

innofood

africa

SOUTH AFRICA



## DEVELOPING SUSTAINABLE AGRI-FOOD VALUE CHAINS

AN AFRICA-EUROPE COLLABORATION



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA



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# message from the consortium leader

THIS PUBLICATION PROVIDES A SYNOPSIS OF THE EUROPEAN UNION-FUNDED INNOFOODAFRICA PROJECT AND THE PROJECT ACTIVITIES CARRIED OUT AT THE UNIVERSITY OF PRETORIA. INNOFOODAFRICA HAS BEEN A TINY GRAIN OF SAND IN THE HUGE EFFORT TO TRANSFORM THE PRESENT FOOD SYSTEM IN SUCH A WAY THAT IT WILL BE CAPABLE OF FEEDING THE GLOBAL HUMAN POPULATION, ALSO IN THE FUTURE.

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It is a big, but not overpowering, challenge to transform the African agri-food system to be able to offer healthy food to all African people when climate conditions are changing and the whole world is facing political turbulence. Both these challenges affect the availability of food, particularly in Africa. The proper food system necessitates the sufficiency of raw materials of a good quality, but also functioning value and supply chains through which the food will reach all consumers.

Another challenge is how to transform the African agri-food system towards indispensable sustainability.

Environmental sustainability is achieved when the food raw materials, e.g. food crops, that are produced are resilient in changing climate and environmental conditions. They should also be harvested, stored and transported so that the quality is maintained on a high level, and waste generation should be minimised.

Social sustainability is achieved when the food that is produced is healthy and nutritious, and affordable, also to low-income people.

Affordability is based on the domestic, intrinsically African, raw materials, increased raw material productivity, and improved support to smallholder farmers. Food quality must be maintained along the value chain, and the value chains streamlined for better efficiency.

It goes without saying that the transformation of the agri-food system necessitates the joint efforts of the academic community, private sector operators (who represent the whole value chain, from smallholder and commercial farmers to food processors and manufacturers, logistic services, packaging and retail organisations, and entities that provide training) and decision makers on all levels. The InnoFoodAfrica project and its partners have done their part to advance this transformation, targeting the challenges mentioned above.

This publication gives a comprehensive description of how acknowledged scientists students at the University of Pretoria have focally affected the success of the project by developing diverse solutions to advance the transformation of the African agri-food system.

I am indebted to Prof Naushad Emmambux for successfully coordinating the research, development and innovation activities and pulling this publication together. I also wish to acknowledge the University of Pretoria's lead researchers. Prof Riëtte de Kock, Dr Marinel Hoffman, Prof Quenton Kritzinger, Dr Diana Marais, Dr Danie Jordaan and Prof Shakila Dada. I wish the students who have contributed to the project through their focal and high-quality studies the best of luck.

**Dr Raija Lantto**

*Coordinator of InnoFoodAfrica  
VTT Technical Research Centre of Finland Ltd.*

# preface

THE EUROPEAN UNION, THROUGH ITS HORIZON 2020 GRANT PROGRAMME, LAUNCHED A 42-MONTH-LONG RESEARCH AND INNOVATION PROJECT, TITLED INNOFOODAFRICA (IFA), TO EXPLORE CLIMATE-SMART AFRICAN CROPS (CEREALS, PULSES, ROOTS AND CROP FRUITS) IN ETHIOPIA, KENYA, SOUTH AFRICA AND UGANDA. IFA IS A MULTINATIONAL, CROSS-CONTINENTAL PROJECT THAT AIMS TO ENHANCE FOOD AND NUTRITION SECURITY IN AFRICA, AND OPEN THE DOOR TO EXPORT MARKETS IN BOTH AFRICA AND EUROPE.

InnoFoodAfrica entails international collaboration between Europe and Africa, and depends on a strong cross-disciplinary consortium of 18 partners, dominated by 13 African organisations with a deep understanding of the local needs of consumers in the four countries involved in the project.

The project has a multidisciplinary approach. It comprises eight work packages, which entail researching consumers in each country's nutrition status and the link to diet-related, non-communicable diseases, empowering farmers, manufacturing healthy foods and food ingredients, and creating bio-based packaging that is naturally sourced and biodegradable.

Upon conclusion of the project, each country's input towards the project's overall goals will contribute to solving societal challenges related to food security, sustainable agriculture and the bioeconomy through the organisation of joint events, technology and knowledge transfer, and the sharing of training materials. The establishment of an African Innovation Platform will therefore steer the project's long-term outcomes beyond a single country by providing peer support for small farmers, and small and medium food and packaging enterprises.

Among other outcomes, IFA will enable compliance with market and supply chain demands, such as good manufacturing practices and the maintenance of quality control parameters. This will contribute to the goals of the European Union's Partnership on Food and Nutrition Security and Sustainable Agriculture (FNSSA), which forms part of the African Union (AU)-European Union (EU) high-level policy dialogue on science, technology and innovation.

This publication reports on the main outputs of the South African leg of the IFA project. The outputs are from research carried out by postgraduate students and postdoctoral fellows at the University of Pretoria. This publication is also a celebration of the young and upcoming African scientists, working in a transdisciplinary, international project to produce excellence in the field of nutrition, agri-food science and technology.

I acknowledge the funder, our consortium partners, colleagues and students at the University of Pretoria, without whom this project would not have been possible.

**Prof Mohammad Naushad Emmambux**

*Principal Investigator: University of Pretoria, InnoFoodAfrica*



# background

## VISION

InnoFoodAfrica addresses the key bottlenecks of African food value chains: low productivity, limited access to urban and international markets, and the lack of affordability and convenience of products. Its actions are tailored to develop novel solutions for agriculture, food manufacturing and the use of residual biomass for packaging in a local context.

## OBJECTIVES

InnoFoodAfrica aims to develop new sustainable value chains to produce and distribute diverse and healthy foods from African farms to local and export markets. It focuses on the southern and eastern African regions, and European export markets by empowering smallholder farmers and entrepreneurs in small and medium enterprises. This is enabled by working on strategic food crops in the partner countries, and developing climate-smart agri-food systems that are resilient to climate change, including research, development and capacity building. This goal is achieved by combining technology development with training and communication activities (with a focus on women's engagement) in farming practices, nutrition, ingredient and food solutions, biopackaging to reduce food losses and waste, as well as related business creation.

*The main objective is broken down into six specific objectives:*

1

The development of resource-efficient, safe and sustainable food production value chains by empowering smallholder farmers, processors, producers and consumers via a co-creation process with African and European experts; and catalysing new local and international business and market opportunities in the cereal-pulse-root crop-fruit food and packaging value chains, engaging value chain actors and investigating new business models.

2

The country-specific adaptation and implementation of dietary guidelines that are based on cereal-pulse-root crop-fruit-based foods and diets that tackle malnutrition in small children, also focusing on the health of expecting and breast-feeding mothers who need to take care of both themselves and their children within the first 1 000 days of life, as well as adults at risk of obesity.

3

The diversification of plant-based agri-food systems that enables nature-benefitting farming and the production of African food, which forms the basis of a balanced diet.

4

The development of safe and nutrient-dense cereal-pulse-root crop-fruit-based food ingredients and products that tackle malnutrition from two angles: nutrient deficiencies and obesity, recognising both children (within the first 1 000 days) and adult consumer segments.

5

Increasing resource-efficiency of the African cereal-pulse-root crop-fruit-based food value chains by reducing food loss and food waste by improving post-harvesting and storage practices, and creating value from side streams via bio-based packaging solutions to replace plastic.

6

The establishment of a pan-African food research, development and innovation community via cooperation and the creation of an open Innovation Platform; contributing to the goals of the EU-African Research and Innovation Partnership on Food and Nutrition Security and Sustainable Agriculture; and cooperating with ongoing projects in the subject area to share innovations, maximise communication and facilitate technology transfer.

Each of the IFA's six work packages addresses one of these specific objectives.

**PARTNERS**



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University of Pretoria **SOUTH AFRICA**



Organisation for Social Science Research in eastern and Southern Africa (OSSREA) **ETHIOPIA**



Amhara Regional Agricultural Research Institute **ETHIOPIA**



Guts Agro Industry PLC **ETHIOPIA**



Addis Ababa University **ETHIOPIA**



Uganda Manufacturers Association **UGANDA**



Food and Nutrition Solutions Limited **UGANDA**



Kulika Uganda **UGANDA**



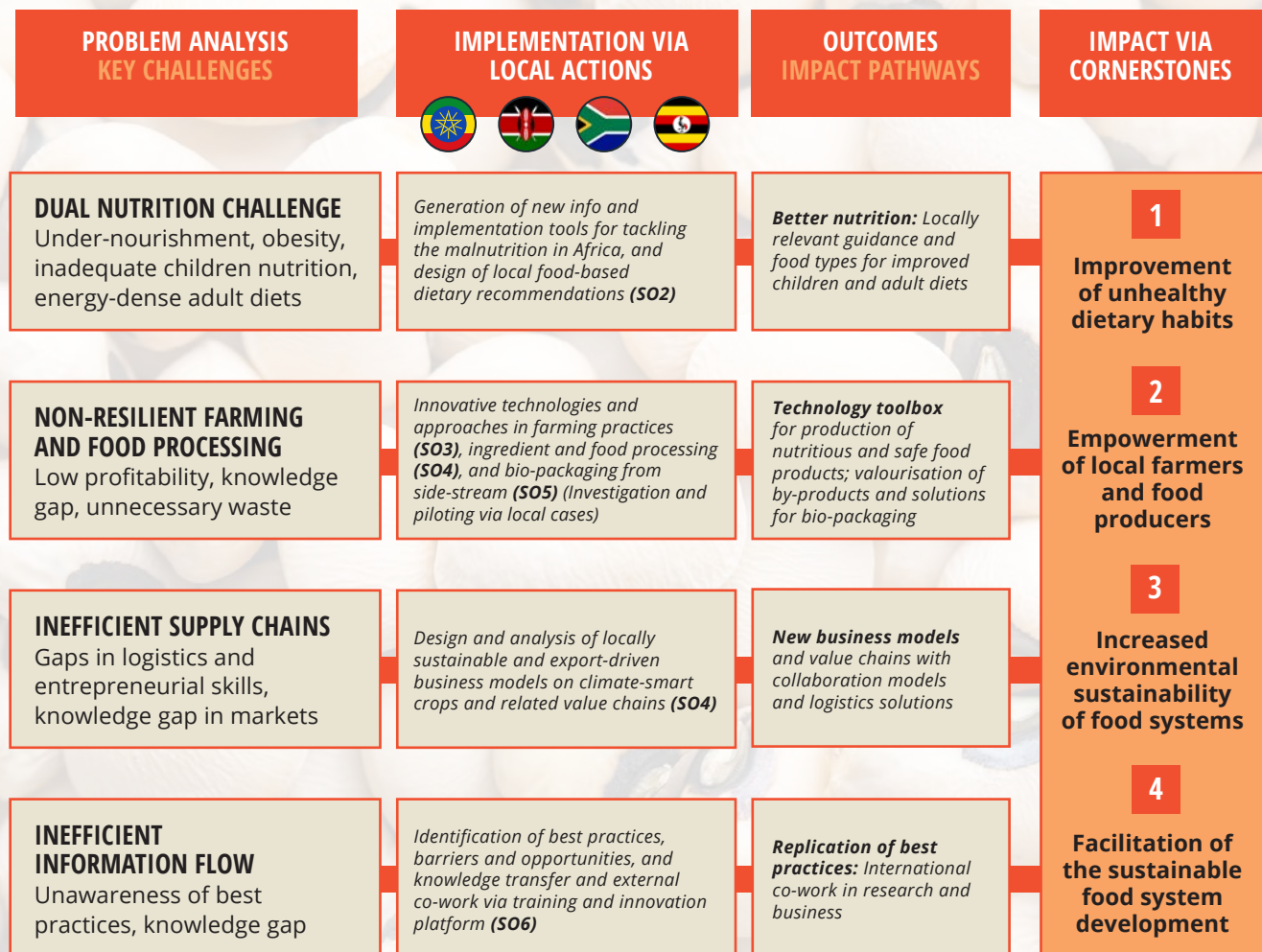
Makerere University **UGANDA**



**InnoFoodAfrica** focuses on the southern and eastern African regions, and European export markets by empowering smallholder farmers and entrepreneurs in small and medium enterprises.

**CONCEPT**

The InnoFoodAfrica concept, with its specific objectives, contribute to developing new sustainable agri-food value chains.



# problem analysis and expected impacts

## ADDRESSING SOCIETAL CHALLENGES

The double-sided fundamental challenge of our time is our survival with increasing population and decreasing agricultural production because of climate change, which is predicted to be the most severe in Africa. The Intergovernmental Panel on Climate Change (IPCC)'s recent special report on climate change and land shares the same concern on land use-related climate change, sustainable food security, and nutritionally balanced and diverse diets.

Furthermore, the EAT-Lancet Commission's report on healthy diets from sustainable food systems states that a rich plant-based diet with fewer animal-sourced foods confers both improved health and environmental benefits. It claims that food is the single strongest lever to optimise human health and environmental sustainability on earth.

The committed and generated excellence and targeted impact of IFA are therefore aimed at tackling this double-sided challenge. Solutions are created to establish diets and eating habits based on sustainably produced plant-based nutritious foods. IFA deploys Afro-European co-creation power to start renewing the African food system with a focus on strengthening African plant-based food markets in southern and eastern African regions, and in Europe.

## ACHIEVING THE EXPECTED IMPACTS

The overall IFA project had six expected impacts in each of the partner countries. These were addressed via measurable objectives.

### 1. Improved food systems, resulting in sustainable, healthy African diets that, in the short term, are to become mainstream in ten African cities.

The project's approach to improved diets is not only related to the generation of practical and locally relevant dietary guidelines and new foods, but especially to addressing the whole food system and value chains from farm to fork. The country- and city-specific field studies and training activities were systematically implemented to boost the food system level change from the local perspective. The development of healthier food products and raw materials was a core element of the project. The sustainability of food systems (implemented by resilient agricultural practices), the use of local plant-based raw materials and their combinations, and energy- and resource-efficient technologies were therefore promoted.

### 2. The empowerment of smallholder farmers, combined with sustainable growth of food chain operators in rural areas in Africa for internal markets and exports.

The empowerment of farmers was based on developing a knowledge toolbox, as well as new business opportunities. In addition to the technology and process development, several training and participatory activities were held in the partner countries to enhance the potential of smallholder farmers and other operators in the rural food value chain, with a special emphasis on women empowerment. Replication will continue after the project via the training of trainers. The sustainability of the value chain is promoted by the uptake of local and climate-smart crops for both food and new bio-packaging solutions that also promote the reduction of food loss and the promotion of export opportunities.



### 3. New market opportunities for novel food products, tools and processes applicable in Africa that are considering food safety issues across the entire food value chain, and reduce food waste.

Consumer insights from the partner countries were investigated. Convenient and safe product prototypes targeting malnutrition in small children, as well as adult obesity in Africa, were developed. The project would enhance the market uptake of new food products in urban African markets, while generating export possibilities. The project also developed affordable and nutritious plant-based ingredients from local sustainable crops with the potential to be used in existing and new value chains, both in Africa and globally. Two new bio-based packaging materials were developed at the pilot scale to reduce the waste load, enabling added-value exportable products.

### 4. Significant reduction of malnutrition in Africa, particularly related to children, implementing nutritional recommendations.

Country- and region-specific food-based diet design was supported by the development of affordable and convenient nutritious food products to reduce malnutrition. IFA focused on the undernourishment of small children, and the obesity risk of adults. The communication and dissemination of healthy diets and related dietary guidelines were done through direct training interventions and broader dissemination activities. The focus was on women and mothers as the main decision makers in African families, who have a direct impact on the nutrition of small children. These food products were characterised as having low viscosity to increase nutrient-density, which was particularly beneficial for small children.

### 5. Major progress towards the establishment of the EU-Africa Partnership on Food and Nutrition Security and Sustainable Agriculture for research, innovation and impact at the local level.

The project brought together African and European partners, establishing international cooperation or links in the field of food and agriculture. Food system innovation was ensured and fostered by the creation of the IFA Innovation Platform, which will engage and activate local networks of stakeholders in different sectors of the value chain, delivering innovation, knowledge and technologies to the end-users in the form most suitable for their uptake. Practical training interventions were implemented to educate local actors from farm to fork. Actions were also taken to network and share results and knowledge with other ongoing projects.

### 6. Development and implementation of pilot innovation actions for the benefit of African and European consumers at a Technology Readiness Level (TRL) of 4 or 5.

Pilot actions and field studies took place in the partner countries at different steps of the value chain. At the farming level, pilot actions were related to the improvement of the productivity and agricultural practices of local crops on local farms, including less exploited crops. Ingredient and food processing included the development of ingredients at the pilot scale and new food products suitable for malnourished or obese urban African consumers. Technologies for processing side streams included the piloting of two bio-based packaging products. Specific export market penetration pathways were considered. Innovations were communicated via the Innovation Platform, which was targeted to specific end-users.

**The goal** is achieved by combining technology development with training and communication activities (with a focus on women's engagement) in farming practices, nutrition, ingredient and food solutions, biopackaging to reduce food loss and waste, as well as related business creation.

# key concepts

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DID YOU KNOW?

## WHAT ARE CLIMATE-SMART CROPS?

Climate change is a global challenge and threat to agricultural sustainability and food production worldwide, leading to reduced crop yields, and livestock, food and production losses. Agricultural systems in Africa are facing several weather-related risks, such as changing rainfall patterns, increasing temperatures, and frequent occurrences of intensified droughts, dry spells, heat waves, floods, pests and diseases.

These risks are expected to advance in the future, and will continue to threaten the sustainability of farming, with smallholder farmers being among the most vulnerable. This is expected to expose the most vulnerable communities to food and nutrient insecurities, poverty, economic crisis, and environmental and ecosystem degradation as the human population is projected to increase in the future.

Climate-smart crops are resilient to drought and can cope with the adverse effects of climate variability. They are often underutilised, and considered to be traditional crops that are not widely included in urban diets. They are often very nutritious, and can contribute to combatting malnutrition and susceptibility to non-communicable diseases. Their production can also lead to the development of new sustainable value chains.

Indigenous vegetables that are regarded as climate-smart African crops, and which have been included in the research projects that formed part of the IFA project in South Africa, include Bambara groundnut, cowpea, orange-fleshed sweet potato and sorghum.



**Bambara groundnut** plays an important role in food security due to its drought-tolerant characteristics. It is an underutilised crop that is indigenous to Africa. Cultivated across the semi-arid sub-Saharan African region, it is a hardy crop and has been recognised as an important nutritious food source when food is scarce. It can fix nitrogen and grow under adverse environmental conditions such as poor soils and drought. As a nutrient-dense legume, it is sometimes termed a “complete food” due to its balanced macronutrient composition.



**Cowpea** is a nutritious, underutilised legume that has the potential to alleviate protein-calorie malnutrition. It can be grown under harsh conditions such as drought and sandy soils. Its ability to tolerate climate change makes it an important crop for food and nutritional security in tropical and sub-tropical regions in the world, including in sub-Saharan Africa. It contributes to the sustainable improvement of the environment due to its biological nitrogen fixation ability, and its positive effects on the soil as it increases the soil's microbial diversity.



**Orange-fleshed sweet potato** is rich in pro-vitamin A and is an ideal staple to grow in densely populated, drought-prone countries. It can fit into diverse farming systems, and its cultivation has been increasing in sub-Saharan Africa over the past 25 years. It is nutrient-dense and breeding efforts have focused on enhancing its drought tolerance, with several drought and disease-tolerant cultivars being grown in Mozambique, Malawi and South Africa. It is rich in micronutrients, matures rapidly and does not require significant amounts of water to flourish.



**Sorghum** is a heat-resistant and drought-tolerant plant. It is a viable crop in even the most challenging of growing conditions. It has many uses as a food and beverage, and has similar levels of macronutrients, vitamins, minerals and dietary fibre to other cereal grains. It is gluten-free and provides sustained energy. It also has the potential to bolster the livelihoods of smallholder farmers in Africa.

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DID YOU KNOW?

**WHAT IS THE SIGNIFICANCE OF THE FIRST 1 000 DAYS FOR OPTIMAL CHILD DEVELOPMENT?**

The importance of optimal nutrition during the first 1 000 days of a child's life, starting from conception to a child's second birthday, is well recognised. Good nutrition during the first 1 000 days provides the building blocks for critical brain development, growth and the building of a healthy immune system. Maternal nutrition during pregnancy is directly linked to an infant's weight at birth. A low birth weight in infants (below 2.5 kg) increases the risk of morbidity and mortality. The offspring of malnourished (underfed) or overweight (excess dietary intake) mothers during pregnancy and lactation, who were also exposed to an obesity-causing environment during childhood, are more prone to develop obesity. Therefore, it is not only the nutritional environment to which a child is exposed after birth, but also the mother's diet or nutritional status that is an important determinant of a child's nutritional status.

Q

DID YOU KNOW?

**WHAT ARE DIET-RELATED NON-COMMUNICABLE DISEASES?**

According to the World Health Organization, unhealthy diets such as those high in sugar and salt, with a lack of nutrients, coupled with a lack of physical activity, may display raised blood pressure (high salt consumption), increased blood glucose (high sugar consumption), elevated blood lipids (intake of diets high in saturated fats such as those from animal-sourced foods, and diets high in trans fatty acids such as fried foods, potato crisps) and obesity (the consumption of a diet high in saturated fats/trans fatty acids, sugar and salt, a low intake of clean water and low physical activity). These are called metabolic risk factors and can lead to cardiovascular disease, which is the leading non-communicable disease (NCD) in terms of premature death.

Q

DID YOU KNOW?

### WHAT IS THE SIGNIFICANCE OF LOW GI AND GLUTEN-FREE MEALS?

Low GI (Glycaemic Index) foods release their carbohydrates slowly. The GI describes the rate at which sugar is released into the bloodstream after foods that contain carbohydrates are eaten. Glycaemic response is important for people with diabetes who want to limit spikes in their blood sugar. Foods that are rich in dietary fibre (e.g. whole grains, fruits and vegetables), with a low GI and glycaemic load, improve one's glucose control and reduce diabetes risk. Consuming these foods may also improve blood lipids, fight against inflammation, and assist in appetite regulation and weight management. Gluten-free foods do not contain cereal flours from wheat, rye, barley and triticale (a cross between wheat and rye), but rather include gluten proteins. Gluten-free foods are important food items for individuals who have coeliac diseases (a condition in which gluten damages the lining of the small intestine), those who are allergic to gluten, and those with a gluten intolerance.

Q

DID YOU KNOW?

### WHAT IS THE VALUE OF UNDERUTILISED AFRICAN CROPS?

Due to their resistance to adverse climatic conditions and nutrient density, the underutilised crops qualify as viable alternatives to address food insecurity and malnutrition. Promoting and incorporating indigenous nutrient-dense crops into food value chains could ensure sustainable and resilient food systems, improve diet quality and increase smallholder farmers' incomes. Underutilised crops have the potential to end hunger and poverty, but they are the most vulnerable crops in food systems. Their production also has poor access to infrastructure, inputs, and markets, and they are often farmed by smallholder farmers with access to less than 2 ha of land. Bambara groundnut cowpea and orange-fleshed sweet potato are examples of relevant African crops that are prevalent and consumed among rural residents in South Africa. However, the potential to commercialise them is hampered due to challenges in their value chains.



Bambara groundnut

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# work packages

THE **INNOFOODAFRICA** PROJECT AT THE UNIVERSITY OF PRETORIA COMPRISED SIX WORK PACKAGES. EACH WORK PACKAGE WAS LED BY A PROMINENT RESEARCHER OR RESEARCHERS IN THEIR FIELD, UNDER THE GUIDANCE OF PRINCIPAL INVESTIGATOR, **PROF MOHAMMAD NAUSHAD EMMAMBUX**.



## **WORK PACKAGE 1**

**Analysis of local value chains by consumer, market and business model studies**

**UP lead researcher: *Prof Riëtte de Kock***

Prof De Kock is a professor in the Department of Consumer and Food Sciences. Her fields of expertise are sensory science and food product development. Her research focuses on the optimisation of the sensory properties of food and beverages that contribute to the nutrition status and well-being of consumers in sub-Saharan Africa. This includes food product development and business creation to meet the demands of a growing and more urbanised African population. She is also involved in the exploration of the sensory experiences from Africa's biodiverse food sources, and designing products that are not only nutritionally adequate, but also appealing and appetising.

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## **WORK PACKAGE 2**

**Contribution to the improvement of the African diet against malnutrition**

**UP lead researcher: *Dr Marinel Hoffman***

Dr Hoffman is a senior lecturer and researcher in the Department of Consumer and Food Sciences. Her field of expertise is nutrition and early development. Her study background includes a postdoctoral fellowship with a focus area on nutrition during pregnancy and early development at North-West University. Her current research focuses on infant nutrition, with a special focus on feeding practices and nutrient intake in association with development during infancy. She is a member of the Research Centre for Maternal, Fetal, Newborn and Child Health Care Strategies at the University of Pretoria, where she works with a clinical team investing in the growth and development of infants and young children exposed to HIV.

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### WORK PACKAGE 3 Improved farming practices<sup>1</sup>



**UP lead researcher: Prof Quenton Kritzinger**

Prof Kritzinger is an associate professor in the Department of Plant and Soil Sciences. While his research activities integrate the fields of mycology, seed pathology and medicinal plant sciences, his main field of interest is the storage fungi, the mycotoxins they produce and their association with orphan crops. The aim is to use plant extracts to develop botanical fungicides that can be used as an alternative, environmentally friendlier approach to prevent and control the fungal infestation and mycotoxin contamination of grain in storage systems. His research projects are aimed at ultimately contributing to enhancing food security among smallholder farmers and rural communities in South Africa and on the African continent.



**UP lead researcher: Dr Diana Marais**

Dr Marais is a senior lecturer in the Department of Plant and Soil Sciences. Her field of expertise is the general agronomic practices of crop production in various crops. Most of her work involves plant nutrition or water use, water-use efficiency and nutrient water productivity. In her most recent research, she also works closely with food security, which has sparked an interest in the field of addressing human nutrition through legume and vegetable crops.



**UP lead researcher: Dr Danie Jordaan<sup>2</sup>**

Dr Jordaan is a senior lecturer in the Department of Agricultural Economics, Extension and Rural Development. His field of expertise is agricultural supply chain analysis, agribusiness management, agro-processing, strategy and management development, and expert quantum reports. His current activities include undertaking agribusiness and value chain research in a range of local and international research projects. His key skills include research and teaching in agribusiness management and value chain analysis in a rural development setting.

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<sup>1</sup> This work package had a leadership team of three members.

<sup>2</sup> Dr Jordaan also provided inputs in Work Package 1.



#### **WORK PACKAGE 4**

**Food processing and product innovation<sup>3</sup>**

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#### **WORK PACKAGE 5**

**Bio-based packaging to reduce food waste along the food chain**

**Principal Investigator and UP lead researcher: *Prof Mohammad Naushad Emmambux***

Prof Emmambux is a professor in the Department of Consumer and Food Sciences. His field of expertise is chemistry, nutrition and technology of food biopolymers (protein, starch and non-starch polysaccharides) in food and non-food systems. He works at the interface of food molecular, nano and micro-structure, nutrition and functionality to structure the design of SMART (safe, marketable, affordable, ready to eat and tasty) African foods with green or energy efficient food processing technologies. He is also the research leader for food processing at the Department of Science and Innovation (DSI)- National Research Foundation (NRF) Centre of Excellence in Food Security.

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#### **WORK PACKAGE 6**

**Engagement with local and international stakeholders to disseminate, communicate and share results**

**UP lead researcher: *Prof Shakila Dada***

Prof Dada is the Director of the Centre for Augmentative and Alternative Communication (AAC) in the Faculty of Humanities. Her research seeks to systematically describe and understand the communication and participation patterns of people with complex communication needs. Much of her work focuses on the role of graphic symbol learning to facilitate the comprehension of language. In the IFA project, she applies this to ensure that nobody is excluded from the research because of low levels of literacy, or not speaking the same language as a researcher. Her main role was to ensure that communication in the project was accessible, ensuring a more inclusive, equitable research agenda, and to ensure the research was accessible, inclusive and disseminated widely with stakeholders and the public.

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<sup>3</sup> Prof Emmambux is the lead researcher in both Work Package 4 and Work Package 5.

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**WORK PACKAGE 1**

**ANALYSIS OF LOCAL VALUE CHAINS BY CONSUMER, MARKET AND BUSINESS MODEL STUDIES**

AT THE UNIVERSITY OF PRETORIA, THIS WORK PACKAGE WAS CO-LED BY **PROF RIËTTE DE KOCK** AND **DR DANIE JORDAAN**. IT AIMED TO GATHER CONSUMER INSIGHTS AND DEVELOP BUSINESS MODELS FOR THE FOOD SYSTEM VALUE CHAINS AND EMPOWER VALUE CHAIN ACTORS TO IMPLEMENT THE SOLUTIONS DEVELOPED IN THE PROJECT.

**The objectives were as follows:**

- Gain knowledge and data on both local and export markets, supply chains and consumer preferences to support the development of new products and value chains.
- Quantify consumer attitudes and dispositions related to food choices and products in cities or regions within the partner countries.
- Draft business models to support value chain development by identifying gaps and opportunities, logistics solutions, techno-economic feasibility, and marketing strategies to promote both local supply and export opportunities.
- Empower local value chain actors, particularly farmers, by providing practical information, knowledge and entrepreneurial skills through training.

**These objectives were achieved through the implementation of different tasks by teams from South Africa, Ethiopia, Kenya, Uganda, Finland, France and Norway:**

- Validating and applying instruments to quantify consumer attitudes
- Measuring consumer attitudes and dispositions related to the new food prototypes developed for the partner countries
- Market surveys and analyses of business models for value chain development
- Empowering farmers and value chain actors

Many complex factors influence food choices. The activities of the work package were therefore to provide the other work packages with insights, especially for the development of innovative new products and bio-based packaging solutions. While new products have numerous health benefits, and can provide economic opportunities and solutions to the challenges of food insecurity, they need to be acceptable to consumers in terms of taste and texture, among other things. It is crucial to understand

how best to introduce new products to the consumer markets.

The activities need to provide researchers, entrepreneurs and producers with an understanding of how best to introduce new products to the consumer markets.

One such activity involved participation in a comparative study among the four partner countries: Ethiopia, Kenya,



South Africa and Uganda. The data would be compared with consumer data from Norway, Finland and France to determine the viability of exporting products manufactured from indigenous African crops to Africa and Europe. The aspects driving food choices were different between Africa, with its developing countries, and Europe, with its more developed markets and different climates.

It was found that the likelihood of a consumer trying a new product is linked to their interests and what is known to them. Determining and measuring consumer interest in products manufactured from African indigenous crops, such as Bambara groundnut, cowpea, sorghum and orange-fleshed sweet potato, are important activities in the development of value chains. Although such crops are well known in the rural areas of the continent, their application as health-promoting products in urban markets was limited.

A further challenge lies in the need to modernise products manufactured from underutilised African crops. Examples of products that were developed are pasta and snacks from cowpea and sorghum so that these can gain popularity in the European market.

A benefit of the commercialisation of such products lies in the fact that the health food market is now more established, even in Africa. However, the marketing of such products requires an understanding of the food choice drivers of urban consumers. Features such as convenience and variety often come into play.

### CONSUMER INSIGHTS

The research in this work package included an analysis of local value chains through consumer, market and business model studies. This work aimed to empower local value chain actors, specifically farmers and food processors, by providing advisory services, market and business information, and training for capacity building and networking to stakeholders.

A toolbox for consumer sensory testing of products was developed. Training was also conducted to support successful plant-based product innovations to create more sustainable food systems.

As part of this work, PhD candidate **Nomzamo Magano** developed an instrument to help us understand the factors that influence African consumers' food choices and to understand end-consumers' preferences for the project's novel food products and packaging options made from climate-resilient food crops.

Magano's findings highlighted the strong influence of financial factors on consumer food choices and preferences. This work was published in an article, co-written by **Prof De Kock** and **Prof Hely Tuorila**, on food choice drivers at varying income levels in an emerging economy, published in the academic journal *Appetite*.

### APPLYING INSTRUMENTS TO QUANTIFY CONSUMER ATTITUDES

Work was conducted to validate and apply instruments to quantify consumer attitudes and dispositions related to food and bio-packaging acceptance or rejection, and to quantify the health and taste attitudes of consumers in the partner countries. This enabled role players to determine the implications of these factors on the acceptance of the developed products.

Food quality perception, preferences and related information to predict food choices and impact on health and individual well-being were assessed to achieve a better understanding of the interaction between consumers and food choice contexts.

This work focused on unpacking the drivers of food choice by South Africans in current times. An outcome of this work was the publication of a new and updated Food Neophobia<sup>4</sup> scale relevant to the African context. This aspect of the project also investigated cultural and attitudinal perspectives related to indigenous crops.

4 *Neophobia: The fear of anything new.*

The research of PhD candidate **Nishanie Moonaisur** focused on plant-based meat alternatives in South Africa. She also reviewed factors such as the nutritional content, ingredients, country of origin, cost and label claims as compared to meat alternatives. Information about possible barriers, drivers, consumer expectations and attitudes towards these products is explored in the next phase of her research.

Moonaisur's research was featured in an article, co-written by **Prof De Kock** and **Dr Nadene Marx Pienaar** from the University of Pretoria's Department of Consumer and Food Sciences, published in the academic journal *Food Science and Nutrition*.

Other studies conducted as part of this work package on the validation and application of instruments to quantify consumer attitudes related to food included the following:

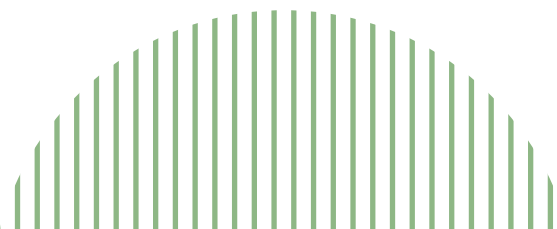
- Consumer acceptance of environmentally sustainable food ingredients: the case of palm oil (PhD study by **Manzi Sishi**)
- Attitudes towards a traditional food: Mala Mogodu (Master's study by **Vimbai Chikwazira**)
- Food neophobia as a determinant of consumers' liking of bread with orange-fleshed sweet potato as an ingredient (Honours study by **Clarissa van Heerden**)
- Food neophobia and consumers' expected and actual liking of plant-based meat alternatives (Honours study by **Lucy Purdon**)

The results of these studies were used to guide value chain development, and design nutritional recommendations for use in Work Package 2, and the development of new food ingredients based on African plant-based raw materials for use in Work Package 4.

### THE COMMERCIALISATION OF UNDERUTILISED CROPS

Promoting and incorporating indigenous nutrient-dense crops into food value chains could ensure sustainable and resilient food systems, improve diet quality and increase smallholder farmers' incomes.

In a research study conducted under the supervision of **Dr Danie Jordaan** of the Department of Agricultural Economics, Extension and Rural Development, PhD candidate **Waliyat Oloyede** focused on the commercialisation potential of underutilised crops along their value chains for food and nutrition security in South Africa. This study examined how to break down barriers to commercialisation in three types of indigenous food crops in Mpumalanga: Bambara groundnut, cowpea and orange-fleshed sweet potato.



## SUPPORTING VALUE CHAIN DEVELOPMENT

The University of Pretoria supported the larger IFA project by providing input to the activities of its partners in Ethiopia, Kenya and Uganda to deliver shared outputs.

This entailed working towards the achievement of the following tasks:

- Market surveys and analysis for business models and value chain development
- Design and analysis of new business models to support value chain development

Business model canvases were created to describe products produced using indigenous African crops and link them to market segments. The researchers obtained knowledge about food and consumption patterns to target the correct market segments in local African markets, as well as in European export markets.

The activities of this work package involved assessing the factors that drive consumers' food choices in different countries and their interest or lack of interest in different innovative products that were developed as part of the project. Key insights were developed for refining business models and identifying segments of consumers with higher potential for uptake.

In terms of market survey and analysis for business model and value chain development, the following were considered:

- Benchmarking the IFA solutions against existing products at market, and assessing the competitiveness of related business models for intensification. For export purposes, gluten-free and biopackaging aspects were evaluated as having potential added-value factors as part of business model studies.
- Identifying the potential of establishing and strengthening linkages between the buyers, sellers, exporters and importers of agricultural commodities and products, addressing issues to enhance participation by all parties.



*Prof Riëtte de Kock with PhD candidates Nomzamo Magano (centre) and Charmaine Sehoole (right)*

- Evaluating market information sources and services, and information flow to end-beneficiaries to improve the effectiveness of market resource centres, including their replicability in the target countries.
- Identifying the potential to harness the power of information and communication technologies as a strategic tool for rural value addition and empowerment to provide a transparent and competitive price discovery mechanism.

In terms of the design and analysis of new business models to support value chain development, a value-added analysis, based on governance using new institutional economics, value chain theory and network theory, was performed to identify and assess the governance structure and bargaining position of value chain actors and the distribution of the added value of the new products developed as part of the project.

The information on the new products that were developed was used to assess the quality, quantity and potential applications of the products. This will be used to design potential business models and market uptake.

## 2

### WORK PACKAGE 2

### CONTRIBUTION TO THE IMPROVEMENT OF THE AFRICAN DIET AGAINST MALNUTRITION

AT THE UNIVERSITY OF PRETORIA, THIS WORK PACKAGE WAS LED BY **DR MARINEL HOFFMAN**. IT AIMED TO IMPROVE AFRICAN DIETS TO PREVENT ALL FORMS OF MALNUTRITION (THE UNDER-NUTRITION OF INFANTS, AND OVERWEIGHT OR OBESITY IN ADULTS AND ADOLESCENTS).

#### Its objectives were as follows:

- Identify the drivers of under-nutrition and overweight/obesity, and potential food and dietary solutions to prevent malnutrition in southern and eastern African countries.
- Develop locally feasible food-based dietary guidelines and nutritional recommendations based on climate-smart crops (working in collaboration with Work Package 3 and Work Package 4), attempting to achieve locally recognisable and healthy dietary patterns, comparable to the traditional dietary patterns of the Mediterranean or Baltic Sea regions.
- Formulate an implementation plan to apply the recommendations, taking regional aspects, both urban and rural areas, specific target groups, and potential crisis situations into consideration.

#### These objectives were achieved through the implementation of three tasks:

- Review the nutritional situation and food consumption in the partner countries
- Develop diet models and nutritional recommendations
- Draft an implementation plan for country-specific, food-based nutritional recommendations for small children and adults

#### NUTRITION AND THE NUTRITIONAL STATUS OF CHILDREN

The research involved in this work package focused on improved nutrition and the nutritional status of children under six, as well as women of childbearing age. This entailed studies on the dietary practices and nutritional status of mothers and their children, and consumers' awareness of the South African Paediatric Food-based Dietary Guidelines (SAPFBDG).

It included a food consumption survey to develop an understanding of the foods that mothers in South Africa consume and feed their children. The consumption survey was followed by a study focusing on their awareness and understanding of the SAPFBDG. Using data from the food

consumption survey, the researchers used linear programming to investigate cost-effective ways for mothers to combine food products to feed their children more nutrient-dense diets.

This was aligned with the project's primary goal of developing advantageous solutions to the challenges of paediatric feeding in rural and urban areas in South Africa. It also guided researchers in Work Package 3 and Work Package 4 regarding the nutritious value of climate-smart crops, and the nutrients that should be included in new products to ensure optimal health outcomes.

Dr Hoffman highlighted that consumers' financial constraints must be addressed and that healthy, nutrient-dense meals

do not have to be expensive. “For infants older than one year, an egg a day is a good choice for healthy growth. We can then add freshly grown vegetables such as carrots or green leafy vegetables to contribute to a healthy immune and digestive system.”

The research was followed by community workshops, in which the findings of the research were shared with the participants to contribute to their education on the SAPFBDG and actions they can take to improve the nutritional status and development of their children. An easy-to-read booklet translated into local languages was developed in collaboration with Work Package 6.

### THE NUTRITIONAL SITUATION AND FOOD CONSUMPTION IN TARGETED AFRICAN COUNTRIES

The University of Pretoria’s data was considered with data obtained in the other partner countries to review the foods available and food consumption patterns of small children and adults in Africa, with a focus on the urban populations in ten cities or urban areas.

The research of master’s student **Rodrey Mafodi** explored the food consumption of mothers and their children, and aimed to determine if there is a relationship between the nutritional status of mothers and their children. She focused on the feeding practices and anthropometry<sup>5</sup> of mothers and their infants in one rural and one urban city in the Free State, and one public health facility in Gauteng.

Her study investigated the dietary practices of mother-child pairs in rural and urban settings in South Africa during the COVID-19 pandemic.

Mafodi found that many of the children in the study population showed signs of malnutrition, and had a low weight and poor growth for their ages. Some of the mothers also displayed low iron levels.

The study concluded that the mothers fed their children food items that were not sufficiently nutrient-dense for optimal growth and development. It also identified high levels of clinical obesity in the mothers, associated with increased risk for cardiovascular diseases.

### IMPLEMENTATION PLAN FOR COUNTRY-SPECIFIC, FOOD-BASED NUTRITIONAL RECOMMENDATIONS FOR SMALL CHILDREN AND ADULTS

The activities of this work package also concentrated on the compilation of two complemented food-based dietary guidelines per country, with practical implementation suggestions. The University of Pretoria’s work in this regard focused on compiling food-based nutritional recommendations for small children and adults in South Africa.

The research of master’s student **Rochelle van Veijeren** focused on consumers’ understanding of the SAPFBDG. These guidelines serve as an educational resource to caregivers of young children to encourage a healthy diet that supports optimal growth and development.

There is a lack of awareness of the SAPFBDG. This study therefore aimed to investigate the potential existence (or absence) of a cognitive bias in consumers’ knowledge of all dimensions of the SAPFBDG. From the study, it is recommended that one uses marketing and education tools with infant feeding-relevant products to promote consumer awareness of the guidelines.



*Dr Marinel Hoffman with master’s students Rodrey Mafodi (left) and Rochelle van Veijeren (right)*

5 Anthropometry: The science that defines physical measures of a person’s size, form and functional capacities.

# 3

## WORK PACKAGE 3 IMPROVED FARMING PRACTICES

AT THE UNIVERSITY OF PRETORIA, THIS WORK PACKAGE WAS LED BY **PROF QUENTON KRITZINGER, DR DIANA MARAIS AND DR DANIE JORDAAN**. IT AIMED TO IMPROVE THE FARMING AND PRIMARY PRODUCTION PRACTICES OF AFRICAN FOOD SYSTEMS.

### **Its objectives were as follows:**

- Increase food diversity by promoting sustainable, climate-smart crop production and post-harvesting practices.
- Boost the productivity and marketability of selected cereals and pulses, as well as root crops and fruit, by supporting smallholder farmers to increase the quantity, quality and diversity of healthy food.
- Support small-scale farmers, especially women and youth, in rural areas to utilise the appropriate post-harvesting handling and storage technologies of crops, including biomass recycling, to meet national, regional and international quality standards.

### **These objectives were achieved through the implementation of four tasks:**

- Increase agri- and food diversity, promoting climate-smart agriculture practices and crops
- Streamline seed systems for optimal performance
- Train farmers on good seed production practices
- Develop post-harvest and storage technologies to reduce loss and support healthy diets

### **PROMOTING CLIMATE-SMART AGRICULTURAL PRACTICES AND CROPS**

Activities by researchers in this work package focused on increasing agri- and food diversity to promote climate-smart agricultural practices and crops. Working with farmers in two communities in Mpumalanga, the focus was to encourage them to produce more African climate-smart crops. Based on a farmers' participatory research approach, the smallholder farmers, researchers and other stakeholders were involved in the research and development process.

The research of master's student **Peggy Chikwaza** focused on evaluating the agronomic practices of cowpea and

Bambara groundnut produced by these farmers to optimise crop yield and quality. She explained that "despite Bambara groundnut's potential as a nutritious, environmentally resilient crop with economic benefits, it remains underutilised." Her research aimed to investigate the current agronomic and socio-economic barriers that limit production and to investigate practices that can increase sustainable production.

She conducted qualitative and quantitative research with smallholder farmers from the Makoko and Mzinti villages in the Ehlanzeni District Municipality in Mpumalanga. She made use of questionnaires, focus group discussions and

key informant interviews to understand farmers' agronomic practices. Farmers' participatory field trials were performed with 19 farmers over two seasons. The trials were conducted in two separate parts.



The survey revealed that cowpea and Bambara groundnut production was mainly done by women over 40 years of age. More than 90% of the respondents indicated that they only produce these crops for home consumption. They do not apply fertilizer or control pests and diseases. The field experiment results showed that fertilizer treatment significantly increased pod yield, while not earthing up, resulting in a significant effect on the number of pods, pod mass and fresh stem mass for Bambara groundnut. The recommended practices significantly increased the number of pods and mass compared to the farmers' practices. For Bambara groundnut, the informal market seed had a better yield than the retailer-sourced seed.

Chikwaza explains that there were challenges with obtaining comparable data. Some of the farmers' fields were not fenced, and grazing animals often fed on the crops. Adverse weather conditions and floods also destroyed some of the farmers' crops during the research period. This negatively impacted the data. The occurrence of rats in the cowpea plantations also presented a problem during the first season.

However, this was addressed and showed improvement during the second season. This highlights the importance of practical solutions.

The value of the targeted crops in improving consumers' nutritional status, especially that of orange-fleshed sweet potato to provide pro-Vitamin A, was aligned with the research of Work package 2.

### **FARMERS' PARTICIPATORY RESEARCH**

Farmers' participatory research formed an important element of the activities of this work package. It focused on the seed-to-produce small-scale farming of indigenous climate-smart crops, such as Bambara groundnut, cowpea and orange-fleshed sweet potato. Stakeholders involved in the research included seed production companies, farm input suppliers and agricultural financing institutions. The research areas included Mzinti in the Nkomazi Local Municipality, and Makoko in the City of Mbombela Local Municipality, both in the Ehlanzeni District Municipality in Mpumalanga.

Field trials were designed, implemented and documented. Best practices were recorded and data collected, including the steps involved in farming these crops to produce the best results: from land preparation and sowing, irrigation, crop management, fertilization and harvesting. Experiments conducted to demonstrate to farmers how to succeed in their efforts to produce the targeted crops included evaluating the application of treatments such as fungicides, Rhizobium and fertilizers. Farmers were educated about the nutritional value of the targeted crops. Through the practice of participatory research, the farmers observed how the use of insecticides increased the quality of their sweet potato yield, for example, and were advised on how to address the problem of rodents infesting their cowpea and sweet potato crops.

The next step was to evaluate more cultivars. This entailed elements of consumer preferences and food choices, as researched by members of Work Package 1. The researchers worked with the farmers to demonstrate to them the best way to cultivate the targeted crops and various treatments that could be applied to improve their agricultural practices.

The experiments highlighted differences between using traditional farming methods, and the research interventions to improve and accelerate crop yield.

As a result of the researchers' interventions, the farmers could increase their yield for home consumption, and market sales to supplement their income. The farmers were very receptive and positive to the researchers' interventions.

Upon conclusion of this stage in the project, the researchers observed that the farmers had attained a new level of knowledge, experience and understanding. They recognised the role that new technologies and climate-smart agricultural practices can play in their farming activities.

To upscale their farming, a need was identified to develop links to the market, as well as to improve the production and marketing infrastructure. The absence of funding and infrastructure presented challenges that would need to be overcome if the successes achieved through this intervention were to be taken forward. The suggestion is that this should be implemented with the collaboration of commercial partners.

### **STREAMLINING SEED SYSTEMS FOR OPTIMAL PERFORMANCE**

The work furthermore aimed to ensure consistent production and sustainability, including the identification of seed supply channels. This included mapping local supply channels for the target crops in the two communities in Mpumalanga. Suitable cultivars that were resistant to the main climatic stresses in the region, and could be adapted to local growing conditions were identified. The identified cultivars were improved varieties of the respective crops that were high yielding, climate smart and resistant to pests and diseases.

In the case of cowpea, it was found that the available commercial cultivars are marketed to be utilised as a forage crop, and not a seed crop. Trials were conducted comparing them to a locally produced variety. However,

the local variety took very long to harvest, so comparable results could not be obtained. It was also found that the farmers made use of an informal seed propagation system, which was unregulated, rather than using commercial seed. Efficient seed systems therefore need to be established for the region. This would include the development of systems for the selected crops to sustain production. Examples include seed banking, multiplication gardens, sorting and grading, the use of granaries and the use of appropriate drying methods.

In the case of orange-fleshed sweet potato, the commercial cuttings were found to be harvested sooner, and to provide a bigger yield than the informal cuttings that were being used by the smallholder farmers. The researchers observed that cuttings would need to be cultivated by a certified supplier, but the necessary logistics had to be put in place to establish an effective procedure to obtain suitable cuttings.

By collaborating with stakeholders such as the Agricultural Research Council, the researchers believe that farmers can introduce cuttings of higher quality into the system, thereby improving the quality and quantity of their yield.

The researchers observed that a commercial thrust is needed to upscale seed production and supply to the smallholder farmers. This would contribute to the region's potential to produce seed on a commercial scale. There are therefore opportunities for entrepreneurs to become involved in the value chain.

### **STAKEHOLDER ENGAGEMENT**

Stakeholder engagement took place in collaboration with Work Package 6. A highlight of this activity for Work Package 3 was having the lead farmers from the two communities in Mpumalanga, Nonhlanhla Ngomane and Alfred Tshangase, provide feedback on the project during a stakeholder workshop held at the University of Pretoria in May 2023. They were pleased to form part of the project, but stated that they needed assistance to ensure that their agricultural produce reached the market.



## In the words of Ngomane:

*We learnt a lot ... By planting the crops ... we have been successful, but we have a challenge. We are unable to get to the market. In terms of knowledge, we also learnt a lot. We were planting sweet potatoes for ourselves. We were planting cowpea for ourselves, and even Bambara. We are even making a lot of money. It is easy to sell Bambara in our location. People can take it very easily. But it is very difficult to support the sweet potato business. We end up harvesting big piles like that of sweet potato ... and it's a challenge to sell them. We cannot eat them all. Can you, please, one of you here, can you help the Mpumalanga team to get access to market? It was just research, yes, but we ended up using it. It's working for the Mpumalanga teams.*

The discussion that ensued at the stakeholder workshop focused on the real-world benefits of the research. The ultimate challenge concerns how stakeholders can work towards making affordable, nutrient-dense produce and foods commercially available to the South African market.

The primary focus of the discussions was on consumer understanding, cultural perceptions of and attitudes towards indigenous crops, and the importance of promoting the profile of these crops.

Limitations linked to the challenges of load shedding on production and cooking times for the indigenous crops were also discussed. Education and awareness were highlighted as key drivers of nutrient-focused food sources, and generating a demand for indigenous crops at the market level. A challenge was put forward to the students present at the stakeholder workshop to assist in raising the profile of these crops through social media.

Collaboration among stakeholders to encourage the government's awareness of the impact of exemption from value-added tax (VAT) for climate-smart crops such as sorghum is essential before the large-scale commercial production of food ingredients and food innovations.



From left: Dr Danie Jordaan, Peggy Chikwaza, Dr Diana Marais and Prof Quenton Kritzinger

## TRAINING FARMERS ON GOOD SEED PRODUCTION PRACTICES

Based on the knowledge gaps identified, the research team developed training manuals and videos on good agricultural production practices, in collaboration with Work Package 6.

These included existing guidelines on best agricultural practices and what was learnt during the research. This material would be available to the farmers online, and would also form part of the Innovation Platform that would be developed as an outcome of the project.

Important topics that the farmers needed training on included soil and water conservation practices, soil fertility building technologies, the use of organic fertilizers to enhance crop yield, nutrient recycling technologies such as crop rotations and companion planting, cropping systems, pest and disease management, seed system management, record keeping, farming as a business, appropriate harvesting procedures and post-harvest produce management, and produce handling and storage methods and logistics. In collaboration with Work Package 6, the training material was translated, and made available in both Siswati and English. Hard copies were also distributed among the farmers.

## POSTHARVEST AND STORAGE TECHNOLOGIES

The final phase of the research project examined postharvest and storage technologies to reduce loss and support healthy diets. This task aimed to ensure the promotion of postharvest practices and the long-term storage of raw materials to ensure the safety and quality of the seeds and produce. Investment and suitable business models are necessary for the acquisition of modern technologies for the harvesting and pre-processing of the targeted crops.

# 4

## WORK PACKAGE 4 FOOD PROCESSING AND PRODUCT INNOVATION

AT THE UNIVERSITY OF PRETORIA, THIS WORK PACKAGE WAS LED BY **PROF MOHAMMAD NAUSHAD EMMAMBUX**. IT AIMED TO DEVELOP SAFE, NUTRIENT-DENSE CEREAL-PULSE-ROOT CROP-FRUIT-BASED FOOD INGREDIENTS AND FOOD PRODUCTS TO TACKLE NUTRIENT DEFICIENCIES AND OBESITY, TAKING BOTH SMALL CHILDREN AND ADULTS INTO ACCOUNT.

### **Its objectives were as follows:**

- Develop five high-quality food ingredient categories from cereal, pulses, root crops and fruit-based raw materials to be further used to manufacture healthy food products for African and European markets.
- Develop at least seven affordable and convenient food prototypes (snacks, pasta, instant foods, bakery products or meat substitutes) for use as complementary foods; at least three to counter malnutrition, and four to address over-nutrition and combat diet-related non-communicable diseases. This will be done using new ingredients and will include the design of at least three food product prototypes specifically for the European market.
- Confirm the sensory and nutritional quality of the developed ingredients and food prototypes.
- Provide process data for value chain, business model and food samples for consumer studies.
- Establish a technology toolbox by combining and sharing the knowledge of local African partners, European Union research and technology organisations, and university partners, focusing on energy-efficient minimal processing, small- or micro-scale food processing and solutions for high-quality, convenient and safe foods.

### **These objectives were achieved through the implementation of three tasks:**

- The development of new food ingredients based on African plant-based raw materials
- The design of food products to combat malnutrition
- The development of a technology toolbox and the sharing of knowledge

### **DEVELOPING NEW FOOD INGREDIENTS BASED ON AFRICAN PLANT-BASED RAW MATERIALS**

Through the development of innovative microwave and infrared drying techniques for the improved retention of micronutrients such as beta-carotene from orange-fleshed sweet potato and nutrient-dense pasta, as well as faster, more convenient cooking methods for indigenous crops such as Bambara groundnut and sorghum, new food ingredients have been developed for improved nutrition.

The raw material for these ingredients was also locally grown. This led to stakeholders identifying the commercial potential of products derived from underutilised crops such as orange-fleshed sweet potato flour, and expanded fibre-rich sorghum.

Value-added ingredients were developed from cereal grains, pulses and root crops. An attempt was furthermore made to improve nutritional quality, including the digestibility of the

nutrients and removal of anti-nutritional factors, as well as the techno-functional and sensory properties of the ingredients. This work included the development of flour from indigenous crops, the development and analysis of ingredients with a low Glycemic Index (GI) and the nutritional improvement of ingredients by making use of bioprocessing technologies, such as fermentation.

The research of master's student **Daddy Kgonothi** focused on the development of flour from orange-fleshed sweet potato. In this study, conventional oven-drying techniques were compared with novel drying technologies such as microwave and infrared energy technologies to determine if they improved the retention of beta-carotene from the orange-fleshed sweet potato after drying. The results indicated that beta-carotene retention was improved by combining microwave during drying with infrared energy. These samples also dried faster than they would using other techniques. Kgonothi's study showed that novel drying technologies can be applied to reduce both time and energy.



*Developing flour from orange-fleshed sweet potato.*

Since the sweet potato has a short period of growth (six months) and requires low agronomical input. It could be used by smallholder farmers, as well as entry-level farmers with limited resources.

Although this orange-fleshed sweet potato flour has commercial potential, it needs to be upscaled and the raw material remains costly. Kgonothi explains that the low starch and its richness in dietary fibre has potential applications for use in baby food and as a thickener in soups.

The research of PhD student **Rose Baah** focused on the production of low-GI flour from sorghum using heat-moisture treatment by infrared and microwave energy.

Sorghum is high in starch and can affect people with conditions such as diabetes and obesity. Her study developed a way of processing the sorghum to lower its glycaemic index, and showed positive results.

Her study, which determined the nutritional and functional properties of infrared and microwave heat moisture-treated sorghum meals using three types of sorghum, found the treatment to be a more environmentally friendly physical modification method that can be used to improve the physicochemical properties of the starch without destroying its granular structure. This increases the amount of slowly digestible and resistant starch and further reduces the estimated GI.



*Producing low-GI flour from sorghum.*

The research of PhD student **Sami Ali**, on the other hand, focused on the effects of the sourdough-type fermentation of sorghum for use in the baking of flatbread. This aligns well with the project's objective of developing sustainable value chains for diverse and healthy African foods.

The study also explored any physical and chemical changes in the four components during fermentation and how these changes affect the quality of gluten-free sorghum flatbread. Fermentation is an affordable, traditional household method that can be used to improve the nutritional value, as well as the techno-functional properties of sorghum flour.

The study showed an interesting application that is useful for the structure design of gluten-free sandwich wrap-type sorghum-based products.





*Producing a flatbread from fermented sorghum.*

For the development of fat replacers, starch from maize and teff was modified with lipids to produce amylose lipid complexes. The modified starch was characterised at a molecular, nano, meso and micron scale. The application of the modified starch in reducing oil/water food emulsions, reducing fat in cake and icing, as well as stabilisers in yoghurt were assessed. This will benefit individuals at risk of obesity. These were researched by **Humbulani Nekhudzhiga, Tilana Marais and Rachel Luyt.**

For the development of protein-rich ingredients, high-protein flour was produced from Bambara groundnut and cowpea using a wet milling process to remove the fibre, fat and starch to produce protein concentrate. The protein isolate was manufactured by solubilising the protein, followed by acid precipitation. Soybean was used as a reference. This was researched by master's student **Sarah Kandolo.**

### **DESIGN OF FOOD PRODUCTS TO COMBAT MALNUTRITION**

The development of new food products was focused on combatting malnutrition (nutrient deficiency, obesity and diet-related non-communicable diseases) for small children and adults in African urban and European markets. The knowledge obtained from Work Package 1 (consumer insights) and Work Package 2 (nutrition guidelines) were utilised to further tailor the product characteristics (nutritional composition and sensorial

preferences) for both African and European markets. For the export market, gluten-free foods were also developed as added-value products.

Extrusion technologies were used to formulate nutrient-dense products, including extruded snacks, pasta and texturised protein. For instant porridges targeted for the African market, nutrient-dense products, whole or dehulled cereal grain and pulse flour were used, as well as root crops and fruit flours rich in micronutrients. Pasta extrusion was developed by high-temperature and low-temperature extrusion. Baking technologies were developed for high-fibre and protein bakery products. Bioprocessing technologies (sourdough and enzymes) were studied to improve the quality of high-fibre and protein bakery products, bread, patisserie, crackers and biscuits.

The research of PhD candidate **Charles Antwi** aimed to produce expanded high-fibre snacks from sorghum, a drought-tolerant crop, using extrusion cooking with an industrial extruder machine. These snacks were a tasty and safe option for patients with celiac disease. The sorghum-expanded snack is high in dietary fibre due to its bran content, without compromising its sensory qualities.

The extrusion technology that Antwi used to develop the snacks is successful in formulating nutrient-dense products, which helps promote healthy snacking. This makes it viable for both the African and the export markets.



*Producing high-fibre snacks from sorghum*

Other academics and postgraduate researchers in the Department of Consumer and Food Sciences also participated in the activities of this work package. This includes **Prof Gyebi Duodu**, emeritus professor **John Taylor**, **Dr Nwabisa Mehlomakulu** and **Prof Riëtte de Kock**. Postdoctoral fellows involved in this research were **Dr Kieran Yisa Njowe**, **Dr James Makame**, **Dr Clarity Mapengo**, **Dr Atefeh Amiri**, **Dr Anton Venter** and **Dr Zeinab Asadi**. The group also comprised **Dr Peter Mukwevho**, a lecturer in the Department, and research assistant **Lunga Manana**.

Dr Mukwevho worked partially on the IFA project for his PhD. The focus of his research is on quick-cooking Bambara groundnut. This previously underutilised and overlooked legume is rich in protein and minerals. It is a climate-smart, drought-resilient indigenous African crop.

Whole-grain Bambara groundnut is also rich in dietary fibre and produces flour with a lower GI than that of bread made from standard wheat flour when made into a porridge.

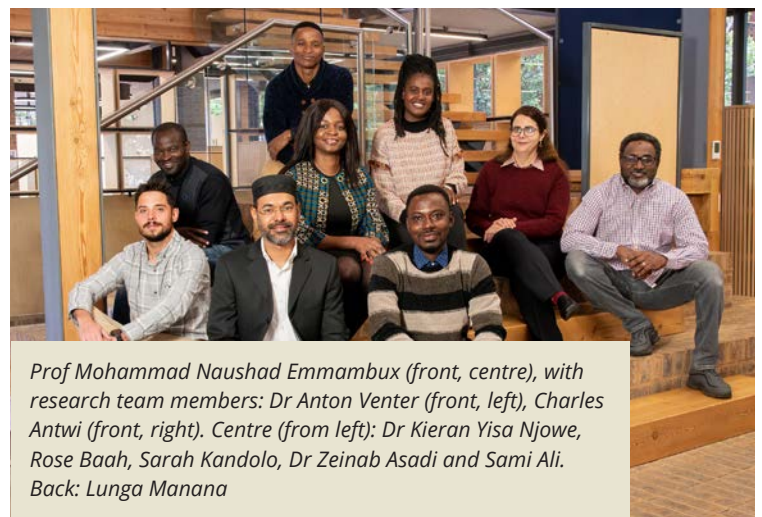
The crop's previous underutilisation is due to its perceived difficulty in cooking. In his study, Dr Mukwevho employed processing techniques such as infrared and microwave technologies to produce quick-cooking Bambara groundnut. This reduces the cooking time from three hours to 25 minutes. Honours student Sonto Pholoana also participated in this research.

Dr Venter, on the other hand, is developing a gluten-free pasta from sorghum flour, as well as sorghum rice. He stresses the importance of incorporating ancient grains into a modern diet. Sorghum is another underutilised indigenous crop, and has several health benefits, particularly due to its protein and antioxidant components. The use of a slow-digestible starch has advantages in addressing non-communicable diseases such as Type II diabetes. Its introduction to the market not only has benefits for the consumer, but also for farmers, who can become involved in the manufacture of sorghum flour as a complementary economic opportunity.

Dr Asadi carried out the descriptive sensory analyses for all the products that were developed (pasta, quick-cooking sorghum and expanded snacks). These descriptive sensory analyses involved what the products taste, look and smell like. Ultimately, this aimed to determine emotional reactions while consuming the products, knowing that they were made from indigenous African crops.

The acceptance of the products and the willingness of the panellists to buy the products if they were available in the market were also evaluated. She remarked that, although products developed from sorghum do not have the same sensory properties as refined flour, consumers still find it acceptable, and it has export potential.

Summarising the work of the Department's research, Yisa Njowe explains that crops such as Bambara groundnut, sorghum and cowpea have always been grown in rural areas, but they have lost value in the eyes of indigenous people who move to cities. However, by emphasising the health benefits, and economic and agricultural potential of these underutilised crops, they can contribute to achieving the Sustainable Development Goal of no poverty (SDG 1), zero hunger (SDG 2), good health and well-being (SDG 3), and responsible consumption and production (SDG 12). The work of the Department's postgraduate students researched products from climate-smart crops to produce nutrient-dense foods that have great potential for commercialisation in the future.



*Prof Mohammad Naushad Emmambux (front, centre), with research team members: Dr Anton Venter (front, left), Charles Antwi (front, right). Centre (from left): Dr Kieran Yisa Njowe, Rose Baah, Sarah Kandolo, Dr Zeinab Asadi and Sami Ali. Back: Lunga Manana*

PROTOTYPES DEVELOPED IN WORK PACKAGE 4

Sorghum snack



Infrared and microwave oven



Sorghum pasta (raw)



Sorghum pasta (cooked)



5

**WORK PACKAGE 5  
BIO-BASED PACKAGING TO REDUCE FOOD WASTE ALONG THE FOOD CHAIN**

AT THE UNIVERSITY OF PRETORIA, THIS WORK PACKAGE WAS ALSO LED BY **PROF MOHAMMAD NAUSHAD EMMAMBUX**. IT AIMED TO VALORISE BIOMASS RESIDUES FROM RAW MATERIAL HARVESTING, POST-HARVESTING AND FOOD PROCESSING THROUGH THE DEVELOPMENT OF BIO-BASED PACKAGING INNOVATIONS TO REDUCE FOOD LOSS, AND INCREASE THE OVERALL EFFICIENCY OF FOOD SYSTEMS.

**Its objectives were as follows:**

- Conduct agri-food chain sidestream analysis (quantity and quality) to map losses and the availability of sidestreams or residues for selected crops and their value chains by conducting a targeted survey in the partner countries. This included the involvement of Thys Rossouw and Dr Corinda Erasmus from Delphius Technologies.
- Investigate the suitability of crop sidestreams and food wastes for bio-based products.
- Evaluate and develop two bio-based packaging materials (film enhancing shelf life and a biodegradable granule) from the crop sidestreams or residues, and food wastes or their mixtures at laboratory and pilot scale. The model materials to be developed will also be suitable for export markets.
- Participate in building a technology toolbox, in collaboration with Work Package 3 and Work Package 4, to facilitate technology transfer.

**These objectives were achieved through the implementation of four tasks:**

- A survey of agri-food losses and sidestreams in the crop value chains in the partner countries
- The evaluation and development of environmentally friendly bio-based packaging materials
- The evaluation and development of a biodegradable composite granule
- The development of a technology toolbox and the sharing of knowledge

**DEVELOPING NEW BIO-BASED PACKAGING MATERIALS AND BIODEGRADABLE COMPOSITE GRANULES**

Data obtained from the survey of agri-food losses and sidestreams in the crop value chain was utilised to select a suitable African indigenous crop to develop new bio-based packaging materials. The characteristics of the raw material were analysed in terms of its chemical composition, storage and safety aspects and microbiology. The bio-based

packaging material that can be used was fabricated and tested to select the material with the most potential for further experimentation.

The biocomposite film that was developed was analysed for barrier quality and its suitability for heat sealing. This resulted in a material that could be used to make a film to replace existing plastic alternatives in food packaging.

The material combination utilised small-scale wood-based cellulose that can be produced from bio-based sidestreams making use of hot water extraction to remove the hemicellulose, followed by alkali extraction to remove the lignin, leaving the cellulose. The packaging material that was developed was evaluated by consumers and industry partners in collaboration with Work Package 1.

Following the evaluation and development of the environmentally friendly bio-based packaging material, a granule-material was made, which comprised byproducts and their extracted biopolymers using green energy principles from the selected crops, compounded with a biodegradable binder. As a result, a granule prototype material (an intermediate product) was produced that could be tested in the laboratory for its strength. Chemical and physical analyses of the granule also took place to experiment with the conversion of these granules in injection moulding, cast extrusion or extrusion blow moulding.

The research of PhD candidate **Mondli Masanabo** focused on the use of cowpea sidestream for the development of biopackaging materials. Masanabo explained that packaging is a huge industry, which accounts for 40–42% of total plastic consumption. Examples of petroleum-based plastics widely used in packaging include polyethylene, polypropylene and polyethylene terephthalate. These plastics are not biodegradable, and take a long time to decompose. When improperly discarded, they can accumulate in the environment as waste. If current plastic production and consumption patterns do not change, plastics will account for 20% of the world's oil consumption by 2050. This necessitates the need for alternative plastics from renewable resources.



*Producing biopackaging material from cowpea sidestream.*

Biocomposite plastics are a type of composite plastics that can be made using biopolymers from renewable sources and agricultural residues, such as cowpea residue or sidestream. These plastics are biodegradable and can serve as an alternative to the non-biodegradable petroleum-based plastics in some applications.



In this study, Masanabo examined the possibility of making packaging using sidestream or residue from cowpea, an underutilised crop that is widely grown in sub-Saharan Africa. The residue left on the farm after cowpea grains have been harvested is underutilised and is not traded as a commodity. Therefore, the conversion of low-value cowpea sidestream into high-value packaging materials can potentially create a new value chain and source of income for farmers. This supports the establishment of a circular economy, where consumption takes place in a way that minimises the use of non-renewable resources, reduces waste and keeps carbon emissions to the minimum.

Masanabo mixed cowpea sidestream with biopolymers from renewable resources to produce granules or pellets using extrusion technology. These granules were further processed into films for application as flexible packaging. In addition, they were processed into injection-moulded materials for potential application as rigid packaging. The granules themselves are a potential product that could be sold for further processing into different packaging materials.

These packaging materials can be processed using the same machinery that is used to process conventional plastics, without the need for complex chemical treatments. This creates a low-investment requirement possibility for existing plastic processors. The technology developed to manufacture these plastics is at a lab-to-pilot scale. With further research, it can be scaled to industrial level and provide the opportunity for new investment.

Masanabo recognises the value of his research in creating a new value chain system and generating revenue for farmers through the conversion of low-value cowpea sidestream to high-value packaging material. Cowpea sidestream currently has no economic value as it is not traded as a commodity.



*Prof Mohammad Naushad Emmambux (left) with PhD candidate Mondli Masanabo (right)*

## 6

### WORK PACKAGE 6: ENGAGEMENT WITH LOCAL AND INTERNATIONAL STAKEHOLDERS TO DISSEMINATE, COMMUNICATE AND EXPLOIT RESULTS

AT THE UNIVERSITY OF PRETORIA, THIS WORK PACKAGE WAS LED BY **PROF SHAKILA DADA**. IT AIMED TO COMMUNICATE THE RESEARCH FROM THE VARIOUS WORK PACKAGES TO INSPIRE AND INFORM DEVELOPMENT POLICY AND PRACTICE. KNOWLEDGE DISSEMINATION FROM THE VARIOUS WORK PACKAGES WAS INTEGRAL BY ENSURING THE SCIENTIFIC INFORMATION WAS EASY FOR STAKEHOLDERS TO UNDERSTAND AND READ BY DEVELOPING MANUALS, BOOKS, NON-SCIENTIFIC BLOGS AND SOCIAL MEDIA POSTS.

#### **The objectives of the larger IFA project were as follows:**

- Communicate and create awareness about the project, its objectives and scope, and disseminate results through various platforms and tools.
- Ensure that dissemination, communication and training materials are appropriate for multilingual populations and those with low literacy.
- Organise at least two international events for knowledge sharing in cooperation with other projects of the European Union's Partnership on Food and Nutrition Security and Sustainable Agriculture (FNSSA) and establish a continuous interface with similar ongoing projects in Africa.

These objectives were achieved through communication and dissemination.

#### **The larger IFA project, with partners in Ethiopia, Kenya and Uganda, as well as the European Union, focused on the following additional tasks:**

- Maximise the reach and usability of research and innovation management
- Create and manage an Innovation Platform

#### **COMMUNICATING RESEARCH FINDINGS**

The University of Pretoria's primary focus in this work package was on sharing the research with the wider public in simple and relatable ways to promote understanding of the research to the people whom it impacts the most: the project's stakeholders.

Prof Dada explained that the knowledge translation process starts with research input, and concludes with research impact. "Research impact is about the wider, real-world contributions of research beyond the academic value of the

work." Facilitating the impact and real-world benefit of the IFA's research for stakeholders, including the public, was a major focus of this work.

Prof Dada highlighted the importance of making science communication relevant to the wider population, multilingual populations and those with lower literacy levels. Research commonly contains complex concepts. It is important to simplify these concepts and ensure that materials are accessible and available in easy-to-read formats.

This work is underpinned by the principle of inclusivity and aims to make the project's research available to diverse audiences. Its communication and dissemination activities included developing communication collateral such as a website, developing a platform for business supplier connections, in collaboration with the Ethiopian section of the project, translating questionnaires and results into different languages, and developing booklets for farmers, and easy-to-read feeding guidelines for mothers and caregivers. It also adapted knowledge into audio recordings and developed video templates and scripts for questionnaires, performed translations and adapted digital information to promote inclusivity. The stakeholder workshop and student presentation symposium that were held addressed this objective, in particular. It also promoted the project's findings at exhibitions for the food science industry. In the process, it sourced additional partners who could benefit from the project's outcomes.

Finally, this work package focused on content creation to post the project's findings and progress on various media outlets, including on Facebook and LinkedIn. In addition, videos, and posters were created, and media and blog posts were written in different local languages.

### **MAKING RESEARCH OUTCOMES ACCESSIBLE**

Prof Dada explained that an important contribution of this work package was making research knowledge more accessible outside of the academic community. As an academic and researcher in the field of augmentative and alternative communication, her focus is on developing systems for people with complex communication needs to comprehend and understand language and meaning. Augmentative and alternative communication includes methods to help people communicate over and above spoken language. This may include graphic symbols, pictures and writing.

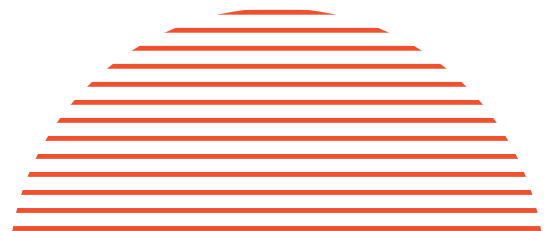
Together with postdoctoral fellow, **Dr Katherine Smith**, her task was to develop strategies to assist in communicating the project's research goals and processes with stakeholders and community members.

Making use of augmentative and alternative communication strategies provides an effective way of obtaining diverse input and encouraging vulnerable groups to participate in the research, from formulating research objectives to data collection, right through to the dissemination of the research findings. The perspectives of people with lower literacy and those from diverse linguistic backgrounds are not always heard in research as traditional research methods can limit their participation. Most of this work involved interactive processes focused on modifications to scientific information and processes in a manner that was suited to the target audience.

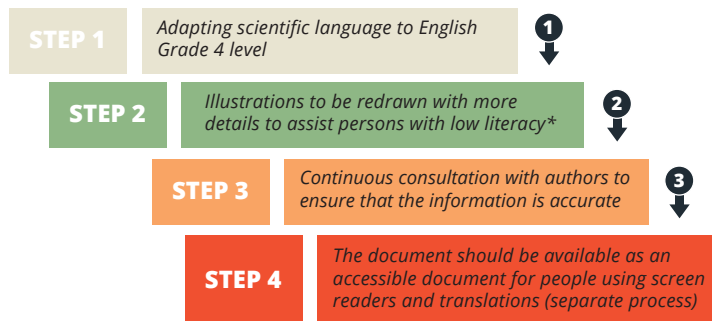
This work package served as a bridging function between the researchers and stakeholders to achieve the project's objectives. A project plan was drafted at the start of the project to determine how best to support the researchers in the different work packages. This included identifying where researchers could be assisted on a case-by-case basis to add value to individual research projects. It participated in monthly project meetings, and offered suggestions or responded to the suggestions of the project members.

This work package provided support to researchers in the earlier phases of the project by developing visual support posters used during training and redrawing diagrams to make information more accessible to farmers and community members. Text was modified and written in everyday, relatable language and jargon was removed. Visual aids like symbols or pictures were included to promote understanding.

Questionnaires used for data collection were also adapted using symbols and pictures to make them easier to understand. Options to respond with voice audio notes were added to questionnaires. These adaptations were essential to ensure that all respondents had the opportunity to share their views.



The key process of adapting information for formulating easy-to-read text, translations, posters and pamphlets, and electronic media involves four steps illustrated below.



Process of adapting information | \*Mbanda et al., 2020

This work package also translated posters, questionnaires, and research findings into languages such as isiZulu, isiXhosa, and Sepedi to ensure that this information is accessible to multilingual populations.

Its adaptation of knowledge was aimed at accommodating varying literacy levels to engage with local and international stakeholders to disseminate, communicate and exploit the research outputs, including the development of an impact map. This involved a stakeholder analysis to identify the key audiences and targets within the project's geographical scope and research boundaries. International and pan-African networks and stakeholders were carefully considered to increase the project's impact. This represented an innovative way of bringing the message to communities.

In the process of translating knowledge, the members of this work package also assisted researchers in engaging with stakeholders. Its interventions therefore had a community focus. The benefits both the work package leaders and the students involved in the research gained from the input of this work package was that stakeholders could be exposed to the research in an easy-to-read format, which facilitated communication about the results of the research.

## STAKEHOLDER AWARENESS

Two knowledge-sharing events formed part of the work package's communication with stakeholders. Their hybrid format enabled both African and European stakeholders to benefit from the presentations.

The first event, a stakeholder workshop with European Union consortium members was hosted at the University of Pretoria's Future Africa Campus. It brought together forward-thinking stakeholders from a range of disciplines to pose solutions to address the challenges facing consumers, food scientists, farmers, and the food production and marketing industries. Stakeholders represented academia, industry, and the small-scale farming sector. About 40 stakeholders participated in the workshop joined by the work package leaders and postgraduate students, whose research was directly related to the project. This was a parallel event to Africa Week, a biennial scientific leadership summit. The objectives of the workshop reflected the theme of Africa Week 2023, "Open Africa, Open Science", with the view of encouraging the scientific community to deliberate solutions for real-world challenges. Topics on the agenda included the outcomes of IFA's consumer and nutritional studies, the farmers' participatory research that was conducted, and food products and packaging technological innovations that were developed.

The second event, a student presentation symposium, hosted at the University of Pretoria in October 2023, allowed the postgraduate students who had been involved in research in the various work packages to present the outcomes of their research.

Prof Dada remarked that the students were well prepared, and treated the audience to articulate and engaging presentations. "They assuredly and skillfully fielded questions from their peers, their supervisors and the work package leaders involved in the project." An easy-to-read abstract was also provided to highlight the importance of translating the essence of their research into terms to be understood by the average person.

The symposium provided the students with a valuable learning experience and included dynamic discussions around key issues related to the IFA project that inspired critical thinking, reasoning, and reflection.

The symposium also provided an opportunity for the students to observe how their studies fit into the objectives of the larger project. The symposium was an invaluable opportunity for the students to practice an academic presentation, and they were provided with advice on various aspects to highlight from their studies.

### CONCLUSION

The members of this work package had a particular interest in communicating information about food security as it applies to vulnerable populations, as their voices are often missing in research. It focused on inclusivity and enhancing participation. This sharing and dissemination of knowledge reinforced the novel contribution of this work package, since the needs of participants are an important element in informing any subsequent research to develop new sustainable value chains to produce, and distribute diverse and healthy foods from African farms to local and export markets.

Reflecting on the impact of this work package, Prof Dada identified the transdisciplinary nature of the project as being particularly unique. With the inclusion of the Faculty of Humanities, its broader impact and meaning for community members in solving societal challenges related to poverty, food insecurity, and health and well-being could be addressed. This contributed to creating awareness of the achievements of the project and sharing knowledge by identifying common ground.

She concluded that perhaps the most important outcome of the project was the way it enabled researchers to learn from each other and stakeholders, not just from the research conducted in the different work packages within a country, but also from the research conducted within a work package by the partners in different countries, and from industry partners.



*Prof Shakila Dada (left)  
with postdoctoral fellow  
Dr Katherine Smith (right)*

# the way forward

UPON CONCLUSION OF THE PROJECT, STAKEHOLDERS WILL BE LINKED VIA A USER-FRIENDLY, UPDATED DIGITAL INNOVATION PLATFORM, WHERE THEY CAN ENGAGE, INTERACT, SHARE AND DISSEMINATE THE LATEST FOOD SYSTEM INNOVATIONS.

## EXPLOITATION AND INNOVATION MANAGEMENT

The main innovation management goals of the IFA project are twofold:

- Identify and further develop innovations with business potential to meet market needs
- Identify innovation in one of the project's country value chains with the potential to be successfully replicated or adapted to different African countries or contexts

Through a complete innovation management process, IFA will ensure that partners can benefit from their transdisciplinary complementarities to fully exploit their market position.

The results obtained and opportunities identified during the respective research projects will be carefully evaluated for patentable inventions, and other Intellectual Property rights exploitation, such as licences, other immaterial rights and technology transfer.

While most of the new products and packaging material developed using

climate-smart crops are at Technology Readiness Level (TRL) 5, they will need to be upscaled from the laboratory to the pilot-scale stage, depending on their feasibility, availability and affordability. This means that they will need to be validated in an industrially relevant environment to determine their commercialisation potential.

The technologies that were developed as part of the project combine the knowledge of local African partners, European Union research and technology organisations, and university partners, focusing on energy-efficient, as well as small- and micro-scale food processing and solutions to improve food safety. Technology transfer will therefore improve the skills and opportunities of economic actors that are active in the value chain.

## DEVELOPMENT OF AN INNOVATION PLATFORM

The IFA website will facilitate the continuation of the project beyond the lifetime of individual projects. It includes a knowledge data centre, with relevant databases from the respective partner countries, where project information can be openly accessed by researchers, manufacturers, governments and the public. This will enable farmers to continue with the projects that have been launched to provide additional economic opportunities, and researchers to identify new projects and challenges with research and development potential.

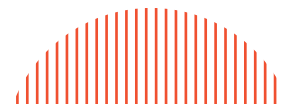
This website will be expanded into a new long-term innovation platform for knowledge sharing in the form of a technology toolbox, to be found at: <https://africainnovationplatform.com/>.

This will provide the opportunity to link local players within the food chain to identify and establish new business opportunities, and provide technical (safety and standards compliance) and business development training.

The innovation platform will therefore steer the outcomes of the research that formed part of the IFA project beyond a single country and a single platform to provide synergy that relates the work packages in the different partner countries to each other. In this way, individual research projects can interact with each other to cover the bigger picture.

The platform will provide peer support for small farmers, as well as small and medium enterprises, to meet compliance market and supply chain demands such as good manufacturing practices and the maintenance of quality control parameters.

It will therefore be a key exchange point to share best practices and innovative solutions among African stakeholders. This will contribute to the wider objective of the EU/Africa Partnership on Food and Nutrition Security and Sustainable Agriculture (FNSSA).



Members of the InnoFood Africa team at the University of Pretoria



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## DEVELOPING SUSTAINABLE AGRI-FOOD VALUE CHAINS

AN AFRICA-EUROPE COLLABORATION



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA



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