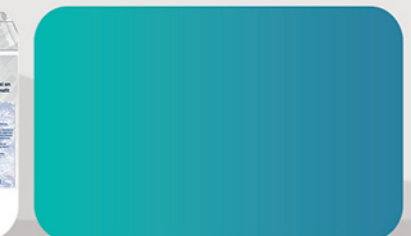


NEW IDEAS FOR AGRICULTURE: THE IMPACT OF INDIGENOUS AND LOCAL KNOWLEDGE ON THE SDGS: REPORT

Online Zoom Webinar

Organized by the WAITRO Secretariat with the
assistance of the WAITRO Regional Focal Points



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WAITRO  **WORLD
ASSOCIATION of
INDUSTRIAL &
TECHNOLOGICAL
RESEARCH
ORGANIZATIONS**

“OPENING REMARKS”



Dr. Paul E. Burrows

Secretary General, World Association of Industrial and Technological Research Organizations (WAITRO)

Vice President, Jiangsu Industrial Technology Research Institute (JITRI)

Ladies, gentlemen, honored guests and experts... Good morning from sunny England, and good afternoon to our participants in Asia. I am Paul Burrows, Secretary General of WAITRO, the World Association of Industrial and Technological Research Organizations. WAITRO is a global network of research and technology organizations established by UNIDO, the United Nations Industrial Development Organization, in 1970. WAITRO is an independent non-profit Association registered, for historical reasons, in Canada.

Since 2019, WAITRO's strategy has been aligned with the UN Sustainable Development Goals, or SDGs, and it aims to promote sustainable development through innovation and collaboration. At its heart, it is a network that provides a platform for researchers to share knowledge and best practices.

Speaking of the SDGs, A draft of the 2023 Global Sustainable Development Report, or GSDR, was released on June 14th of this year and provides an update on progress made at the halfway point since the 2015 establishment of the 2030 Goals. It makes for sobering reading for anyone invested in achieving the SDGs (which should be all of us). It finds that many of the SDGs are not just moderately to severely off track but are even going backwards, partly because of the challenges of the last 3 years.

The draft report, however, also contains a bright point that discusses the role of science in the transformations that are required to enable renewed progress towards sustainable pathways. It contains much that should be of interest to WAITRO members. The report notes that the traditional process of production, validation, and dissemination of scientific knowledge is not sufficient to result in meaningful change. Transformations, it says, must be rooted in “socially robust” science, where scientists, policy makers, and multiple social actors work closely together at the science-policy-society nexus.

Indeed, that Chapter 5 of the draft GDSR report particularly calls out the valuable roles of indigenous technology in achieving these transformations. Indigenous agriculture is an important part of our cultural heritage and plays a vital role in ensuring food security, building resilient local ecosystems, and preserving biodiversity. The draft states that “African indigenous scientific and technological innovations were routinely ignored during and after colonialism... Recent examples of fusion of technology with Indigenous and local knowledge in Africa demonstrate the creative, technological, and scientific intellectual agents emerging from the continent.”

And it is not just Africa. I have already seen remarkable research results using products from local fruits for cancer-fighting food supplements in Costa Rica, cosmetics in Malaysia and, of course, the long history of traditional medicine in China. What can these geographically disparate efforts learn from one another?

How can the inheritors of these long local traditions secure the value of their technology for their local economies rather than seeing it expropriated by an anonymous multi-national company?

I often describe WAITRO's member organizations as pearls of research excellence. Just like pearls in jewelry, if they are threaded together on a string they can make something more beautiful and more valuable. I believe WAITRO can be that string and can make valuable contributions in this area.

WAITRO's unique promise lies in its structure as an Association of Organizations. Most UN organizations take as their Members countries, and countries most often find reasons to disagree with one another. Go to research organizations, however, the WAITRO Global Innovation Family, and you usually find people who just want to work together to solve problems. And at the research technology organizations that make up WAITRO's membership you also find the local expertise to develop that “socially robust” science that the GSDR calls for.

Indeed, WAITRO already has a track record of working closely with indigenous communities to develop innovative solutions that can help address the challenges of sustainability. A project coordinated by WAITRO from 2014 – 2017 studied the preservation of spontaneously fermented foods that are central to the West African diet. The preservation of the microbial biodiversity is a crucial step towards food security. It was funded by the Danish International Development Agency and involved WAITRO members from Denmark, Benin, Ghana, and Burkina Faso. That project itself was a continuation of a WAITRO Capacity Building program for Research and Development on African traditional foods, which started in the early 1990s, also with funding support from DANIDA and the EU. WAITRO has also been involved in developing technologies that can help improve soil health, reduce water usage, and increase crop yields.

In conclusion, I hope this webinar will address the simple question of what WAITRO can contribute to the development of indigenous products for a resilient, sustainable future. Please ask questions in the chat, give feedback both positive and negative. Follow WAITRO on its website at www.waitro.org and on LinkedIn under WAITRO. Sign up for the WAITRO Newsletter and become a part of the Family. Thank you for giving us your time, and best wishes for fruitful discussions.

“ADDITIONAL OPENING REMARKS”



Dr. Wang Liang

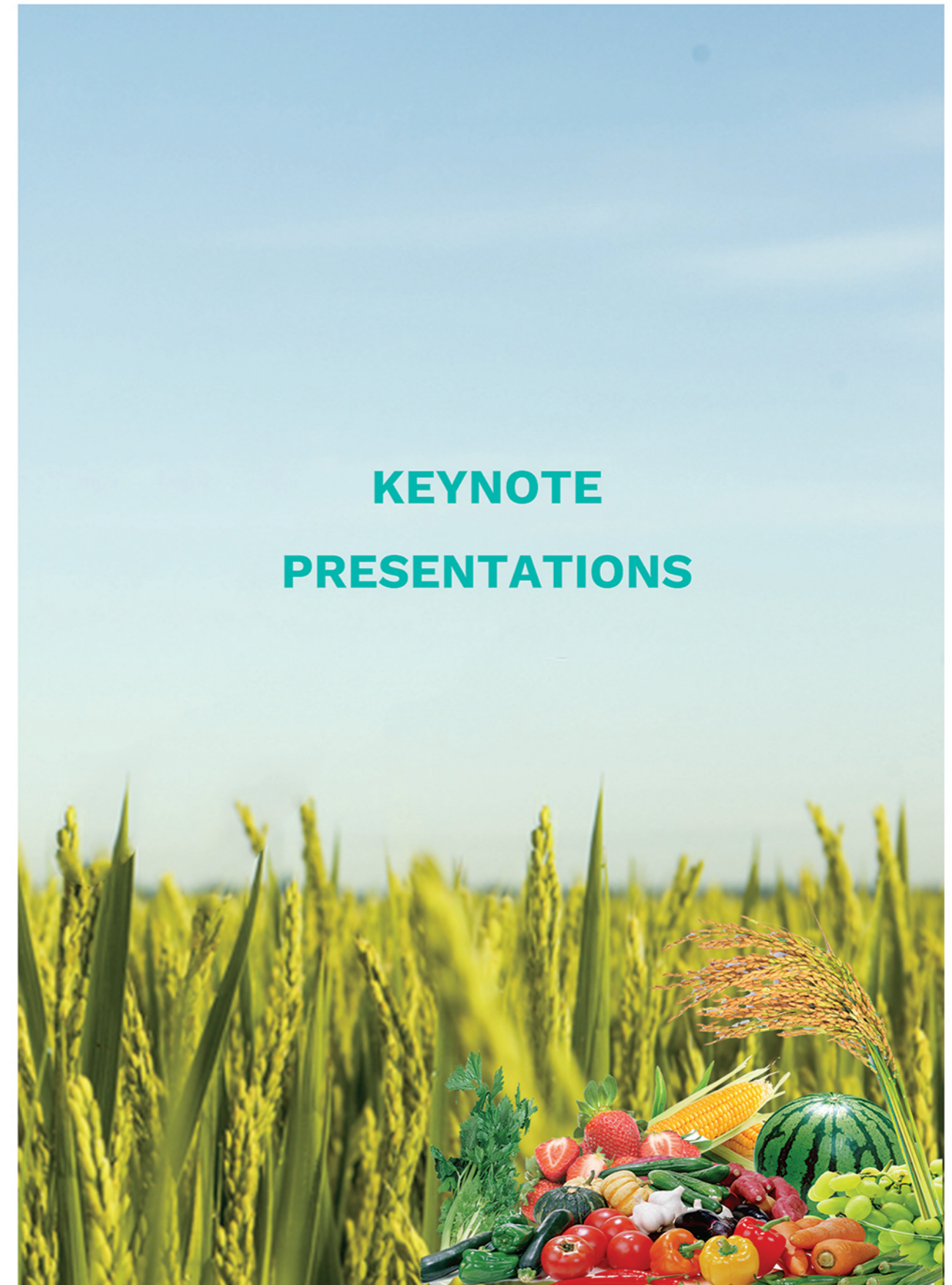
**Director, Overseas Cooperation Department,
JITRI**

Good morning, good afternoon, good evening, I am Wang Liang, Director of Overseas Cooperation Department of Jiangsu Industrial Technology Research Institute and Head of the "Belt and Road" Innovation Institute for International Cooperation on Agricultural Resources and Environment (ICARE), and I am very pleased to see so many researchers and experts in the field of agriculture gathered at the WAITRO event today. I would like to express my sincere welcome to all guests.

JITRI has hosted the WAITRO Secretariat since 2019, and JITRI has been actively playing the role of a bridge to continuously promote international cooperation among members and contribute to the Sustainable Development Goals (SDGs) through a wide variety of member activities and online and offline platforms. JITRI also took the lead in building the "Belt and Road" Innovation Institute for International Cooperation on Agricultural Resources and Environment in 2021, aiming at linking global wisdom with the resources of the Innovation Institute.

Local products have always been valuable resources for local communities around the world, and the wisdom passed down from generation to generation contains the value of science. This WAITRO Symposium invites researchers and experts from different countries engaged in the development of local resources to share their valuable experiences on how to enhance the value of local products through modern research and how to incorporate new values into local ecosystems in order to contribute to the Sustainable Development Goals (SDGs).

I would like to wish the event a great success and welcome all the guests again!





Prof. Sechaba Bareetseng

Program Manager in Indigenous Knowledge Systems, Agriculture and Food Cluster, CSIR, South Africa.

Currently managing a portfolio of projects on indigenous knowledge, systems, research, development and commercialization, funded both by South Africa's national government and international organizations.

“Interfacing Indigenous Knowledge and Scientific Knowledge for Developments of Health and Food Products”

The CSIR stands for Council for Scientific and Industrial Research of South Africa. We are the government research and technology, development and implementation institution for industrial development. And we report to the ministry for higher education, science, and technology and innovation.

And I've been asked to present about how, from the African continental perspective, do we interface indigenous knowledge systems and modern scientific knowledge into the development of innovative technologies and products of market impact on industry and society?

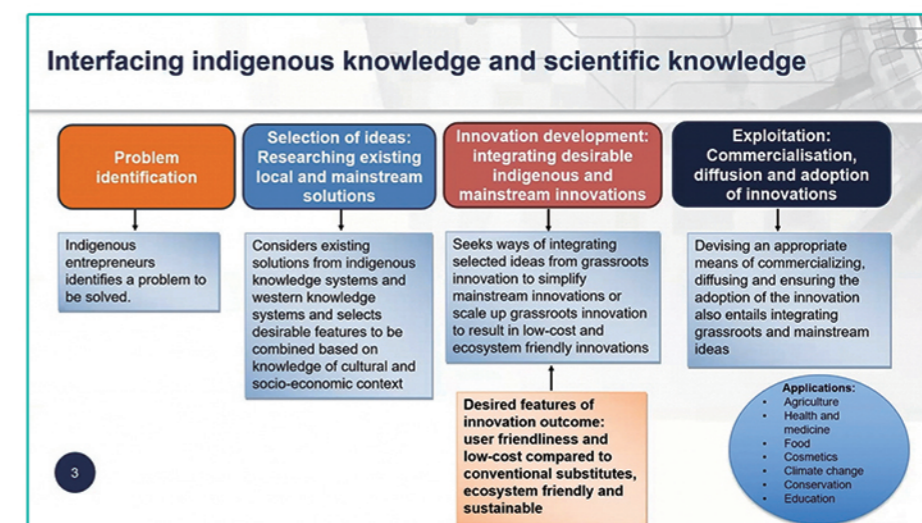
There are diverse definitions of indigenous knowledge in academic literature but all agree that indigenous knowledge is the knowledge that has been developed over time by communities, mostly in rural areas, in relation to their environment. This knowledge forms part of their cultural practices to address some of the issues that they may face in that particular geographical area like, for example, in the area of climate change, where they are able to develop those systems in order to respond to the severe consequences of climate change. Another example is in the area of health, where communities including Traditional Health Practitioners are able to use indigenous knowledge acquired over time through ancestral dreams and interaction with their environment to identify the plant species which they can identify and develop into products to treat, both human and animal diseases.

Indigenous knowledge encompasses the wisdom, the skills, the technologies and the innovations of communities. Farmers, hunters and gatherers use their indigenous knowledge systems to survive; and to become competitive in a given market segment through the production of innovative products and services. Indigenous knowledge is dynamic, sophisticated, extremely complex, and sometimes not easy to understand by many. The communities, however, developed the knowledge through local experimentation, like the example of using medicinal plant species to treat diseases. They may develop innovative ways of interacting with the plant species, while ensuring that it can regrow for future generations. By its nature, knowledge is communal and is transferred from one generation to the next to ensure its preservation.

Indigenous knowledge is in contrast to scientific or modern knowledge systems, generated usually in a university laboratory environment, with scientists doing experiments and coming up with knowledge that can be documented in publications or patents.

It is difficult to compare the two systems of knowledge (i.e. indigenous knowledge and scientific or modern knowledge), as indigenous knowledge is more spiritual and can be based on rituals, religious practices, and taboos in the communities. Unfortunately, indigenous knowledge is not exploited to its full potential to contribute to sustainable development goals stimulated by the United Nations. Furthermore, there has been insufficient exploration of how indigenous knowledge might collaborate with other knowledge systems to come up with innovative products that can contribute impactfully to the sustainable development goals.

This is a model uplifted from the literature on how indigenous knowledge and scientific knowledge can collaborate or be interfaced. I mentioned that indigenous knowledge systems are used by communities to address problems in their local context. Indigenous communities are researchers, scientists, innovators, and technology developers in their own way. Indigenous innovation can even follow a classical innovation process that has been documented in the literature. Firstly, communities identify the problem, and then select ideas within their local context to address or solve the problem. Secondly, communities can consider existing solutions around their local context and learn from other knowledge systems such as western knowledge systems and then select those desirable features which they are interested in and then integrate them into their own indigenous knowledge systems and seek ways of mainstreaming ideas for development and scale up. This can result in low cost technologies that are environmentally friendly.



Indigenous knowledge systems can add value to science and innovation but can also be more powerful when systems collaborate with other knowledge. This is where collaboration between local communities or indigenous entrepreneurs and the scientific community becomes important, and this is what we do in the context of South Africa at the CSIR. I will introduce you to some case studies generated through the collaboration between the modern scientists and communities including Traditional Health Practitioners. The case studies can be valuable lessons to the WAITRO community to develop innovative approaches and new collaborative models to tap into the indigenous knowledge systems to contribute to the sustainable development goals.

There are several regional and international organizations that recognize the value of indigenous knowledge as shown here. These include the United Nations in its sustainable development goals (SDGs), the African Union in its Agenda 2063, and the Science Technology and Innovation Strategy, which recognizes the important role of indigenous knowledge in several fields such as health, cosmetics, food, climate change, and so forth.



Here is one example of a project under the SANBio BioFISA II platform, funded jointly by the governments of Finland and South Africa from the SADC region comprised of 16 countries of the Southern Africa Development Community (SADC). The project developed a food pellet that increases milk production in goats, promoting good health by alleviating gastrointestinal parasites. This project was a collaboration between Eswatini, Zimbabwe, and South Africa, and a private sector company from South Africa. Indigenous farmers noticed that when their goats

Dairy goat feed with *Melia azedarach* – animal nutrition



- Product development and commercialisation of pellet goat feed formulated with the plant species, *Melia azedarach*, to solve problems of poor nutrition, poor growth, gastrointestinal parasites infestation and poor milk production in dairy goats
- Consortium: University of Eswatini, Chinhoyi University of Technology, Zimbabwe and Arrow Feeds (Pty) Ltd, South Africa
- Product developer, University of Eswatini, product testing and the IP owned by the University & the prototype pellets tested for quality, nutritional & health and cost benefit advantages & currently the goat farmers are feeding their goats with the pellets
- IP strategy: Trade secret
- Commercialisation strategy: University of Eswatini spin out company to commercialise the final product; and will grow the *Melia azedarach* and manufacture through a contract manufacturing
- Eswatini Access and Benefit Sharing frameworks compliance

ate a plant called *Melia Azedarach*, milk production was enhanced and the goats became healthy. This informed the collaborative project to develop an innovative product: goat pellets. The IP strategy that was adopted was trade secrets, to protect the formulation of the different ingredients. All the required beneficiary agreements are also in place to protect the indigenous knowledge of the farmers or communities.

Another project is based on Moringa, “Chicken feed with Moringa – feed for poultry” to promote growth and good health in chickens. This project was a collaboration between South Africa and Zimbabwe. The composition of the chicken feed has been protected through trade secret because different ingredients are combined in a unique manner into a final product, to produce desired properties in chickens.

Other projects also shown in the figure, are “Resurrection bush tea” – a collaborative project between Zimbabwe and South Africa and “Marula kernels extraction for natural seed oil” – a collaborative project between Botswana and South Africa.

The “Resurrection bush tea” project is based on the Resurrection bush plant that is indigenous to Zimbabwe and traditionally used there to treat mostly respiratory infections such as colds and flu and even asthma. This plant was developed into a tea plant combined with Rooibos tea. This product is currently on the market in Zimbabwe. I was personally involved with the community members, interacting with them, to ensure a good benefit sharing agreement, and

also getting more insights from them into the product development strategy in order to come up with this and other innovative products.

Finally, there is a project led by Botswana based on the fruit of the marula tree. Blue Pride is a private company in Botswana, and also an industrial partner in South Africa that was involved in the design of the equipment, to crush the marula nuts to produce high quality oil, which in this case can be developed into cosmetic products that are now being exported to the European market. All the required benefit sharing agreements are in place with the communities from Botswana.

The CSIR has been approved for funding under the Support for Industrialisation and Product Sectors by the SADC Secretariat under the SADC industrialization strategy to implement the ARV value chain for the management of HIV and AIDS using indigenous knowledge systems. The official title of the project is “Indigenous Knowledge for the Development and Production of Herbal Remedies to Manage HIV and AIDS in Eswatini and Zimbabwe.” The project is to develop two complementary medicines that can be registered with the health products regulators of Eswatini and Zimbabwe in accordance with provisions of the Nagoya Protocol of Access and Benefit Sharing, by ensuring that there are Prior Informed Consent, Material Transfer Agreement and Benefit Sharing with the Traditional Health Practitioners of Eswatini and Zimbabwe, respectively. The agreements are to protect the indigenous knowledge as intellectual property of the Traditional Health Practitioners and conserve the plant species used in the formulation of the complementary medicines where the harvesting permits will take place.

Chicken feed with *Moringa* – feed for poultry



- Develop and commercialise broiler chicken feed with *Moringa Oleifera* as a partial substitute for soy cake in Zimbabwe & develop a type two Moringa leaf-based feed for ruminants in South Africa
- Consortium: Bindura University of Science Education (BUSE), Zimbabwe and University of Venda (UNIVEN), South Africa and Codeco (Pvt) Ltd, Zimbabwe
- BUSE (Zimbabwe) and UNIVEN (South Africa) were responsible for research, product development and testing, and IP issues
- Commercial partner, Codeco involved with processing, packaging and distribution logistics of the product
- IP strategy: trade secret owned by BUSE
- Commercialisation strategy: Joint partner agreement
- Revenue: R299 113 on three commercial batches of feed (5 tonnes, 15 tonnes and 25 tonnes) & a distribution network to cover the whole nation of Zimbabwe has been established

Symba, functional symbiotic sorghum-based Beverage – human nutrition



- Development and marketing of sorghum-based instant beverage enriched with phytonutrients and symbiotics; product name: Symba
- Consortium: Tshwane University of Technology (TUT), South Africa and National Food Technology Research Centre (NFTRC), Botswana
- Project based on pre-existing IP developed by TUT which was transferred to NFTRC to develop a product to suit the Botswana market
- Two functional food products have been developed for two distinct markets: 1. Symba cereal beverage for the Botswana market and the Niselo sorghum drink for the South Africa market
- Commercialisation strategy: Start-up company, Nutrikon Pty Ltd and entity of NFTRC involved with processing, packaging and distribution logistics of the product
- Revenue: R150,000 in revenue in the two countries (demand 15 000 litres)

Resurrection bush tea



- The Resurrection bush tea project was one of the seed fund projects of the NEPAD SANBio and Botswana Innovation Hub, that is informed by traditional knowledge of the Chivu community in Zimbabwe
- The resurrection bush plant species grows widely in Zimbabwe and is drunk by a small niche population as a tea beverage - it is also traditionally used to treat colds, kidney problems, asthma, backaches and headaches
- Bio-Innovation Zimbabwe and Perceval Pharmaceuticals collaborated to develop and commercialise Resurrection Bush tea products in both Zimbabwe and South Africa.
- At the end of the project, the team had reached its target with a product launched on the Zimbabwean market (under the petalilli brand) and sales in South Africa to the hospitality industry
- The project has already influenced the implementation of the Nagoya Protocol on Access and Benefit Sharing regulation in Zimbabwe. No single project in Zimbabwe has previously received an access and benefit sharing permit; this will be the first of its kind

Marula kernels extraction for natural seed oil



- Marula kernel extraction machine for the Marula nut to reach targeted quality standards for marula oil export markets
- Consortium: Blue Pride Pty Ltd, Botswana and Industrial Partner – Destek Design CC, an engineering company from South Africa
- Blue Pride had a prototype decorticating machine (IP) which slowed down the marula kernels extraction and therefore impacting quality of the oil and profits & Destek Designed marula kernel extraction machinery to optimise the process
- The project has led to an increase in production of commercial cosmetic grade morula oil because of technology implementation
- Exports marketplaces: export to South Africa, Germany and US.
- Community involvement in the supply chain and Botswana ABS framework compliant

Lippia javanica and community enterprise development



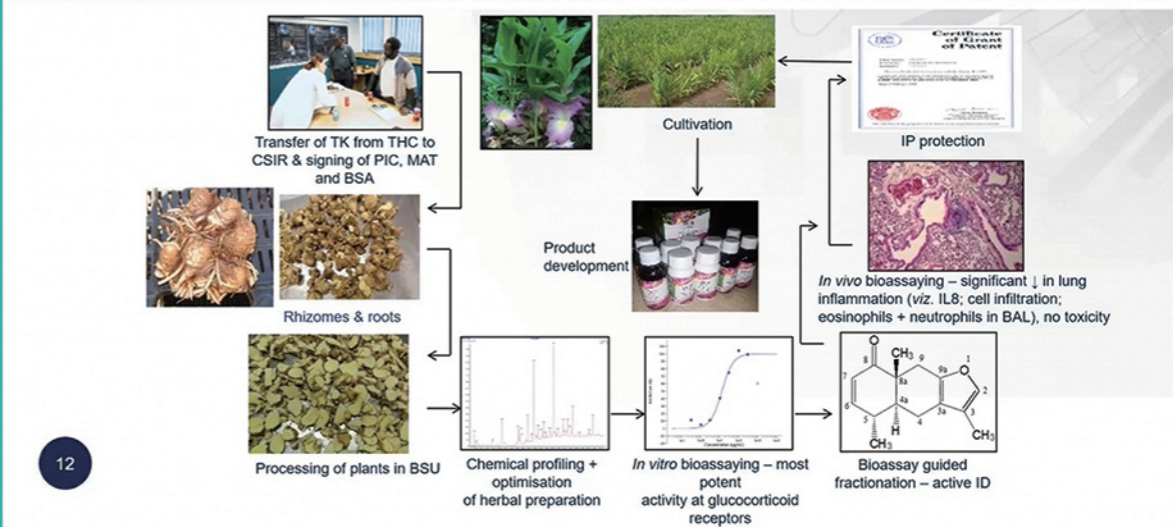
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Hi-Hanyile / Dzundze Trust, Giyani, Limpopo Province

From the Southern African context, another plant species, *Lippia javanica*, was identified by the CSIR through collaboration with the Traditional Healers Committee, who had shared the indigenous uses of the plant species to repel the mosquitoes. Using the indigenous knowledge systems of the Traditional Healers Committee, the CSIR designed an R&D program to investigate the traditional uses of the plant species in repelling mosquitoes. The plant species is also traditionally used as a medicine to treat flu and malaria infection. We used our R&D capabilities and tools to identify the chemical compound of the plant species that is responsible for mosquito repellency. An essential oil was then extracted from the leaves of the plant and developed into candles, which are currently available on the South African market at selected retail stores. The final technology was transferred by the CSIR to the communities of Gyani in Limpopo to establish a community enterprise for job creation, poverty alleviation and wealth creation. The communities were trained by the CSIR to acquire and adopt the technology and you can see in the figure. The communities are doing the oil distillation and quality controls and formulating the candles. This was really, I think, one of the most impactful projects from CSIR, funded by the South African government through the Department of Science, Technology, and Innovation and co-funded by CSIR.

Another project, which is currently in a clinical phase, is based on African ginger, otherwise known as wild ginger (*Siphonochilus aethiopicus*). The project is currently funded by UNDP to develop African ginger as a complementary medicine through Phase I clinical studies. This plant species was also identified through collaboration with a Traditional Healer Committee who use it to treat a variety of ailments like flu, influenza, pain, and asthma. We undertook an extensive R&D program to investigate the traditional uses of the plant species for asthma through in vitro and in vivo systems, which revealed that the plant has the potential to treat asthma. We identified chemical compounds from the plant that have the potential to treat asthma and optimized the process technology. Several patents were obtained in several countries around the world, including China. Now, therefore, a Phase I clinical trial is underway with a clinical research organization to take this plant to a human trial. After that, it will be registered under the South African health product regulatory committee as a complementary medicine.

Siphonochilus aethiopicus (African ginger) and R&D



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Cultivation of African ginger



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Unfortunately, African ginger is extinct in South Africa, due to over-harvesting from the wild. We have identified the cultivation facility of African ginger in South Africa. The rhizomes and the roots, seen in the figure, are used in traditional medicine, although the plant also produces flowers during spring. The first objective of the project is to develop a benefit-sharing agreement in accordance with the Nagoya Protocol on Access and Benefit Sharing provisions with the communities of Limpopo, Mpumalanga and KwaZulu Natal provinces of South Africa, as African ginger is native in these provinces, and then conduct Phase I clinical studies and register African ginger as a complementary medicine, meeting the requirements of the South African Health Product Regulator Authority. So we expect this project to unlock the commercial opportunities for industry and communities.



Dr. Nurul Izza Nordin

Head of Cosmetics and Natural Products Section, Industrial Biotechnology Research Centre, SIRIM Berhad, Malaysia.

Unlocking the Skin's Secret: Exploring Microbiome Skincare as a Revolutionary Approach to Skin Health and Beauty

About 20 - 30 % of the world population has atopic dermatitis, Part of the reason is due to genetic and environmental factors but the most significant factor an imbalance of in terms of good and bad bacteria in our body, It is interesting to explore the diversity of skin microbiome. Normally people know that the microbiome is the probiotic of the gut. So now we will be talking about the skin microbiome, which is the probiotic of the skin.

SIRIM BERHAD is located in the heart of Malaysia. We have an R&D section and also commercialization and testing certifications. Our R&D ranges from energy management, smart manufacturing and nanotechnology to my area, which is the environment and biotechnology. We are a one stop center for technology and product development, focusing on cosmetic and natural products and also bioprocess technology. We are ISO9001 MS ISO IEC/17025 accredited and consist of chemists and biologists in various areas. We focus on producing natural products as active ingredients for skin care and nutraceuticals. Prior to the creation of the SDGs and awareness of ESG, we mainly focused on herbal and plant based extracts for cosmetics.

Now we are expanding towards biomass-based products, focusing on circular economy applications and using probiotic and postbiotic ingredients for cosmetics. We also apply fermentation technology to ingredients for cosmetics. We use nanotechnology concepts for effective delivery systems. We have GMP and halal cosmetic factories. We also provide production for detergent and training for all these areas. We focus on fermentation technology, utilizing micro biology application using fungal and micro algae. Using micro algae for production of biofuels is a current trend using gene editing as part of the process in different fermentation technologies. We produce bio plastic and bio pigment utilizing natural renewable plants or biomass encompassing consumer products, medical devices, pesticides, traditional medicine, beverages, and pharmaceuticals.

Micobiome in skincare is a recent trend that it was already valued at about \$381 million in 2022 and is expected to grow at a CAGR of 10.9% from 2023 to 2030. There is a huge market for a different kind of cosmetic approach. Microbiome connects between the needs for human wellbeing and environmental health, and can also lead to economic prosperity, and advances

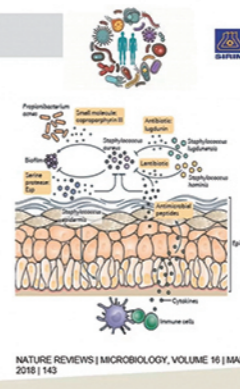
some of the SDG goals. There are many types of skincare using the microbiome in the market.

One of the main concerns in Malaysia is about halal; whether the starting material, process or final products are halal. Use of synthetic alcohol is not a problem in cosmetic because it will evaporate but alcohol in fermented cosmetics is still a debate and no actual guideline exists for skin care ingredients.

Nevertheless, there is a guideline that is based on the halal guideline for food. The main thing is that we need to ensure that the starting material and process is halal.

WHAT IS MICROBIOME?

- *The microbiome is the collection of all microbes, such as bacteria, fungi, viruses, and their genes, that naturally live on our bodies and inside us*
- Skin probiotics vs gut probiotics
- The healthy composition of skin microbiome develop since birth before exposure to inflammation sources/ bad microbe
- Good probiotics could regulate immune responses due to bad microbe etc
- Healthy interaction between immune cell, skin cells and skin microbiome shall determine skin well being



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Some SMEs, think that mixing probiotic and prebiotic together in the formulation of the cosmetic would yield good results. However, the efficacy is still questionable because normally a combination of probiotic and prebiotic requires the right environment to produce good metabolites or product. So in this case, fermentation would be the best process, because the whole process of fermentation is involved in the reaction between prebiotic and probiotic.

The microbiome is the collection of all microbes, such as the bacteria, fungi, viruses, and their genes that is in our bodies, inside or outside of the body. There are good bacteria and bad bacteria and if you have more good bacteria in your stomach, it would lead to health wellbeing. It's the same with the skin as well. You need an abundant amount of probiotics on the skin. The most common bacteria on our skin are staphylococcus. If your body has a good environment in the neonatal and young stage, for example, exposure to dirt develops an immune system against bad bacteria. It's the same for the skin.

Exposure during an early age leads to a healthy composition of the skin microbiome. Good probiotics can regulate the immune responses caused by bad microbes. A healthy interaction between immune cells, skin cells and the skin microbiome determines skin well-being. For example, lactobacillus (probiotic) produces lactic acid, which aids the hydration of the skin and can thus serve as a defense against infection by staphylococcus and other kinds of bad bacteria through broken skin or wounds.

PROBIOTICS + PREBIOTICS = POSTBIOTICS

Postbiotics

A postbiotic is a preparation of inanimate microorganisms and/or their components that confers a health benefit on the host.

Postbiotics may contain intact inanimate microbial cells...

and/or microbial cell fragments/structures...

with or without metabolites/endproducts

Source: ISAPP infographic on the postbiotic definition.

Today I will focus on the metabolites of the prebiotics and probiotics in the fermentation process to generate postbiotics. Postbiotics may contain intact, inanimate microbial cells, fragments, fatty acids and metabolites that are beneficial to your skin, like vitamins. Selecting the source of the prebiotics, the substrate, is important in producing good metabolite. Prebiotic could be from sources such as coffee beans, fermented soy, rice, natural herbs and agricultural biomass such as pineapple. Rather than recycling materials, which breaks them down to make

PROJECT SHARING SESSION



Dr. Montse Jorba Rafart

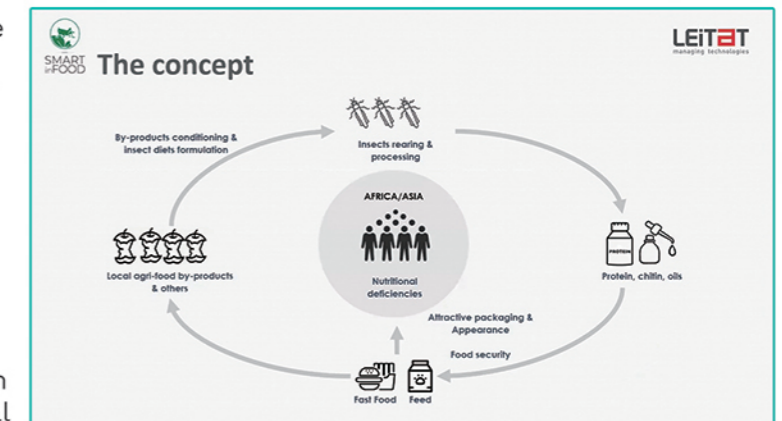
Area Manager of R&D Bioresources & Agrifood Technologies Department, Leitat, Spain

WAITRO innovation award winner of 2021

Insect-based Food Sources to Supplement Nutrient Deficiencies in Vulnerable Areas

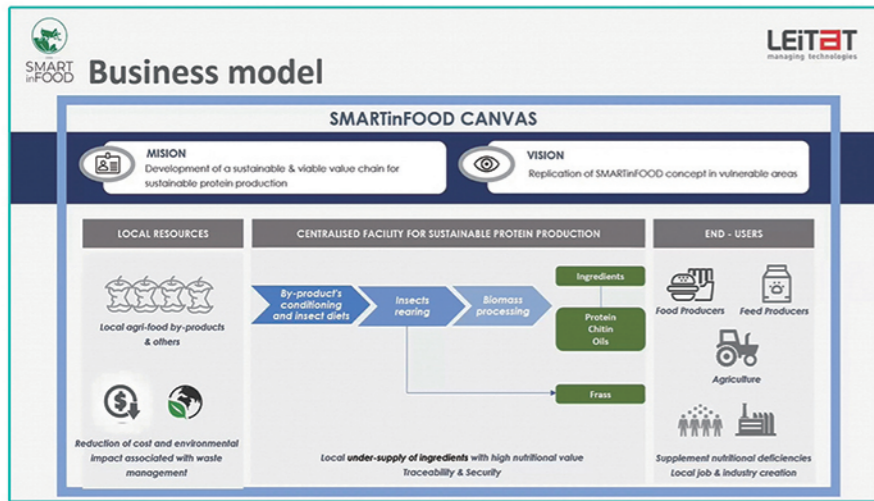
In our group at Leitat, we like to focus on production of our alternative protein from microalgae, marine, vegetable and insect sources. We are applying extraction and production technologies as well as applying food technologies for the production of active ingredients and innovative food products.

Food demand is expected to increase by around 70% by 2050 in order to feed 9 billion people. Chronic hunger is likely to be a problem, particularly in areas of the world that also have other stressors, such as climate change or geopolitical conflicts. Without responsible production and consumption, population growth is unsustainable. The SmartInFood project contributes to the use of waste, the optimization of production processes, and the promotion of local industry to supplement nutritional deficiencies in vulnerable areas in a circular economy approach by developing insect-based food. The objective is a human-centered solution to alleviate nutritional deficiencies in proteins, vitamins, and minerals using food and feed products obtained from insect breeding and processing, fed with local byproducts.



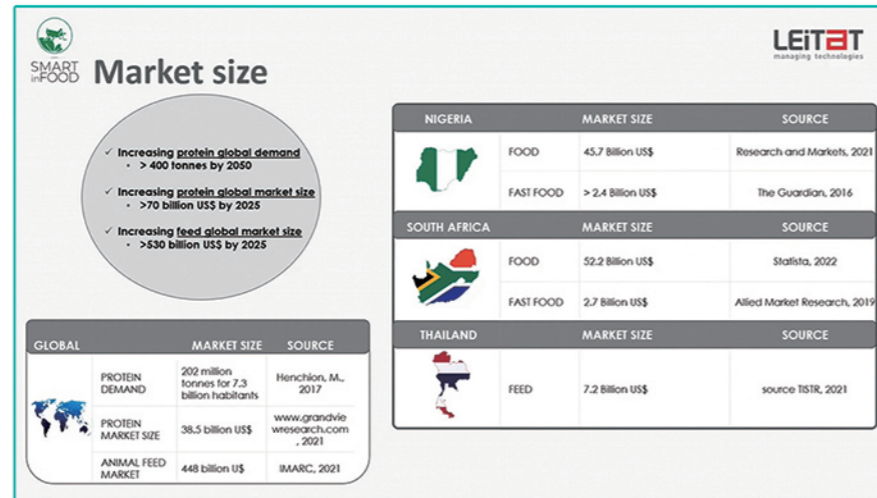
The SmartInFood business model is based on a novel value chain in three steps. The first one is focused on the utilization of food waste as a sustainable feed for insects. The second stage considers biomass conversion. The project is not only focused on protein but are also considering how to use other products such as chitin and oils.

The business plan shows the potential market size on both a local and global level. Without going into details, it is clear that there is an increasing level of protein demand and market size.

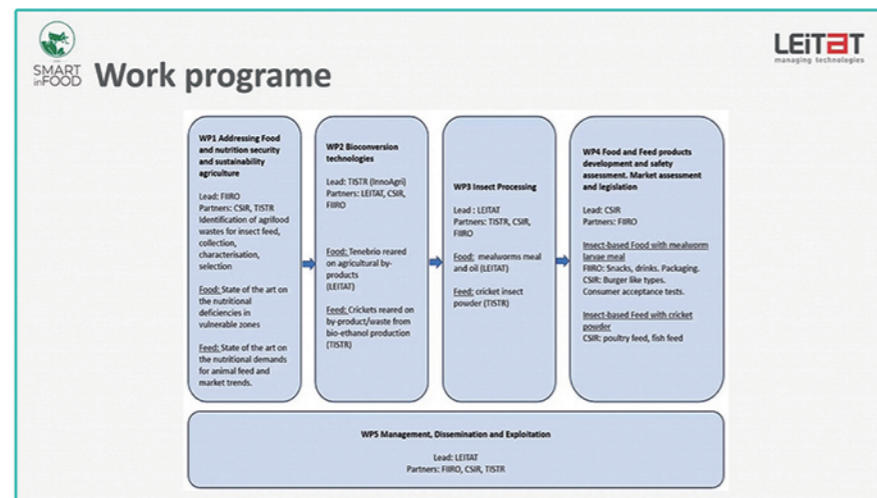


The team is a consortium of technological centers from Europe, Asia, and Africa. FIIRO in Nigeria and CSIR in South Africa are focused on developing attractive fast food products while TISTR in Thailand is focused on alternate protein for novel feed production. At Leitat in Spain we are coordinating the project, contributing our knowledge, science, and experience with insect research lines at the international level.

The structure of the project is shown in the Figure; it is based on a flexible platform. We use different byproducts, depending on the availability of them in each specific area, as well as a different nutrients and insect species, depending on their requirements. Similarly, various specific fast food products are being developed, because they are interesting for that specific population



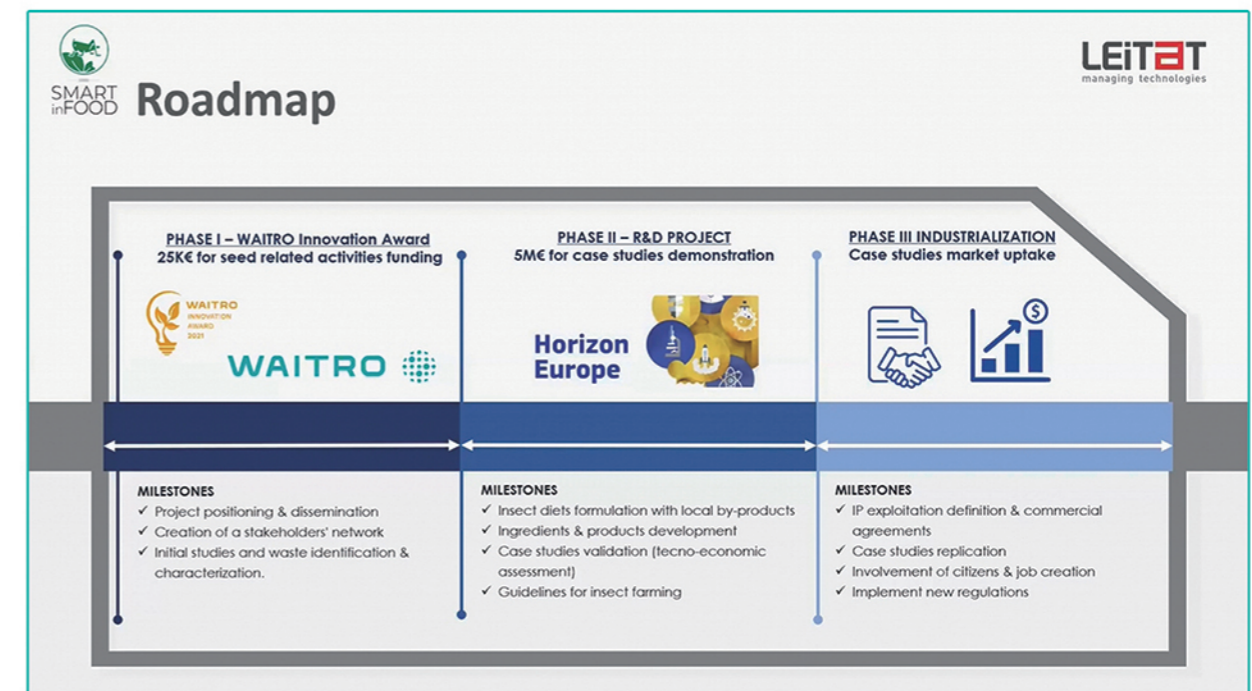
The main outcomes, in this case in Nigeria, was the identification of a specific seed and nut as the most promising for cultivation of palm weevil grubs, and the development of a preliminary methodology for insect production. Requirements for suitable packaging for insect-based food products were identified and studied and a particular highlight is our networking with insect farms such as the Brave Integrated Farms, Ltd.



In the case of South Africa, food waste from a specific market was identified for insect feed formulation, blended with a specific vegetable byproduct as feed for mealworms. A proof of concept formulation was developed. In Thailand, a bioethanol product from a specific pulp was identified as a supplement for insect feed formulation. Production of crickets at larger scale was developed and, again, networking activities were established in the area. Leitat in Spain focused on project coordination, and dissemination of the project together with the other partners, including a SMARTinFOOD capacity building workshop, and inspecting potential calls for future proposals and collaborations in the area.

The road map for the project is shown in the final slide. Thanks to the WAITRO Innovation Award we were empowered to establish the basis of the solution and so the first stage is already achieved. Now, the second stage is the demonstrative project that aims to validate the solution, incorporating additional partners such as food producers, as well as public administrations.

The third stage is designed for the industrialization. The idea is to replicate the solution in other areas. Even though the project has been a success, we have a great deal of work before us to achieve the desired impact.





“Strengthening Food Sustainability in Southeast Asia by Utilization of Local Tuber of Amorphophallus Muelleri Blume”

This project was led by me, Achmat Sarifudin, and my partner Dr. Waraporn Sorndech from the TISTR in Thailand. We were one of the winners of the WAITRO Innovation Award in 2021. The goal of the project is to strengthen food sustainability in Southeast Asia by utilizing a local tuber known as Amorphophallus Muelleri Blume.

We hope that this project can advance SDGs 2 and 3. The background of the research is that we need to take care of what we consume, particularly for those of us who are over 50 years old. Statistics show that every 40 seconds in the United States, someone has a heart attack. Similar problems exist all over the world. Other health problems for the over 50s are obesity, diabetes, and cancer. The source of this problem partially comes from our food. Most of us consume high glycemic index foods, which induce high blood sugar and other health problems. So we have to overcome this by consuming healthy staple foods and also snack foods. The criteria are the food should have low calories, high fiber, high minerals, and high antioxidants. We are developing two potential solutions for Southeast Asia. We have a local tuber, known as Porang or in China and Japan known as Konjac tuber. We want to enrich a product from this tuber with other functional ingredients, moringa leaves, and aloe vera extract in order to get a product that has a low glycemic index and high functionality.

The tuber is high in fiber and can be used as a prebiotic and immunomodulator. And everybody knows moringa leaves as a so-called super food because it has high essential amino acids. Another ingredient that we want to explore is aloe vera.

The project is divided into two parts from my team in BRIN in Indonesia, we want to develop what we call a green production process to produce glucomannan flour from this tuber and the team from TISTR in Thailand is developing staple foods and snack food that satisfy the regulations of Thailand or global standards.

We have developed a processing line for glucomannan flour and have used the WAITRO funding to finish some of this processing line; we also try to employ the glucomannan flour that we obtain to make what we call shirataki noodle.

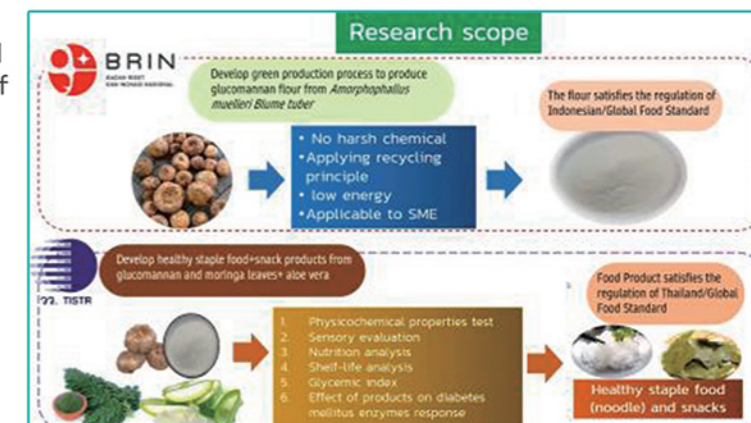
The figures show some projects that we have done so far. First is the centrifuge to separate glucomannan flour from other impurities such as calcium oxide. We have published these results. We have published these designs in the proceedings of the International Conference on Food and Agricultural Sciences (ICFAS)

Secondly, we use ethanol in the extraction process so we have to recover it so that it can be used again in the next process.

We have also published the analytical techniques to determine the impurities and details of the extraction process using freeze-thaw cycles in Food Science and Technology. And this one also we have published this. We have also filed for a patent in Indonesia on both the process and how we produce the shirataki noodles at the lab scale.

But also, at the same time, we also want to develop this small equipment to be more feasible to be used in SMEs. So we also develop equipment for scale up.

Meanwhile, the TISTR team is developing product. The first is noodles from glucomannan flour. They characterized the raw ingredients, glucomannan, aloe vera, and moringa leaf powder. They characterized the antioxidant activity or IC50, and it is clear that aloe vera has the highest antioxidant activity. So that is how they develop a noodle with low glycemic index and high antioxidant activity using these three ingredients.




They characterized using confocal laser scanning microscopy to determine the texture profile of their product. And they did also sensory evaluations and most people were accepting of their products. They also analyzed the antioxidant activity in the product, showing that it is also high.

Results: Antioxidant activity

- The raw moringa leaves provided the highest IC₅₀ (2.34 mg/mL).
- The sample with the highest content of moringa leaves showed that it could exhibit the lowest DPPH-IC₅₀ (S11, 44.05 mg/mL) which corresponded to the raw materials used in the recipe.

Table 2. Antioxidant activity of raw ingredients and noodles

	Sample	IC ₅₀ (mg/mL)
Raw materials	Moringa leaves	2.34±0.04 ^a
	Aloe vera	128.71±4.58 ^b
	Glucomannan	7.55±0.24 ^f
Noodles	Control	176.27±0.89 ^a
	S5	90.16±0.57 ^c
	S11	44.05±0.80 ^e
	SR	70.34±0.68 ^d



Their second project was to develop a snack from these ingredients. They developed a methodology and did an analysis to determine the carbohydrate, fat, moisture, and calorie content. They also analyzed the color properties and textile profile, crispiness, and hardness, which are all available from TISTR for interested parties. The sensory evaluation for this product shows that 80% of their respondents find the products were acceptable in terms of sensory properties. It is classified as a medium glycemic index and shows antioxidant activity but not especially high. These two products are mostly ready for market introduction.

Results: Glycemic index & α-glucosidase inhibition

- The sample with the highest content of glucomannan present the significant lower estimated glycemic index (eGI) which showed the medium eGI (67.35 out of 100).
- The α-glucosidase inhibitory activity of the sample with the highest content of moringa leaves (S11) could inhibit α-glucosidase activity up to 19.73%.

Table 3. Estimated glycemic index & α-glucosidase inhibition

Sample	Estimated glycemic index	α-Glucosidase inhibitory activity (%) at 1 mg/mL of sample
Acarbose	-	61.07±0.76 ^a
Control	73.93±0.12 ^a	1.62±0.15 ^d
S5	67.35±0.28 ^c	15.55±1.34 ^c
S11	68.82±0.77 ^b	19.73±0.91 ^b
SR	68.84±0.22 ^b	14.14±1.18 ^c

Part 2: Development of vegetable sheet with medium glycemic index and high antioxidant from *Amorphophallus muelleri* Blume and *Moringa oleifera* leaves

Introduction

- The rise of functional foods market is related to the need of healthy food to reduce non-communicable diseases or NCDs.
- Aiming at generating a medium to low glycemic index and high antioxidant activity snack by adding *Amorphophallus muelleri* Blume and *Moringa oleifera* leaves which have health functionalities, the designed snack recipe were crispy vegetable sheet.




Ms. Luo Xian
Researcher, Jinghua Pharmaceutical Group Co., Ltd, China

“The R&D of Wang’s Baby-Health Pill”

The company has successfully transformed ancient Chinese prescriptions into modern treatments through advanced R&D. Ms. Luo Xian spoke in Mandarin with a translator and introduced "Wang's baby-health Pill's Inheritance and Innovation", and the development history of Jinghua Pharmaceutical Group Co., Ltd., the history of China's first pill (magical pill) - gastrointestinal dynamics - Wang's baby-health Pill, the characteristics of the product, the pharmacology and the latest results of the clinical research were introduced in detail.

Wang's baby-health Pills, as a national treasure of China and a national non-heritage product, has been tested in the market for more than a hundred years and has shown its unique clinical value in the treatment of digestive and respiratory diseases. Jinghua Pharmaceutical Group Co., Ltd, will continue to inherit and carry forward the cause of Chinese medicine culture of the Chinese nation and make greater contributions to the development of human health.

产品介绍

Medicine Adjuvant Homology



道地药材，药辅同源

Traditional pan-making process



传统泛制工艺

来自四川阿坝的川贝，化痰止咳；
Chuanbei from Aba, Sichuan, reduces phlegm and relieves cough
产自湖北的鸡爪黄连，清热止泻；
Chinese Goldthread (Coptis chinensis) from Hubei can clear away heat and relieve diarrhea;
荸荠凉血生津。
Water chestnut cools blood and promotes body fluid

采用传统泛制工艺，66次逐层泛入药粉；
小丸中药物分布均匀、剂量统一、载药量大且小丸匀称圆润光滑。
Using the traditional pan-making process, 66 times of pan-filling the powder layer by layer; with uniform drug distribution, uniform dosage, large loading capacity, granules are well-proportioned, round and smooth.

安全研究

Preclinical toxicology studies have shown that

北京大学联合北京医院及中国人民解放军空军特色医学中心，对王氏保赤丸的临床前毒理研究表明：利用动物实验进行28天的连续给药并进行15天的恢复期观察，未见王氏保赤丸导致肠黑变现象的发生，高通量基因测序也未发现王氏保赤丸对细胞通路有明显的毒性作用。

南京中医药大学中药研究院研究的急性毒性试验结果表明：灌胃测定LD50，在体积最大、浓度最大时，无法测出。最大耐受量为12g/kg。相当于临床用量的1000倍。

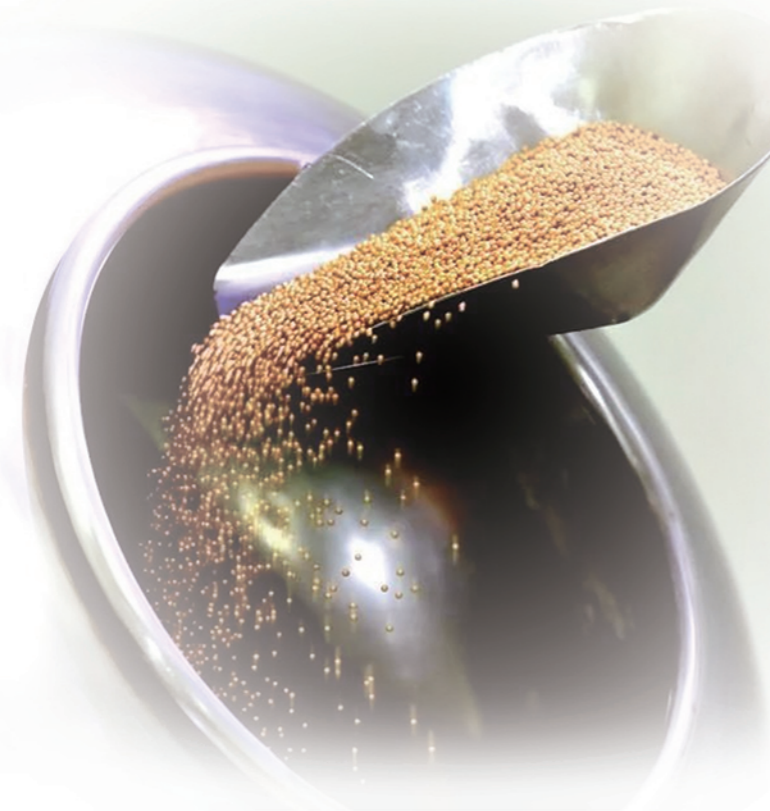
Acute toxicity test results show that: LD50 can not be measured when the volume and the concentration is the largest. The maximum tolerated dose is 12g/kg. It is equivalent to 1000 times of the clinical dosage.



Using animal experiments for 28 days of continuous administration and 15 days of recovery, Wangshi Baochi Pills did not cause intestinal melanosis, and high-throughput gene sequencing did not find it has any significant toxic effects on cell pathways.

南京中医药大学联合东南大学对王氏保赤丸长期毒性试验结果表明：未观察到大剂量王氏保赤丸长期连续给予大鼠后造成的明显毒性反应、毒性反应器官以及停药后的不良反应。

The results of the long-term toxicity test showed that no obvious toxic reaction, organ toxic reaction and adverse reaction after drug withdrawal were observed after long-term continuous administration of large doses of Wangshi Baochi Pills to rats.



CAPACITY DEVELOPMENT SESSION





Prof. Liu Aijun
Associate Professor, Nanjing Agricultural University, China

Associate Professor, Nanjing Agricultural University, China

The research presentations have been very interesting but I am working with business, so I am more focused about how we can make money! I think we have a lot of good knowledge from local knowledge but how to commercialize is very important. I have been lucky in the past to work with colleagues from Europe, from America, and Africa. We are more interested about how can we make the industry profitable from a small business perspective.

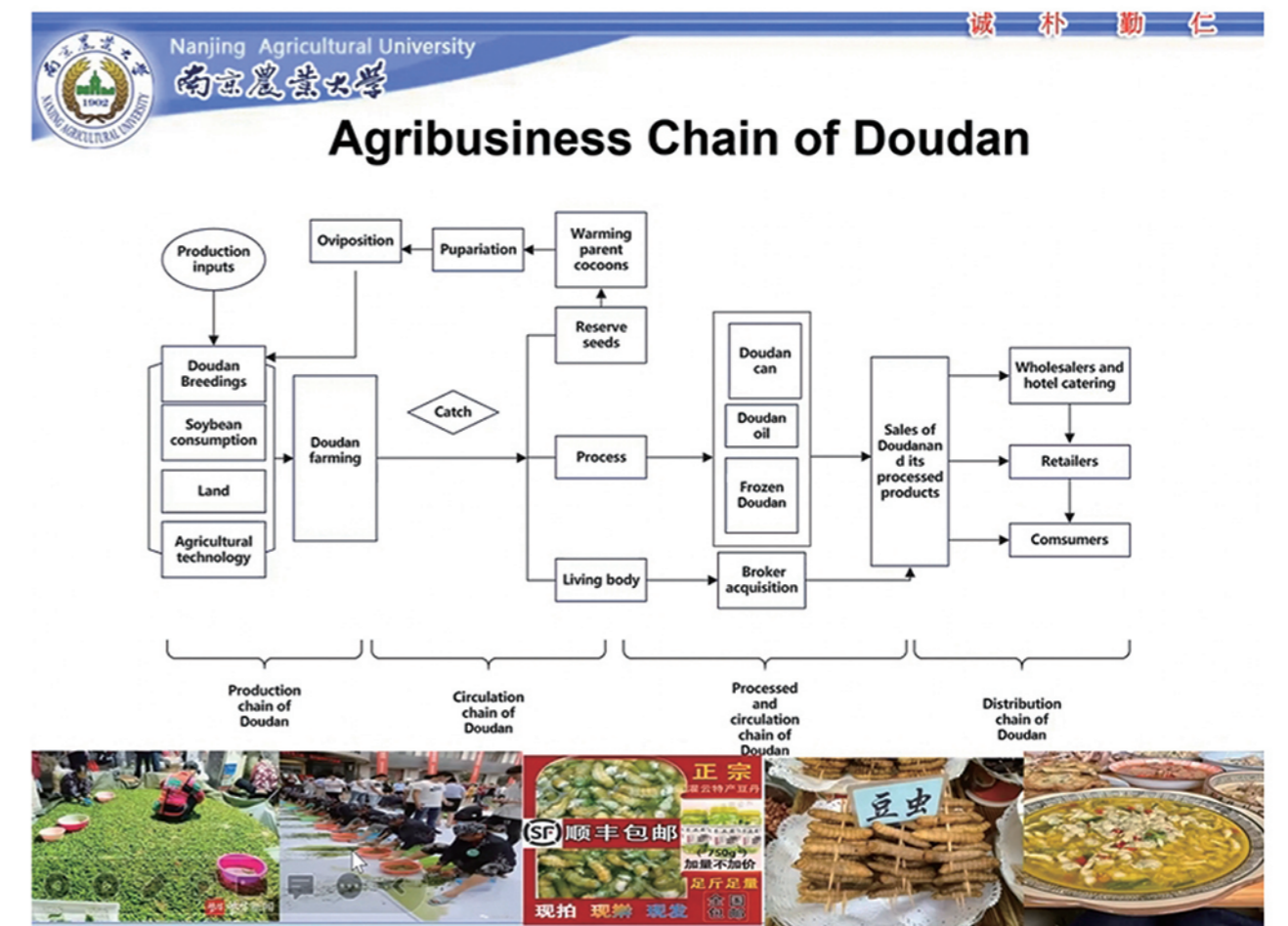
Insects are a traditional food in China. So every region has a local diet and nowadays it developed very fast. Indeed, China has a long history of insects breeding and also use the medicine, almost 5,000 years, and a lot of insect species are used as meals in china according to the literature. And also eggs and adults are processed and prepared for snacks while larvae and pupae are mostly concerned as the main course in restaurant. Cooking also included many methods. We have frying brazing and searing; a lot of methods.

Doudan is a kind of worm, that is, bean worm.

Nowadays, I think 20 or 30 popular species are used in restaurant year round. For example, grasshoppers, silkworm pupae, wasps, bamboo insects and stink bugs are very popular. The Chinese Ministry of Health has promoted silkworm pupae as a new food source. Most of the Chinese consumers are familiar with edible insects. Their acceptance of insects as food is generally higher than in the West.

In China, people love to try new foods, while in Europe and in USA people are more interested from the point of view of sustainable development. Research shows that the Chinese are very concerned about insect taste, and nutrition value. Generally, they have a high acceptance of insect food compared, for example, with German consumers. Insect phobia, feelings of disgust, knowledge level, age, household size, household income and region are all factors influencing purchase decisions. Senior people more likely to accept insect food because, in the past, they have experienced food security problems. They are used to getting protein from insects and the family is more likely to enjoy insect food. High income groups are now also more likely to accept insect food because they want to try something new. Regional differences also play a very important role because in the south part of China, it is usually a rice-based meal whereas in the north part it is a wheat-based meal. We can try to educate consumers about insect food, which could increase their acceptance.

I want to show our friends a successful case of introduction of insect food in my region: Doudan. This is hawkmoth larva, a pest that eats bean leaves and drinks nectar for a living. This region is a farm area and because these pests are eating the leaves, people discovered that it is a good and high protein and started to cook it. It is similar to a silkworm and is a local delicacy in Jiangsu province, China. It is also pollution-free and natural. Nowadays it becomes a famous food, very popular nowadays and a good business. It is said around 100,000 farmers are working on it, and also around hundreds of middlemen are doing business here. The farmers and local institutes even made a festival to promote it.



This shows the agribusiness chain and you can see that it is well organized. The inputs are the eggs and soybean production. This area is traditional good for beans production, which create the condition. Then farmers will catch the worms, do the process to turn them into food and Doudan oil. They also make frozen doudan for longer term storage.

The product will go to the wholesaler, retailer and consumers. But the most important part actually is how can a local food make money? They do a lot of promotion, which attract a lot of tourists come to try. A competition is organized around the annual festival. Farmers show the processing of the worms and they also use the internet. The final products, mostly are for soup or barbecue.

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Table 1 Input and outputs of production of Guanyun, lianyungan, China in 2019

Cost		金额 (元/亩) Yuan per Mu	占总成本 比例 (% of total cost)
固定成本 (fixed cost)	土地租金 (Rent for land)	594.00	10.92
	利息支出 (Interests for loan)	20.59	0.38
	大棚造价及维护 (Cost for Tent and mantaining)	1121.00	20.60
	制种室建设维护 (Cost for facility for seeding)	321.00	5.90
	固定资产折旧 (Depreciation of fixed assets)	111.20	2.04
可变成本 (Variable cost)	豆丹种苗 (Breeding for Doudan)	1789.00	32.88
	大豆消耗 (Cost of bean as feeds)	350.00	6.43
	水电 (Water and ecletrcity)	89.50	1.64
	人工管理费用 (Labor cost)	689.12	12.66
	技术指导费用 (Tenical extension cost)	356.23	6.55
	总成本 (Total cost)	5 441.64	100.00
豆丹总收入 (Total income)	15, 238.12		
黄豆效益 (Income just for bean)	1,000~2,000		



The cost and benefits comparison is shown in the figure. The major cost is the breeding but it is more profitable than just growing the beans. The government also tried to give subsidies for agricultural greenhouses so the farmer can arrange the production. Most important is that people sometimes love to try something not only just for product, but about its distinct attributes; tourists love to try and they also love to see how it works in the countryside.

We need to think about multi-functionality of the agricultural product, not just food, but also education culture and ecology. Doudan is a natural product, no pollution, let alone extra pesticides and fertilizer, so people love it for those reasons. There is also a culture park organized in the region to show how the Doudan was developed and how it was traditionally cooked.

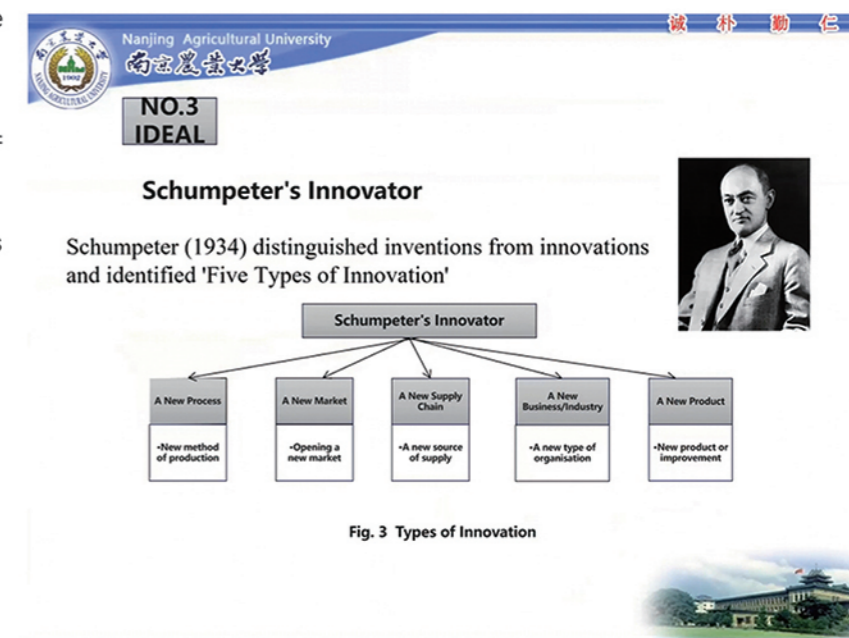
Nowadays people have a better income, so we are looking for something different. City people with good income are looking for some luxury, which means something they have never tried.



Examples include the products shown. Just grass in a pot, when marketed properly becomes a toy and kids love to grow it and have scissors to cut and trim it, like a haircut. It becomes something entertaining. Ants can be marketed as a toy, where kids can watch the ants rest, search for food, build a bigger colony. In my region, freshwater crab is very popular but actually most consumer they don't know how to eat it. So if you can provide education and sell the kinds of tools shown, the consumer would like to try and you can sell at a premium.

If we want to make money from indigenous food products, we need to think about how to find a market. Schumpeter said that if you want to make money, you have to innovate, you need a new process. Just like the eggs production of Doudan. And we also need to find new market, not in local, but for the tourists, who are from Shanghai, Nanjing and other cities.

Another one you need to have a new source of supply. You can see the chain is very developed. Another one and you need to find new types of organization. The middleman play a very important role for the marketing of it. Nowadays local is not enough so they also get Doudan from neighborhoods where they don't eat it, but are happy to supply the worms. Another is a new product improvement. So nowadays not just a soup ingredient, but also as a canned food, or barbecue; a lot of things are new. Nowadays they also sell on the internet, which is very popular.



Consumers are also very concerned about the freshness, so they will buy from street markets and, nowadays, farmer markets, which can therefore charge a higher price for the fresher produce. Street vendors can make more profit than someone selling in a wet market or supermarket. Convenience is also very important. Pork does not make money except for the supermarket. This is because they do all the cutting and packaging. After cutting, it's very convenient and so consumers are willing to pay a higher price. In China, an increasing percentage of fresh produce is going to the internet. Consumers love it because of the convenience. So that means local products also need to think about how to meet the standards of the online market.

So how does Doudan make money? The local area has a tradition of bean farming so they are familiar with it and used to eat Doudan.



Secondly, many people they are used to it from their childhood memory. So nowadays, as their income improves, they are looking for it without having to go there. The producers of Doudan also try to have diversity of their product. So they have canned, barbecue, and frozen product, which means that they can go to the online channel. They also reach the consumer via a culture park and the Doudan festival every year, and they use it to promote a healthy lifestyle because Doudan is natural with no pollution. Nowadays they also use influence from live stream, from Ticktock and they also try to have a public brand. It's very difficult for a farmer to have a brand but the local government can create a local public brand. So everyone, if qualified, you can apply for that. So they use the government's reputation to maintain a quality.

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Marketing Strategies of Doudan

<p>Product</p> <ol style="list-style-type: none"> 1.Traditional Soil bean production area. 2.Cook bean insects dish 3.Caned bean insects food 4.Frozen ben insects 	<p>Promotion</p> <ol style="list-style-type: none"> 1.Cultural park 2.Festival 3.Heathy life 4.local food 5.Influencer 6.Childhood memory 7.Public Brand
<p>Place</p> <ol style="list-style-type: none"> 1.largest whole seller market 2.Middle man play a imporant role 3.Middle man 	<p>Price</p> <ol style="list-style-type: none"> 1.Net income is 7 to 15 times than bean production. 2.50-500 Yuan Per kilo.

If you want to make money, sometimes cheaper doesn't mean better. Doudan is very expensive but the tourists love it. The strengths are high protein, natural, no pollution. And it is linked to the history of Liangang, Jiangsu, China. The culture park and the public brand is used for promotion in the media. Generally income is better in China, so consumer especially from developed area like to try something different. That's opportunity for the future, several things are important.

- Improve consumer acceptance and improve R&D to get more eggs from Doudan
- Build legal regulation of insect food at the national level
- Improve the process technology and recognize the parallels between medicine and food
- Set up a traceability system for good production of farmed or wild-caught insect food

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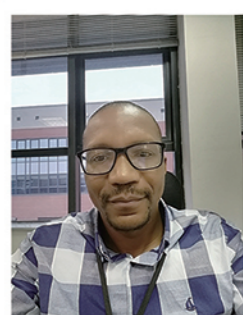
PANEL DISCUSSION

Dr. Jeffrey Robens (Moderator) is Editorial Development Manager at Nature Research and is responsible for conducting the Nature Research Academies—training workshops to improve publication output worldwide. He has strong scientific qualifications with 20 years of academic experience and numerous publications and awards. He received his PhD from the University of Pennsylvania and then worked at premier research institutes in Singapore and Japan, including RIKEN and Kyoto University. Since leaving academia in 2012, he has conducted over 250 academic training workshops across Asia and the Middle East to help researchers improve their publication quality and impact.



Prof. Sechaba Bareetseng, is currently the CSIR IKS Programme Manager within the Advanced Agriculture and Food Cluster at the Council for Scientific and Industrial Research (CSIR). He holds a PhD in Microbiology, Master of Management in Innovation Studies, as well as several certificates, such as advanced intellectual property management and bioentrepreneurship. He is currently managing a portfolio of projects and programs on IKS research, development and commercialization which are funded by the South Africa's national government and its STI agencies and international organisations, such as the UNDP. In 2018, he was a visiting scholar at Kansai University in Japan on Traditional Knowledge and Biodiversity; and was part of the fact finding mission team on behalf of the SA DTIC to China, where he visited and interacted with the research institutions and pharmaceutical companies involved in the Chinese traditional medicine R&D and manufacturing.

Dr. Thanchanok Muangman, is a Senior Researcher with the Expert Centre of Innovative Herbal Products at the Thailand Institute of Scientific and Technological Research (TISTR) in Pathum Thani, Thailand. She was previously awarded a Postdoctoral Fellowship at the French Alternative Energies and Atomic Energy, a Ph.D in Biopharmaceutical Sciences from Mahidol University in Thailand and also an M. Sc in Nutrition, and a B. Sc in Radiological Technology from the same institution. She is an expert in pharmaceutical science, molecular biology, and genetic toxicology and first joined TISTR in 2011.,



Vincent Phemelo Rapoo received his Bachelor of Arts in Archaeology and Environmental Science from the University of Botswana in 2006, and a Masters in Intellectual Property from Africa University – Zimbabwe in 2015. He joined Phuthadikobo Museum in 2008 as the Director and was involved in community development, policy development and innovations in Indigenous Knowledge for eight years. He joined the Department of Research Science and Technology in 2017 as the Principal Research Science and Technology Officer – Intellectual Property Rights. His main areas of interest include IP Policy development, IP Strategy development, Technology Transfer Strategies, IP Management and Commercialization and Access and Benefit Sharing. He further worked on the rollout of the IP Policy in Botswana and providing other IP Support mechanisms to different stakeholders in the field of Research, Science, Technology and Innovation. He is currently working for the Companies and Intellectual Property Authority as Copyright Specialist which he joined in 2019.

The Panel Discussion...

Jeffrey Robens: I'm senior editorial development manager at Nature Portfolio. I develop and conduct training workshops for researchers worldwide called the Nature Master Classes. But today I'm here to moderate the panel discussion for today's event. It's an honor to be here with all of our esteemed panelists. Let me briefly introduce them to you now.

You've already met Dr. Sacheba Bareetseng, who gave a really insightful keynote address earlier in the event today. Professor Bareetseng is from the Council of Scientific Industrial Research in South Africa, where he's the Program Manager of Indigenous Knowledge Systems program.

We are also joined by two others that you have not yet met. First is Mr. Vincent Rapoo, who's the intellectual property consultant at Vipra Overseas in Botswana and it will be great to get his personal insights related to IP with respect to indigenous projects. Also we have Dr. Thanchanok Muangman who is a Senior Researcher in innovative herbal products at the Thailand Institute of Scientific and Technological Research (TISTR).

While we are waiting for some questions to come in, I'll start off with the question that I think is really kind of central to the event that we're holding today. That's related to the importance of collaborations. I think a lot of the projects we're discussing in today's event are focused on leveraging collaborations to gain new insights and to drive those ideas forward. But collaborations, although they have their advantages, also come with challenges and need new strategies to help to overcome them. I'd be really curious to hear from our panelists about what your feelings about the importance of collaborations, and any challenges that we should be careful of. And what strategies have you found to be particularly suitable or useful to help to overcome those challenges?

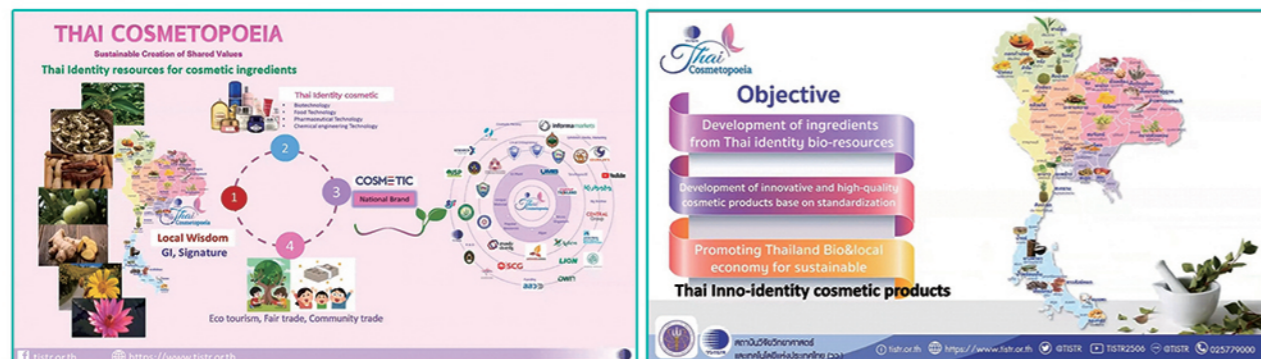
How about we start with Professor Bareetseng? What are your ideas and views on collaborations and the importance they have in today's academic society?

Prof. Sechaba Bareetseng: I think this is a very important question. Collaboration is one of the CSIR key values. So why collaboration? Collaboration in research and technology development and commercialization is really about the sharing of the resources, especially in the context of Africa, where financial resources for research and development are limited. So collaborating with other research organizations and even cross-border collaboration, is really about sharing resources, building the requisite capabilities and learning capabilities to come up with innovative ways of conducting research. Another advantage is obtaining results much faster than you would have done it yourself. So collaboration is about tapping into each other's knowledge pools and capabilities, sharing of experiences to accelerate technology development and subsequently the desired impact.

JR: Dr. Muangman, please give us your insights on the importance of collaborations and share some of the success stories that you've had with the research that you're doing.

Dr. Thanchanok Muangman Some important things on research collaboration might be the exchange of expertise or knowledge, but the most important thing is commercialization, where relating to the private sector because of the budget and economic purpose.

I can give one example in the case of TISTR, we have worked together with other organizations in Thailand to drive the local economy and industrial resources of Thailand. We have some policies to stimulate the local economy by developing natural indigenous resources. The project is called Thai Cosmetopoeia. This is like the project that we find out with the development ingredients from Thai bio-resources and develop them for innovative, high quality cosmetics based on standardization of the raw materials and promoting Thailand and its local economy as being sustainable.



The model is that we work together with a local enterprise that provides some resources that have Thai identity. We contribute scientific research and innovation to develop that ingredient. We work together collaborate with the private sector with the goal to try or improve the local indigenous products and take them to the global market, working with overseas companies such as one from France, for example.

We are also working together with the Cosmetic Valley in France and COSMED (The French Cosmetics Association for SMEs), a unit of a cosmetic and natural ingredient company in Europe. They have many members from the private sector that might be to open the opportunity from to push indigenous products of Thailand to a global market.

We also work with a company S&J International Enterprises in Thailand to make a cosmetic, using local ingredients, that they export to China. This is one of the biggest of the cosmetic companies in Thailand. Also, we work together with a large enterprise called Lion Corporation to research local resources to make a new ingredient eligible for global registration. These are examples of our project and TISTR policy.

JR: Thank you very much for sharing that. I think it's interesting to see how the research and development working with the private sector can really drive these ideas forward, especially from a global perspective. Talking about the private sector is going to lead to important issues related to intellectual property. That's what I would really like to hear from Mr. Rapoo. Can please share with us some of your insights and the importance of protecting IP, particularly for indigenous products when dealing with collaborations.

Vincent Rapoo: I think collaboration in terms of IP is very, very important because it will bring in the financial and human capital. Most of our indigenous knowledge is from rural areas or indigenous people. So once an R&D institution or a company that wants new products comes in, they will bring with them the financial muscle and also technical and human capital because this will lead to technology transfer. Our people, the knowledge holders, also need to understand all these processes work in terms of the processing of the indigenous plants or the like, and also because we will need to make mutually agreed terms with the communities and material transfer agreements at the end of the project, so that the communities themselves

will have something that they own. Also, IP will determine who owns what in the communities, how much of the IP they will own after that, and how much of the benefit will they accrue.

So if an institution comes to commercialize or do R&D with the goal of commercializing, then we need to know how much will there be for the community, not only in terms of money but also in new knowledge the community needs to develop their indigenous village. For example, we may have a particular indigenous knowledge that can help in terms of benefiting the skin but we may not have the necessary techniques or technologies that help us to do the required processing of that product. So collaborations will be very, very beneficial in that regard.

JR: Thank you very much for sharing those insights. So we do have a couple of questions from the attendees and we read the first one. This was specifically focused on use of insects that has been the subject a couple of the talks today. I want to slightly broaden the question but will read it directly from the attendee: "I wanted to ask about regarding the use of insects as food to feed humans? Will the speakers have plans for Muslim countries and markets where the use of most insects is prohibited from a religious point of view?" I think that is also related to being aware of cultural or religious sensitivities when we are trying to globalize or internationalize indigenous products. I'd like to hear again from our panelists. How do you think we should be careful with these cultural or religious sensitivities with our products to ensure that we're going to really maximize the benefits on a global scale? Would any of the panelists like to give their insights on this topic?

VR: It's very, very important. First and foremost, when you develop a product, a need must be identified. When you go into in an area, you will find that there are specific or religious issues that have to be addressed in the development of that particular product. If you want a market in Africa and we have to understand the culture. We have to understand the religious beliefs of those people. Ultimately, what do they actually need the product for, whether for consumption or for cosmetics? So you need to start with a background check on your target market so that you are able to come up with something that would be beneficial. Also, the preparation method might need to be halal. If it is necessary, then it should be taken into consideration so that when you go to the people, as part of a marketing strategy, you will ensure them that you have considered their beliefs and considered their culture.

JR: And that maybe it also related to Dr. Muangman for selling your products to China. Do you think it's important to get perspectives from your international partner to really ensure that the marketing or the products are going to be appropriate for that market? Is that something that you are exploring in that collaboration?

TM: For the next collaboration they are looking for other resources and ingredients to offer to the private sector to increase exports to China. Nowadays, there is Mistine, which has constructed its manufacturing plant in China. We have a contract to try to use things with a Thai ingredient in the manufacture and to expand to the global market, for example the connection that TISTR has with the organization in France that I mentioned. In European countries, they have expertise with the formulation of cosmetic but they like the particular ingredient and in Thailand we have many other resources of ingredients. There are some barriers in Thailand, because in east of the country the documentation and regulation is so different. We work with private enterprise in Thailand, therefore, to try to improve the documentation, standard and quality for the global market.

JR: Thank you very much. We have another really great question on which I would like to get insights from Professor Bareetseng. Most of the challenges we have in virtually all developing countries has been the huge gap between the products of innovators and the market. And the solution has always been to bridge the gap. How can these gaps be bridged knowing the series of mitigating factors that are not encouraging this to happen?

SB: That's a very complicated question. I would approach from the government legislative point of view, as well as via institutional arrangements. There is an example in South Africa that can affect the continent in general as to how to translate R&D data into technologies and products. The government introduced legislation for an institution called Technology Innovation Agency that provides funding to the universities and research institutions to translate their research results into technologies and products of market value. This creates an environment to actually apply for funding in order to translate research to the market. One of the requirements is collaboration. They require a private sector company to be part of the collaboration when undertaking the applied research to get products onto the market.

So I think it starts with establishing institutional arrangements that actually focus on putting the resources into collaboration and then putting very strong requirements of private sector involvement, as innovation takes place in the private sector who understands the needs of the market. Private sector can tailor the product concepts to meet the needs of the market. For example, under the SANBio platform - the Southern African Network for Biosciences actually promotes and formalizes collaboration and then it was able to mobilize resources. In that process, the private sector and companies become very important. To work along with the research institutions including universities, to ensure that the research is translated to technologies and products and created the impact that we envisaged.

JR: I agree that laying down the right infrastructure is one of the key things to bridge the gap. Thank you very much for highlighting that. We have a question that is perfect for Mr. Rapoo because it's about IP. "A lot of our researchers have patented their inventions but moving on to the next stage has always been a challenge. How can patent holders move their innovations to the market? What would be some of your key advice for people facing this challenge?"

VR: You find that there is always that gap from patent to commercialization. One of the presentations touched on this. Once you have done the R&D and then patented, it's easier to find a commercial partner.

You can establish a spin-off company to commercialize products. That way it becomes easier and you as the researcher have time to do other R&D because commercialization is very complex and very difficult. It involves a lot of work. Your job is mainly to do R&D and to come up with a solution. So collaborations are very, very important. You have to have a commercial partner during the course of your R&D so that once you are done with the product, then somebody takes this over, and then they put it up for marketing. It will always be easier if you take that route.

JR: Again, it brings us back to the importance of collaborations to help assist people with the challenges they're facing related to IP and drive those patents forward to commercialization.

Thank you very much for your insights. We have one more question from Dr. Burrows and he will ask it.

PEB: This also somewhat addresses the question about the gap between invention and commercialization. I'd really like to hear what the panel thinks about this. I found Dr. Liu's comments, from the Nanjing Agriculture University, to be very entertaining. He spoke about the concept of exploiting the multi-functionality of agriculture. He was talking about concepts in the Chinese market of using scarcity to drive value, of using the perception of quality to drive selling tools associated with a new type of food and of selling tourist experiences to make money. Now our goal is here is zero hunger, we're not explicitly trying to serve the tourist industry but when you have an unconventional agricultural product that you need to drive to scale, achieving sustainability requires some income. Are these concepts of multi-functional agriculture generalizable to other markets? Like Africa? Like Southeast Asia? Or is it a unique success story in the Chinese market? What do you think of using unconventional approaches to achieve scale so that we can then attack the real problem of global hunger?

SB: Absolutely. I think all the projects that I have shared the experiences with you during my presentation is all about developing unique collaboration models and the one that Dr. Liu that presented can be replicated in the context of Africa provided there is a collaborative partner to provide the insights into the market needs. I think it would need to have that kind of collaboration between China and Africa coming together and sharing those experiences to be replicated in Africa. This is where a collaborative partner will provide those kinds of insights such as the market need, policies, legislation governing R&D and international collaboration. So I think that is very important. And it should be encouraged.

JR: I can also imagine doing so could lead some potential IP challenges beyond just focusing on commercializing the product, trying to broaden out to other types of areas where there's tourism or products on other types of more interesting products like little toys that Prof Liu had shown. Mr. Rapoo, what are your insights on that type of strategy? And what are some of the additional IP challenges we may be facing related to that? Or could be potential successes?

VR: There could be successes. Like Dr. Bareetseng said, you need to find out or understand the culture of the people. Obviously, we have different cultures from China to Africa. In Africa. We have different challenges. We also have political issues, which also have been getting in way of the life of our people. So in terms of what can be leveraged on, we will have to look at the areas that we have in our country. We have rural areas, we have urban cities. Some of the aspects that he presents can work very, very well in the urban areas. Because obviously, when you come up with a product, you have methods for preparation of that process.

Sometimes you find that we share similar products, for example, chicken feet, we eat a lot of chicken feet here in Africa. When I was in Tanzania, I made a couple of friends from China who came with the product. It was packaged and prepared very, very nicely. And we could see that this thing, if we can take to Africa the way it has been packaged, then it will make it have more value. And currently what we have right now, the method of preparations and then the marketing and the package and everything would work better for us. And like Paul said, when looking in Africa, we have serious issues of food security but, at the same time, we also want to encourage innovations. So we find that a lot of innovations are around preparations of food, how people can come up with small cooking utensils that are affordable that can be used on the go. All those issues that affect, as we always try to come up with you. So developing a product and then coming up with some technology innovations around its preparations. It becomes very, very important for us to build innovation and also to build the economy.

So obviously, you like we said, people who need to understand the products were coming up with maybe giving them also an opportunity to investigate the technology. When so that they are able to see in terms of their culture, what is it that they can work for them? So that at least you are not only bringing them everything. They are not only in putting all of they are able to come up with their own domesticated products for consumption and the like and preparation think.

JR: Thank you very much. Mister Rapoo and Dr. Muangman, did you want to share any final our words about the topic before we close out the panel discussion?



TM: I think the appropriate technology is key to success. It might lack of this in many facilities in the developing countries but we can create or add value from our organization, especially if you are seeking a local identity. Identity can create value for commercialization and may drive demand from customers. This is an example product from an aroma plant, not consisting a lot of innovation, but just a mixture of ingredients with the aroma plant, and put into the container. This is a kind of inhaler for relaxation and possibly relief of nausea and vomiting. The packaging carries Thai identity and creates value for the indigenous product. The innovation is just the use of processes from pharmaceuticals to mix and preserve the ingredients and to know how to make the formulation and what it is useful for.

JR: I think it's a great point about trying to retain that national identity with indigenous products, even when you are going global to really retain where those products have come from. I'd like to first like to thank WAITRO for the wonderful opportunity to moderate this panel discussion. I'd like to thank all the panelists, an absolute pleasure working with all of you during the panel discussion. Now I'd like to hand back over to Dr. Burrows for the closing of the event. Thank you very much, everyone.

Closing Comments

Dr. Paul Burrows, WAITRO Secretary General

Thank you Jeffrey. That was a huge amount of information in a very condensed space. It's certainly going to take me a while to absorb it. We started with case studies in Southern Africa, went through probiotics in Thailand, insect food between Europe and Africa, native tubers in Indonesia, traditional medicine in China, turning the tables on the pesky Doudan in China by eating them for fun and profit... and through it all ran the constant thread of the importance of collaboration and partnership, which is the very essence of WAITRO, the Global Innovation Family. How can we position WAITRO to enhance partnerships across boundaries and help indigenous groups learn from successful commercialization efforts around the world?

We will make a report based on this webinar so please watch out for it, discuss, argue, tell us where we're wrong and tell us what's going, right. WAITRO has a working group on SDG2: Zero Hunger that is currently led by researchers at BRIN in Indonesia. Perhaps the ongoing conversation can be part of that working group, or perhaps it deserves one of its own. We are willing to consider that so please let us know your thoughts.

It's only left for me to thank all of our guest speakers for their valuable time Prof. Sechaba, Dr. Nurul, the keynote speakers, our project presentations from the WAITRO Innovation Award and elsewhere. Prof. Liu from Nanjing Agricultural University. Mr. Rapoo, Dr. Muangman and Prof. Sechaba doing double-duty also on the panel. Thank you all. I hope you all got something out of the interactions here that justifies your investment of time, and I hope you'll continue to be involved.

I especially acknowledge Dr. Jeffrey Robens from Nature Portfolio for moderating our all-too-brief panel discussion with flair and style. Thanks also go to our staff from the WAITRO Secretariat China Office for doing the hard work of organizing this webinar, particularly Duan Ran and Jiang Yiwen here in Nanjing. If you can't tell so far, this entire event is a bit of an experiment. What should WAITRO do? How should we advocate for our members in this important area? I hope that this closing speech will actually be a beginning rather than an end. The beginning of a conversation about how we can achieve an equitable fusion of science, technology, and indigenous knowledge to achieve the SDGs. The experiment will only work if you, the participants, follow up with feedback.

Any questions that didn't get addressed due to time constraints won't be wasted; we will capture them and follow up offline. So thank you all and farewell from Nanjing and England!



New Ideas for Agriculture: The Impact of Indigenous and Local Knowledge on the SDGs

◆ Objective

To help members find the best way to develop the indigenous products, and to create local ecosystem, then take the traditional use and make them bankable.

Establishing networks between representatives of science and industry.

◆ Hosts

-WAITRO Secretariat China Office

-Innovation Institute for International Cooperation on Agricultural Resources and Environment, China ICARE

◆ Date and venue

August 29th 2023, 9:00am -11:40am CEST

◆ Agenda

CEST Time	Session	Speaker	Organization
9:00-9:02	Instruction		
9:02-9:10	Opening speech		
9:10-9:30	Keynote Speech: Interfacing indigenous knowledge and scientific knowledge for the development of health and food products: SADC experiences	Dr. Sechaba Bareetseng	CSIR IKS Programme Manager Advanced Agriculture and Food Cluster CSIR South Africa
9:30-9:50	Keynote Speech: Unlocking the Skin's Secret: Exploring Microbiome Skincare as a Revolutionary Approach to Skin Health and Beauty	Dr. Nurul Izza Nordin	Head of the Cosmetic and Natural Product Section in Industrial Biotechnology Centre, SIRIM Berhad,

9:50-10:05	Project 1: Insect-based Food Sources to Supplement Nutrient Deficiencies in Vulnerable Areas	Dr. Montse Jorba Rafart	Area Manager of R&D Bioresources & Agri-food Technologies Department, Leitatz, Spain
10:05-10:20	Project 2: Strengthening Food Sustainability in Southeast Asia by Utilization of Local Tuber of <i>Amorphophallus Muelleri</i> Blume	Dr. Achmat Sarifudin	Senior researcher BRIN, Indonesia
10:20-10:35	Project 3: The R&D of WANG'S Baby-Health Pill	Ms. Luo Xian	Researcher Jinghua Pharmaceutical Group Co., Ltd, China
10:35-11:05	Capacity development session: Research on commercialization of insect food: a case study in China	Dr. Liu Aijun	Associate Professor Nanjing Agricultural University, China
11:05-11:35	Panel discussion	Moderator: Dr. Jeffrey Robens Guests: -Dr. Sechaba Bareetseng -Mr. Vincent Phemelo Rapoo -Dr. Thanchanok Muangman	Senior Editorial Development Manager Nature Portfolio
			CSIR IKS Programme Manager Advanced Agriculture and Food Cluster CSIR South Africa
			Intellectual Property Consultant Viphra Overseas, Botswana
			Senior Research Officer Expert Centre of Innovative Herbal Products (InnoHerb), TISTR, Thailand
11:35-11:40	Closing	Dr. Paul Burrows	WAITRO Secretary General