donor assistance by utilizing educated, proactive, and rational decision-making practices and upholding the ideals of ethical scientific and administrative conduct.

Our Aim & Goals

1) To become a greater force for national and economic development in Sierra Leone; 2) To promote the education aspect of SciInnovTec Research's mission, 3) To be recognized as a leading scientific research institution in Sierra Leone and globally.

Our Products & Services:

- Scientific Innovation & Technology Development (R&D)
- Research activities including consultancy services primarily across the Pure & Applied, and Social Sciences field
- Intellectual Property (IP) Management
- Strategic Research & Development Partnerships in R&D activities

The background, knowledge and experience embodied in our team for this project is based on the diversity of the activities and the expertise of each member / partner. SciInnovTec Research is the project initiator and applicant that will lead the project implementation/execution as well as its monitoring and evaluation. We will facilitate communication and organization among team members/partners in order to coordinate team activities. SciInnovTec Research will also coordinate the preparation of all reports and will support the activities of all partners in the proposed project.

Operational capacity: Skills and expertise of members involved in the RUTF project

Name of Research Team Member / Entity	Summary of Relevant Capacity, Skills and Experience
Prof. Witoon Prinyawiwatkul (Overall Supervisor and team Member) Lecturer & Researcher	Dr. Witoon Prinyawiwatkul is a professor of Food Science at Louisiana State University (LSU) and LSU Agricultural Center, USA. His research has been focused on sensory sciences, consumer research, and value-added/healthier product development. He oversees the Sensory Services Lab, and actively collaborates with researchers worldwide. He has published 270 refereed articles (an h-index of 58; an i10-index of 183) and is an author/co-author of 2 book edited and 5 book chapters. His publications have been cited nearly 1,021, 418, and 335 times for the top 3 articles (as of 10-13-2023). He is the fellow of Institute of Food Technologists, USA. He has served as the Scientific Editor, Section Editor, Academic Editor, Guest Editor, and an editorial board member for prestigious journals, including Comprehensive Reviews in Food Science and Food Safety, USA (Impact Factor: 14.4).
Dr. Janette Saidu Lead or Principal Investigator (SciInnovTec Research - Executive Director)	Dr. Saidu is a Food-Nutrition and Healthcare Scientist with over 25 years' work experience spanning across government, NGO, academic, and the food industry sectors. She has worked both at national and international level. She has four (4) refereed publications, eight (8) consultancy reports, and twelve (12) published scientific abstracts. Her publications have been cited over 400 times as reported by Academia.edu.

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Operational capacity: Skills and expertise of members involved in the RUTF project	
Name of Research Team Member / Entity	**Summary of Relevant Capacity, Skills and Experience**
J. Saidu (Continue)	In various positions she has served as nutritionist - government of Sierra Leone (GoSL), as Consumer and Senior Scientist in the Food Manufacturing Industry in the USA; Consulting Scientist (Cadbury's) in South Africa, Extraordinary Lecturer and Consultant (University of Pretoria), Internal and External Examiner (University of South Africa (UNISA)) - South Africa; Lecturer - Njala University, and volunteer Lecturer and consultant - COMAHS, as consultant - Helen Keller International, Adam Smith International, World Health Organization (WHO) etc. Ms. Saidu brings with her enormous experience across these sectors, strong leadership values to nurturing and growth of any organization. Functional expertise in: Food Science (a. Product Development, b) Sensory Product testing / research with Difference Testing and Descriptive Analysis, c) Consumer Research–Quantitative and Qualitative and d) Market research with Consumer Insight working knowledge of advertising, e) market and brand image tracking research, f) simulated market testing and forecasting etc.); Agro-foods processing, Nutrition, Education & Training.
Dr. Mohammed Sherrif Associate Analytical Chemist - SciInnovTec Research, and Owner/Director - Esters of Nature Company - USA	Dr. Sherriff holds a Ph.D. and Master's degree in organic Chemistry from Louisiana State University and Illinois Institute of Technology, respectively. Dr Sherrif brings on board over 15 years of physico-chemical analytical skills and experience, skin care product formulation experience as well as teaching and supervisory experience from academics and industry. Although he is presently in and out of Sierra Leone, but his role at SciInnovtec in overseeing analytical activities is an added value to the entity and the team.
Mr. Moses Ndomahina (Project Coordinator -SciInnovTec Research)	Moses Ndapie Ndomahina: LLB (Hons), Njala University; B.Sc. Administration; Post Graduate Diploma Business and Finance; Master's - Leadership and Governance Master's - Rural Development Studies. His background and work experience in proposal development and project management in combination with his recent legal background, makes him an asset to advise on legal project framework (Local & International) and above all shall develop, design and review all partnership agreement. Shall monitor and evaluate risks, and project timelines over the 21 months period.
Mr. Dauda Saffa (Research Coordinator - SciInnovTec Research)	Mr. Saffa is a research coordinator at SciInnovtec Research and brings on board teaching and research supervision and related experience from the University of Sierra Leone, and from the Statistics Sierra Leone department. He is a prospective M.Phil. graduate student awaiting graduation. He has worked as field enumerator and supervisor at Statistics Sierra Leone. Mr. Saffa is passionate about research and moving into the scientific research realm and looking forward to broadening his knowledge, skills and experience.
Mr. Omar Alghali (Owner and Director -Debar Group Ltd -Sierra Leone)	Mr. Alghali is an Agricultural Agronomist with over 25 years extensive work experience in agricultural cooperatives development, value chain development in Sierra Leone. He is presently the owner and Executive Director for DEBAR Group Limited, an Agriculture based consultancy entity. His expertise deals with Agricultural Production, Agronomic practices for increased crop yield, Value and Supply Chain (VSC) development & analysis, Rural Agricultural Development, Agricultural Environmental Vulnerability and Social effects. Mr. Alghali holds a B.Sc. and other certificates in Agricultural Sciences. He will be responsible for the development of RUTF Value and Supply Chain analysis in conjunction with SciInnovTec Research.
Chemistry Department (Fourah Bay College - University of Sierra Leone)	The department of Chemistry at Fourah Bay College is one of the oldest departments within the University of Sierra Leone's academic system. Though limited in analytical capabilities, we hope to partner with them based on available resource and any applicable analytical capabilities for the project.