

**9<sup>th</sup> INTERNATIONAL CONFERENCE ON DRY ZONE AGRICULTURE  
(ICDA 2023)**

**“SMART Gears for Mitigating Food Crisis”**

**CONFERENCE PROCEEDINGS**



**Faculty of Agriculture, University of Jaffna, Sri Lanka**

**20<sup>th</sup> of September 2023  
Faculty of Agriculture, University of Jaffna, Sri Lanka  
Ariviyal Nagar, Kilinochchi, 44000, Sri Lanka**



**PROCEEDINGS OF THE 9<sup>th</sup> INTERNATIONAL CONFERENCE ON  
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**“SMART Gears for Mitigating Food Crisis”**

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# CONTENTS

## Message from Dignitaries

Message from the Chief Guest	X
Message from the Conference Chair	XI
Message from the Convener	XIII
Message from the Conference Secretaries	XIV

## Address from the Professional Excellency

Special Guest Address	
<b>“Research and Development Focus Towards Sustainable Development in Food and Feed Crops in 2030 and Beyond”</b>	<b>2</b>
Ms. Malathy Parasuraman	
Keynote Address	
<b>“Preparedness for Food Crisis: resilient?”</b>	<b>7</b>
Emeritus Professor Koichi Usami	

## Abstracts

### ***I. Resilient agronomic approaches for bumper yields and Soil and waste management for a conducive environment towards increased crop productivity***

<b>Growth and Yield Performance of Selected Vegetables in <i>Gliricidia</i>-based Alley Cropping System</b>	<b>14</b>
*Mithusha, B., Jeyavanan, K. and Sritharan, S.	

<b>Effect of Different Planting Methods on Growth and Yield of Paddy Variety BG-360</b>	<b>15</b>
Subaraj, R., Pradheeban, L. and *Thanusan, K.	

<b>Feasibility of Propagating <i>Dioscorea alata</i> using Vine Cuttings under Aeroponic System</b>	<b>16</b>
*Kajanan, S., Thayalan, S., Anmeegan, S., Thishanthiny, S., Sahna, M.S.F. and Wishwajith Kandegama, W.M.	

<b>Diversity of Underutilized Plant Species in Knuckles Forest Reserve, Sri Lanka: A Case Study</b>	<b>17</b>
*Anushka Bandara, P.H.C., Jeyavanan, K. and Sivananthawerl, T.	

<b>Effect of Assisted Natural Regeneration on Tree Diversity and Carbon Regulation</b>	18
*Rajapakshe, R.P., Jeyavanan, K., Sivananthawerl, T., Sivachandiran, S., Venukopan, N. and Sritharan, S.	
<b>Analytical Hierarchical Process Approach Based Assessment of Land Suitability in the Face of Climate Change in Coconut Cultivation in Sri Lanka.</b>	19
*Gunawardena, L.K.A.D.W.T. and Edirisinghe, J.C.	
<b>Evaluation of Soil Biota as Bio Indicators of Soil Quality in Organic-Amended Maize Cultivation</b>	20
*De Silva, A.G.S.D. and Siyamalan, S.	
 <b><i>II. Livestock, aquaculture, and fisheries for nutritious food production</i></b>	
<b>Factors Affecting the Reduction of Milk Production under the Nomadic Pastoral System in Murunkan Veterinary Region from 2018-2020</b>	22
Bandara, R.M.U.S., Dias, V.C., Fernando, A.P.S. and *Somasiri, S.C.	
<b>Preliminary Study on Factors Affecting the Keeping Quality of Milk in Batticaloa District of Sri Lanka</b>	23
*Sanotheran, N. and Vanajah, L.	
<b>Development of a Milk Based Condensed Curd</b>	24
Jayasinghe, W.D.M.N.I., *Rikkas, F.R. and Thanusan, S.	
 <b><i>III. Eco-friendly plant protection and novel approaches in crop breeding for universal food production drive</i></b>	
<b>Preliminary Study of Odonates in Kilinochchi Premises of University of Jaffna, Sri Lanka</b>	26
*Samarasinghe, D.V.L.V. and Thanusan, S.	
<b>Remunerative Intercropping Systems for Fall-army Worm Management in Maize</b>	27
*Sivamurugan, A.P., Pazhanivelan, S. and Suganthi, A.	
<b>Characterization of the Volatile Organic Compounds of Traditional Maize Accessions Present in Sri Lanka using GC-MS</b>	28
*Ranaweera, G.K.M.M.K., Kumara A.D.N.T., Ranasinghe, P. and Mubarak, A.N.M.	

- Variation in the production of Leafroller-induced and Constitutive Plant Volatiles in Two Rice Varieties in Tamil Nadu, India** 29  
Nishintha, N., \*Premalatha, K., Vellaikumar, S., Nalini, R. and Shanthi, M.
- Studies on Olfactory Response of Egg Parasitoids' to info Chemicals of Infested Rice Plant** 30  
Nishintha, N., \*Premalatha, K., Vellaikumar, S., Nalini, R. and Shanthi, M.
- Cost-effective DNA Extraction Method Suitable for Downstream Applications and Molecular Identification of *Salicornia brachiata*** 31  
Sridewa, K., Neththipola, T., De Silva, W.L., Perera, D. and \*Attanayake, R.N.
- IV. Food technology and nutritional sciences for a healthy generation**
- Effect of Traditional Cooking and Frozen Storage on Phenolic, Tannin and Flavonoid Content of Selected Vegetables** 34  
\*Thulashika, U. and Vengadaramana, A.
- Quality Evaluation of Pregelatinized Palmyrah Tuber Flour-Based Bread using Response Surface Methodology** 35  
\*Tharsika, R., Sobini, N. Jayathunge, K.G.L.R., Sangeetha, S. and Srivijendran, S.
- Effect of Various Processing Techniques on Nutritional, Biological, Techno-functional, Structural, and Molecular Interactions of Finger millet (*Eleusine coracana*)** 36  
\*Fonseka P.S.R. and Gunathilake K.D.P.P.
- Development of an Instant Fried Rice and Suitable Seasoning Powder Mix, Incorporated with Powdered Leaves of *Moringa oleifera*** 37  
Chandradasa, B.A.R.I.S., Mendis, B.E.P., \*Senarathne, S.M.A.C.U. and Rajapakse, R.P.N.P.
- Formulation of a Syrup having Functional Properties using Leaf Extract of *Costus igneus*** 38  
Mayoorika, T., \*Jayanath, N. Y. and Selvaluxmy, K.
- Comparison of Proximate Composition, Phenolic Content and Flavonoid Content of Raw and Malted Foxtail millets Grown in Northern Province of Sri Lanka.** 39  
\*Rajeetha, J., Sivakanthan, S., Liyanagae, R. and Madhujith, T.

***V. Agricultural economics, extension, and agribusiness management in optimizing the production***

**Consumers' Demand for Different Types of Rice, Wheat and Rice Flour in Western Province of Sri Lanka** 42

\*Suganya, J., Sooriyakumar, K., and Kamshajini, R.

**Inter Linkages among Agriculture, Industry and Service Sectors: Empirical Evidence from the Provinces of Sri Lanka** 43

\*Tharshini, N., Sooriyakumar, K., and Kamshajini, R.

**Factors Influencing Exporters' Shares on Value-Added Tea Exportation in Sri Lanka** 44

\*Jayasooriya, I. B. R. D. H. and Amarathunga, M. K. S. L. D.

**Impact of Dynamic Employment Preferences of the Youth on the Agricultural Labour Force in Kegalle District, Sri Lanka.** 45

\*Wedage, W.G.C.D.K. and Wattage, P.

**Problems in Adoption of Scientific Agricultural Practices in Agroforestry Home Gardens with Special Reference to Weligama, Sri Lanka** 46

\*Abeyasinghe, M.G.D., Samaraweera, G.C. and De Zoysa, M.

***VI. Agricultural modernization, mechanization, and water management strategies for increased food reserve***

**Pesticide Residue Deposits in Crop and Environmental Samples of Rice Field Sprayed using Unmanned Aerial Vehicle** 49

\*Suganthi, A., Kumaraperumal, R., Pazhanivelan, S., Thangachamy, P., Krishnamoorthy, S.V. and Shanthi, M.

**Optimizing Turmeric (*Curcuma domestica*) Production through Digital Monitoring and Precision Agriculture: A Study on the Usage of Smart-climatic Agricore Platform** 50

\*Ranasinghe, W.M.A.M., Pilimathalawwa, A.M.C.T., Rajendran, M.A., and Chamara, S.

**Teleconnection between Ocean-atmospheric Oscillations and Extreme Rainfall: A Case Study for Jaffna Peninsula during 2015 and 2020** 51

Chathumal, K.P. and \*Chandrasekara, S.S.K.

**Preliminary Reviewers Panel** 52

**Panel of Reviewers** 53

# **Message from Dignitaries**

## Message from the Chief Guest



**Prof. S. Srisatkunarajah**  
Vice-Chancellor  
University of Jaffna  
Sri Lanka

I am greatly honored and privileged in delivering this message on the Intentional Conference on Dry zone Agriculture 2023. Agriculture research is a continuous process and the outcome is vital for elevating and improving human life. The appropriate technologies are to be incorporated for improving lively hood of farmers community especially in the dry zone. This forum welcomes the young scientists and the university researchers globally for push forward their recent findings and innovations in Agriculture and its related fields. The theme of this year's conference has been framed as "SMART gears for mitigation food crisis." The impact of climate change and unsettled condition in Europe in recent years has led to the serve food crisis universally at present which has compelled the scientists for finding feasible solutions and challenging technologies to combat this food crisis. As such this theme is timely and this conference also would bag such kind of findings after going through a vigorous review process by eminent researchers and academia who have screened these manuscripts. I am certain that this conference would be a successful event and the participants would enjoy the benefits of it. Therefore, I take this opportunity to extend my wholehearted gratitude to the team who have worked hard to make this conference as a fruitful endeavour of high quality.

All glories to God.

## Message from the Conference Chair



**Prof. S. Vasantharuba**

Dean  
Faculty of Agriculture  
University of Jaffna  
Sri Lanka

It is with great pleasure that I deliver this message as a Conference Chair and the Dean of this Faculty to the 9<sup>th</sup> International Conference on Dry Zone Agriculture-2023 (ICDA 2023) which is being held today 20<sup>th</sup> September 2023. ICDA is one of the most important events in the academic calendar of the Faculty and has been a great success in the past eight years. As in previous years, ICDA 2023 provides an excellent forum to bring researchers from different disciplines and countries to a common platform to disseminate their findings, exchange knowledge and ideas, and build partnerships on a variety of topics.

The theme of ICDA 2023 is “SMART Gears for Mitigating Food Crisis”. The majority of the world’s poor live in rural areas and agriculture is their most important income source. Developing the potential to increase the productivity and income from the smallholder crop, livestock, fish and forest production systems will be the key to achieving global food security over the next twenty years. Climate change is expected to hit the developing countries hardest. Its effects include higher temperatures, changes in precipitation patterns, rising sea levels, and more extreme weather events. All of these pose risks to agriculture, food, and water supplies. Resilience is therefore a predominant concern. Therefore we have to introduce SMART technologies in the Agriculture sector to mitigate this food crisis. Smart agriculture is a farming management concept using modern technology to increase the quantity and quality of agricultural products. Climate Smart Agriculture is an approach to help the people who manage the agricultural systems respond effectively to climate change. The climate-smart approach pursues the triple objectives of sustainably increasing productivity and income adapting to climate change and reducing greenhouse gas emissions wherever possible. Mitigation can often be a co-benefit of action to strengthen adaptation and enhance food security.

## XII

On behalf of the Faculty of Agriculture, I wish to express my profound gratitude to our Vice-Chancellor for his generous support towards our faculty. I also wish to thank the keynote speaker, special guest, chair of the sessions, presenters, reviewers, sponsors, members of the organizing committee as well as everyone who helped in numerous ways to make ICDA 2023 a successful event. I sincerely hope these conferences will be organized in the future years also.

I hope the ICDA 2023 will be a great success and contribute immensely towards the development of the dry zone agriculture of the whole country. While warmly welcoming all delegates to the ICDA 2023, I hope that participation at ICDA 2023 will be a rewarding experience for them.

## Message from the Convener



**Dr. S. Jameson Arasakesary**

Senior Lecturer

Department of Agricultural Biology

Faculty of Agriculture

University of Jaffna

Sri Lanka

I am greatly delighted to share this message with the profoundly technical community that generates marvelous technologies for feeding hunger. The prime benefit of any technology is that it empowers people to do what they want to do. It lets people be creative. It lets people be productive. It lets people be free from the burden and lets the people face threatening challenges, especially in mitigating the food crisis. It is all about the potential of the researchers functioning universally. The theme of this year's conference is to focus on SMART agricultural technologies to mitigate the current food crisis prevailing especially in Sri Lanka, the conference will pave the way for scientists not to be lulled which could urge them to find appropriate technologies considering climate change impact which is a massive threat currently to agriculture. A team of young and energetic staff drive this conference holding the utmost dedication and enthusiasm with the fullest support of the faculty staff, Dean, and VC of this university. The Japanese counterpart from PRICIDA UOJ, Rotary Club of Killnicnochi town, CIC Holdings PLC, Iranamdu Farmers Society, Peoples Bank, Nestle lanka PLC and other contributors are backing this event. Therefore, I wish all the stakeholders including the students and the farming community will enjoy the benefit of this important annual event of the faculty of Agriculture, University of Jaffna.

May God bless you all.

## Message from the Conference Secretaries



**Mrs. Kasthuri Kajeewan**

Lecturer  
Department of Agricultural Chemistry  
Faculty of Agriculture  
University of Jaffna  
Sri Lanka



**Mr.K. Venugoban**

Instructor in Computer Technology  
Computer Unit  
Faculty of Agriculture  
University of Jaffna  
Sri Lanka

As the joint secretaries of the 9<sup>th</sup> International Conference on Dry Zone Agriculture, we are delighted and honored to bring this message. This year is a significant one, as we, the Faculty of Agriculture, have decided to hold this prestigious conference as a hybrid conference. Our theme, “SMART Gears for Mitigating Food Crisis,” was created to leverage this amazing gathering of professionals to bridge the gaps in agriculture and connect the gaps in a new and fresh way. This conference will provide valuable opportunities for top-notch research and showcase innovative research that utilizes revolutionary technologies.

We are transforming the way we operate to continuously improve our ability to meet the ICDA conference publication’s standards. Our team of ICDA 2023 staff and reviewers have continued to work rigorously to meet the challenges and excel despite practical difficulties. We should all be proud of where we are today and excited about the voluntary support of everyone associated with ICDA 2023. We would like to thank each of you for attending ICDA 2023 and bringing your expertise to this awesome gathering. With a record number of participants expected this year, we hope that these annual conferences will become larger and more substantial annually.

With all your blessings, we hope that the ICDA-2023 will be an unforgettable experience for all the participants.

Good Luck.

# **Address from the Professional Excellency**

## SPECIAL GUEST ADDRESS

**“Research and Development Focus Towards Sustainable Development in Food and Feed Crops in 2030 and Beyond”**



**Ms. Malathy Parasuraman**  
 Director General,  
 Department of Agriculture,  
 Sri Lanka

I, as the Director General of Agriculture, am proud to deliver this important message in this conference which holds a timely theme of SMART gears to mitigate the food crisis. Currently the World faces threatening challenges to sustain the food security and the nutritional status of the people especially the children who live in the developing countries. The sustainable development goal formulated by UN focusing zero hunger (Goal1) and responsible consumption and production (Goal 12). In addition, the same summit has also focused to no poverty in this universe (Goal 1), In this context the we the agriculturist are aiming to ensuring a consistent supply of safe nutritious food, Sustainable Production and consumption of food and Mitigated malnutrition which covers the food security as a whole. The move towards the above targets should go along with the environmental preservation which includes protect the ecosystem with safeguarding soil, water and biodiversity, prevent environmental degradation though crop management, resilience to climate change used for sustainable production and Climate-resilient crops with suitable management to assure production also to be looked in. On the other hand, the Sri Lanka has been compelled to jump in to rapid actions on its economic prosperity through a sustainable food and feed system, empowerment of rural livelihood, eradicate rural poverty and enhance the contribution of GDP by improvement of agro based products. The prime way to achieve economic prosperity is by reduced dependency on imports for leading to self-sufficient level for ensuring the national self-sufficiency in food crop production in order to saving huge foreign exchange

### **Agriculture research and development.**

The Department of agriculture is responsible for the research and development of agriculture sector. Our mandates are tremendous and huge. Generate ap-

appropriate technologies, disseminate matured technologies to the doorsteps of the clients, ensure local food supply and export agro-based product and, ensure production of healthy nutritious local food with international quality standards are our stipulated tasks.

The technologies for production and quality improvement covers the development new varieties and the development agronomic packages suitable for those varieties. Resource efficiency is another task. The war for water leads to find out the ways and means to optimize water usage. The pesticide and chemical hazards aims to Minimize chemical inputs. Declining the nutritional status leading to enhance nutrient management with Improved labor efficiency. Frequent incidences of pest and disease in recent times urges us to find out suitable integrated pest management strategies along with the crops which have disease-resistant traits. On the other side the major concern is the biodiversity conservation in order to maintain genetic diversity and the conservation of valuable indigenous flora and fauna. Knowledge Transfer is the other ray which is necessary to fill the Knowledge gap between farmer and researcher, access of latest scientific knowledge and to promoting their capacity building thereby increasing overall agricultural productivity. All these could be achieved with proper policy formulation/ policy studies which need of production driven overarching agriculture policy coupled with Export and Economic Growth for ensuring quality agro product aiming for meeting international standards, exploring new market opportunities in order to enhances the country's competitiveness in the global market thereby boosting economic growth by identified new ventures

### **Agricultural landscape of Sri Lanka**

The characteristic features of Sri Lankan agricultural land scape is that it has potential of growth presently contributing about 7-8% GDP with approximately 27 to 30 % labour force engaged with considerably small land holdings (>1ha) which shows the fragmenting trend continuously in general which also leads to Increase food demand but reducing land availability for agriculture, attributing to an increased demand for housing and infrastructure. However, notably these are the main components to ensure Food security. this scenario leads to supply labour to other sectors, rural-urban migration also, leading to younger generations often migrate to urban areas, causing to labor shortages in rural areas and hindering for eradicate rural poverty. Our country's structure has often changed demand of food. Above all the human influence is a great threat to biodiversity. As a whole the followings are focused for immediate attention. Food Security: Contributing Substantial share of food (rice, vegetables, and fruits), crop Diversity: Sri Lanka boasts a diverse range of crops due to its varied agro-climatic zones, including rice, tea, rubber, coconut, and spices, Change food habit: - Increase

per capita income demand more luxury food and appropriate Market Access: Access to local and international markets is a challenge for smallholders. the market is unstable and prevailing High-cost production, Transportation, Quality standards, Price fluctuations, Policy Focus: Government initiatives and policies are aiming to Modernize agriculture, increase value addition and Promote sustainable practices for a resilient future.

### **Challenges in Agriculture.**

Though the researchers are fighting continuously for overcoming threats in agriculture the following challenges are surfing against us.

1. **Climate Change Impacts:** Erratic weather patterns, including drought, flood, temp rise and changing rainfall patterns, pose significant challenges to crop productivity and stability.
2. **Land Scarcity:** Increasing population and urbanization lead to land conversion for housing and infrastructure, reducing available arable land for farming.
3. **Smallholder Farming:** A majority of farms are smallholder operations with fragmented land, limited access to modern technology, and challenges in accessing markets.
4. **Resource Management:** Limited water resources and inadequate irrigation systems affect crop yields and sustainability.
5. **Market Access:** Limited access to domestic and international markets, coupled with volatile prices, affects farmer income and overall economic growth.
6. **Pest and Disease Management:** Increasing pest and disease pressures, aggravated by changing climatic conditions, impact crop health and yields.
7. **Limited Value Addition:** Lack of processing facilities and value-added products reduces the income potential of agricultural produce
8. **Aging Farming Population:** Demographic changes resulting in an aging agricultural workforce.
9. **Outdated Practices:** Dependence on conventional farming methods and inadequate knowledge of modern practices hinder productivity and sustainability.
10. **Lack of Agricultural Finance:** Limited access to agricultural credit and financial services constrains investment in modern technologies and practices.

## **Vision for Sustainable Food and Feed in 2030 and beyond**

The primary vision is to cope up and urging climate Resilience by developing climate-resilient crops coupled with technologies for sustainable farming. Secondly on biodiversity conservation with the development eco-friendly agriculture to quality assured soils and water resources. Also, the reduced environmental Impact: Implementing practices that minimize resource use, water pollution, and greenhouse gas emissions, contributing to a cleaner environment. Accordingly, Technology Integration towards harnessing advanced technologies, such as precision agriculture and data analytics, to optimize resource utilization and productivity. Another vision is to increase food and nutritional Security: for ensuring a consistent supply of safe and nutritious food for all Sri Lankans and eradicate hunger and malnutrition. Nutritional diversity: Encouraging the cultivation of a variety of nutritious crops and feed sources to improve dietary diversity and livestock health. Sri Lanka to be ensured with proper market Access: Facilitating access to domestic and international markets thus expanding international markets enabling farmers to secure better prices for their products. Another sector vision holds the education and awareness: Promoting awareness about sustainable practices among farmers and consumers, fostering a culture of responsible for food and feed production, e-agriculture, and mass media uses. All these for our community empowerment: Engaging local communities, farmers, and stakeholders in decision-making processes to ensure the inclusivity of sustainable development for economic Prosperity: Uplifting rural livelihoods and fostering economic growth by enhancing the productivity of agricultural systems and value chains

### **Policy interventions**

The unstable government policies are to be re-looked in order to the followings Promote crop Productivity, self-Sufficiency in Key crops, export Promotion, production of Animal Feed Ingredients, Farm mechanization, reduced pesticide reliance, land consolidation, crop diversity and Specialization, and finally on Value Chain Development

### **International collaboration.**

The economic growth of any country shall be boosted with sound international collaborations. Those to be focused with fostering knowledge exchange, resource sharing, and cross-cultural insights that accelerate scientific advancements and address global agricultural challenges more effectively. The facilitating the sharing of knowledge, resources, and best practices by connecting diverse expertise, enabling the exchange of innovative ideas, and pooling together collective strengths to address complex agricultural issues on a global scale. Sri Lanka can

enhance its standing in the global agricultural landscape by leveraging its unique agro-climatic diversity, fostering research-driven innovation, and actively participating in international collaborations, thus contributing valuable insights and solutions to global agricultural challenges

## **Conclusion**

Therefore, my dear friends I shall conclude my message with emphasizing agricultural research drives innovation, fostering the development of climate-resilient crops, sustainable practices, and technology integration. This ensures a productive and environmentally conscious agricultural sector which is vital for Sri Lanka's sustainable development. The food security and economic growth by addressing challenges like climate change, population growth, and resource scarcity, Agricultural research strengthens food security, enhances rural livelihoods, and contributes to economic growth through increased productivity and market competitiveness. The global engagement and collaboration shall embrace international collaboration and knowledge sharing amplifies Sri Lanka's presence on the global agricultural stage, allowing the nation to contribute to solutions for shared challenges and benefit from diverse perspectives. Also, the empowerment and future preparedness as agricultural research empowers farmers with knowledge, modern techniques, and cutting-edge tools, enabling them to adapt to changing conditions, make informed decisions, and drive the nation's agricultural progress well into the future for mitigation food crisis.

# KEYNOTE ADDRESS

## Preparedness for Food Crisis: resilient?



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## I. Food Crisis

Food crisis is a phenomenon of “widespread scarcity of food in a society”, being caused by such factors as crop failure, population explosion, government policies, and inaction in terms of food production (Osabuohien et al., 2015). Encyclopedia.com says that the understanding of the nature of food crises have evolved, from those stressing “nature” or lawlike causes, to those emphasizing the social nature of such crises. Sen (1981) says that the Bengal Famine in 1943 was not primarily caused by harvest failure in Bengal, but by wider economics, social, and political conditions pertaining to the colonial economy, the nature of Bengal society, and political conditions during World War II. In the recent, along the shift of focus from production to distribution and from food crisis to food security, the political emphasis shifted both in national governments as well as in global organizations.

According to Lee et al. (2012), two major food crises occurred in 1973 (caused by rapid decline of production rather than the price upsurge) and 2008 (induced by the price rise) on a global scale, while minor ones took place less uniformly for different years in different countries during 1961 to 2009.

## II. Sustainable livelihood

The livelihood of a household or individual is based on their capabilities, assets/capitals (natural, physical, financial, human, and social) and activities. The sustainable livelihoods approach is a helpful framework to understand the main factors that are influential to poor people’s livelihood, and the relationships among these factors, and this accordingly facilitates the planning and implementing effective development interventions. A livelihood is sustainable when

it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base. (DFID, 2000)

### **III. Smart gears**

#### **1) Smart**

Longman Dictionary of Contemporary English says that “smart” means “intelligent”, “sensible”, or “clever”. Meanwhile, in terms of technology, it means “being controlled by computers and being designed to react in a suitable way depending on the situation”. A dictionary says that “smart” means “multi-functional and high-performance using IT (Information Technology)”. In the modern life, smartphone, smart speaker, smart key, smart city, and smart home are well known as familiar terms.

In such context, the followings have attracted attention in agriculture, especially from the viewpoint of efficiency, equity, and sustainability: Smart Agriculture, Precision Agriculture, and Digital Agriculture. Broad factors enable the spread of digital agriculture: digital infrastructure, agriculture’s role in the country, human capital, policy and regulatory environment, and research environment (Wikipedia, 2022)

#### **2) Gears**

Cambridge Dictionary says that “gear” means “a device, often consisting of connecting sets of wheels with teeth (=points) around the edge, that controls how much power from an engine goes to the moving parts of a machine”, while “the equipment, clothes, etc. that you use to do a particular activity”. For example, the latter is a fishing gear.

### **IV. Resilience: preparedness is enough?**

As for the disaster management, the assumption such as “damage scale” and “frequency of occurrence” have changed indeed. In food stocks/reserves as a food security, being a countermeasure, I am wondering if the nation has reached the consensus, especially consumers rather than producers. Is it sure that the prevailing distribution supported by smart gears can systematically work so that households and community can be aware enough of and seek out livelihood strategies to cope with food crisis as a stress to them?

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# Abstracts



**“Resilient agronomic approaches  
for bumper yields”  
and  
“Soil and waste management for  
a conducive environment  
towards increased crop  
productivity”**

## Growth and Yield Performance of Selected Vegetables in *Gliricidia*-based Alley Cropping System

\*Mithusha<sup>1</sup>, B., Jeyavanan<sup>1</sup>, K. and Sritharan<sup>2</sup>, S.

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The *Gliricidia* [*Gliricidia sepium* (Jacq.) Walp] is used as a hedgerow tree species in alley cropping system. However, studies on the impacts of *Gliricidia* on alley crops were limited to the dry zone of Sri Lanka. This experiment was conducted at alley cropping units of Department of Agronomy, Faculty of Agriculture, University of Jaffna, located in dry zone of Sri Lanka to assess the effect of *gliricidia* hedgerows on growth and yield performance of Tomato (*Solanum lycopersicon* L.), Radish (*Raphanus sativus* L.), and Water spinach (*Ipomea aquatic* F.). Three treatments; (i) 5 m spaced hedgerows, (ii) 10 m spaced hedgerows, and (iii) no hedgerows as a control, were laid out in a Randomized Complete Block Design (RCBD) with 3 replicates. Growth and yield parameters were measured and expressed in two ways; (1) per plot and (2) distance from a hedgerow. Light intensity was measured thrice a day. ANOVA with Duncan multiple range test was done at  $\alpha$  0.05 using SAS 9.1 package. Results revealed that the average yield of Tomato ( $1.29 \pm 0.22$  t/ha) and Radish ( $7.15 \pm 1.85$  t/ha) was significantly high in 10m alley. The average yield of Water spinach was significantly high in control ( $9.07 \pm 1.42$  t/ha). The average yield of all crops was significantly low in 5 m alley. Light intensity was greater in control by 35.14 % and 88.78 % compared to 10 m alley and 5m alley, respectively. Yield with hedge row distance showed that significantly high yield was recorded in the middle of alley (Tomato:  $0.27 \pm 0.12$  kg/plant, Radish:  $0.561 \pm 0.28$  kg/plant, Water spinach:  $0.66 \pm 0.28$  kg/plant) than closer to the hedgerow. Light intensity was greater (22.72 %) in middle of the alley than closer distance to the hedgerows. Plant height of tomato was significantly high in 5 m alley, but number of fruits and leaves was significantly high in 10 m alley. For Water spinach, number of suckers and leaves was significantly high in the control. For Radish, root length and circumference were significantly high in 10 m alley. The average yield was low compared to recommended yield however, crop performance was comparable with alley cropping system. From this study, 10 m alley can be recommended for Tomato and Radish for better yield whereas Water spinach can be cultivated without hedgerows.

**Keywords:** Alley cropping, Alley width, Dry zone, Hedgerows, Vegetables

## **Effect of Different Planting Methods on Growth and Yield of Paddy Variety BG 360**

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Rice is the staple food in Sri Lanka. Bg 360 is currently considered the best improved paddy variety cultivated by farmers in Mannar. In Mannar district, different planting methods are practiced by farmers and number of effective tillers obtained are varied which caused yield variation and different cost of production in paddy cultivation. To solve this issue, and find out the better method of cultivation an experiment was carried out in randomized complete block design with three replications by adopting five different methods of planting as treatments, namely broadcasting (T1), drum row seeding (T2), SRI method of planting (T3), manual transplanting (T4), and machine transplanting (T5). Growth parameters such as plant height, leaf area index and tillers and yield parameters such as number of grains, panicle numbers and yield per plots were measured. Data were analyzed in SAS 9.4 version and mean separation was performed in DMRT to identify the best treatment. The results of the experiment showed that the planting methods have significant effects on the plant height, effective tillers and grain yield. The high number of effective tillers (between 6 – 20 per plant), 1000 grain weight (12.72) and number of panicle per plant (19.89) were observed in SRI methods and low value received from broadcasting method. and number of grains per panicle was observed high in broadcasting method (270.47), also had significant effect on the time of crop maturity (by two weeks). Direct seeded rice matured early (110 days) while transplanting took 120 days. Further, transplanted rice especially in SRI method showed low seed requirement, low weeds and pest diseases incidence and low cost of production. However, farmers are not adopting SRI method for cultivation because of high time consuming with high labour requirements. Based on the study, it can be concluded that transplanted rice especially SRI Method is more beneficial than other methods of planting and awareness should be given to farmers regarding SRI method of planting and its benefits.

**Keywords:** Rice, SRI, Tillers, Transplanting

## **Feasibility of Propagating *Dioscorea alata* using Vine Cuttings under Aeroponic System**

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*Dioscorea alata*, is a popular tuber crop, and nutritionally superior to other tropical root and tubers. It is a staple food for approximately one billion people in Asia, Africa and the Pacific region. It is an important reliable source of diosgenin, a pharmacologically active ingredient to treat arthritis. Despite the high demand of this crop for diverse purposes, the production is far below due to different reasons. Expansion of the cultivation is limited due to lack of technology for year-round production of planting materials. Tuber is the main propagation material that is used for commercial cultivation. This study was focused on evaluating the feasibility of using mature vegetative parts of the vine as propagation materials. Vine with leaf and vine with nodes treated with three different root inducers (Aloe Vera, activated charcoal and commercial plant rooting hormones) were used for initiating roots and mini-tubers. Planting materials were placed in aeroponic chamber and fertigated with automated sprinkler system in 30 minutes interval. Water quality, temperature, pH and electrical conductivity were monitored daily. Number of roots, root length, tuber formation and tuber size were measured for 6 weeks. All treatments were replicated three times. Complete Randomized Designing was used and compared the growth performances using ANOVA. The data were analyzed using Minitab version 10.1. Callus initiation was observed from 14 to 21 days after establishing whereas the rooting induced after 18 days. The longest root growth 4.81 cm and 4.88 cm were observed in both vine with leaves and vine with nodes respectively treated with commercial root hormone. Activated charcoal demonstrated the lowest root growth. Mini-tuber development was observed in several nodes in the same vine which can be used as a novel mass propagation material in *Dioscorea*. However, further studies are required for further evaluation of their performance as propagation materials under the Aeroponic system. This research was funded by FAO Sri Lanka (LoA No: 378/22/TCP/SRL/3804).

**Keywords:** Callus, Mini-tubers, Rooting, *Dioscorea alata*, Aeroponic system

## Diversity of Underutilized Plant Species in Knuckles Forest Reserve, Sri Lanka: A Case Study

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Underutilized plant species often find themselves confined to homegardens, small-scale farming systems, and forest ecosystems. Among these production systems, there has been insufficient attention given to studying the underutilized species and their economic potential in forest reserves. Therefore, this study was carried out to assess the diversity and economic importance of underutilized plant species in the four divisions of Knuckles forest reserve (Riverston, Pitawala, Laggala and Kaluganga) in Matale District, Sri Lanka. There were 40 sampling plots laid with a dimension of 20 m × 20 m. The plant species were taxonomically identified through expert consultation and validated using specimens available at the Herbarium. The study identified a total of 34 underutilized plants from 27 families in the area. The diversity index was calculated for each division. Relative frequency of species indicated that the most widespread species were *Neolitsea cassia* (11.6%), followed by *Antidesma alexilaria* (8.3%), *Syzygium cumini* (7.4%), *Calamus rotang* (6.6%) and *Careya arborea* (6.6%). The highest relative density was observed for *A. alexilaria* (17.4%), followed by *N. cassia* (12.3%), *C. rotang* (11.2%), and *Osbekia octandra* (10.3%). The highest species richness was reported in the Pitawala division (22) next to Laggala division (18), But it was very low in Kalugana division (6). A similar trend was obtained for Shannon-Wiener Diversity Index and it was 0.895 in the Pitawala division which indicated that this area had highest diversity of underutilized species. Mean number of population was high in Riverston (600±152 stem ha<sup>-1</sup>) next to the Pitawala division (416.65±82.62 stem ha<sup>-1</sup>). Further studies are necessary to assess the diversity of underutilized species and their potential applications across the Knuckles forest reserve.

**Keywords:** Economic potential, Knuckles forest reserve, Underutilized plants, Sri Lanka

## Effect of Assisted Natural Regeneration on Tree Diversity and Carbon Regulation

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Assisted Natural Regeneration (ANR) is one of the popular techniques to restore an ecosystem. This study aimed to assess the effect of ANR on biodiversity and carbon regulation in young plantations at reforestation units of the Kilinochchi premises, University of Jaffna (80° 24 E' 61° 6 N'). A total of 63 plots (2.52 ha) were laid with a dimension of 20 m × 20 m. The sampling plots were categorized into mixed plantation (MP) and unmixed plantation (UMP). Tree height (TH) and diameter at breast height (DBH) were measured. Shannon-Weiner Index (SWI), species richness, evenness and Important Value Index (IVI) were estimated. Allometric equations were used to estimate the carbon stock. A total of 931 individual trees comprising 27 species, 24 genus and 14 families, were identified. MP had a significantly ( $p < 0.0001$ ) high SWI with a mean value of  $1.34 \pm 0.07$  compared to UMP ( $0.45 \pm 0.05$ ). Similarly, species richness and evenness were significantly high in MP ( $5.09 \pm 0.34$ ,  $0.86 \pm 0.02$ ) than UMP ( $2.17 \pm 0.14$ ,  $0.43 \pm 0.05$ ), respectively. These results represented that tree species were evenly distributed with high species diversity and richness in MP than UMP. The IVI revealed that most dominant species was *Terminalia arjuna* (Maruthu/Kumbuk) (124.45) next to *Khaya senegalensis* (Khaya) (53.84), *Mangifera indica* (Mango) (41.51), *Gliricidia sepium* (41.4), *Albizia lebbek* (Vakai/Mara) (30.54), and *Syzygium cumini* (Naval/Danba) (27.76). The species Naval, Maruthu, Vakai, Khaya, *Madhuca longifolia* (Iluppai/Mee), *Pongamia pinnata* (Pungai/Karanda) had more than 90 % of survival percentage ( $p < 0.001$ ). Mean DBH and TH were  $10.82 \pm 0.22$  and  $6.34 \pm 0.11$ , respectively and were not significantly differed ( $p = 0.645$ ,  $p = 0.186$ ) among the plantation category. Mean tree density and basal area were  $364.44 \pm 40.37$  stems $ha^{-1}$  and  $2.996 \pm 0.46$  m<sup>2</sup> $ha^{-1}$ , respectively and were not significantly differed ( $p = 0.213$ ,  $p = 0.259$ ). Diameter increment was high in *Albizia saman* (Pare mara) ( $4.07 \pm 1.55$  cm $year^{-1}$ ) next to *Khaya* ( $3.83 \pm 0.43$  cm $year^{-1}$ ). Mean biomass and carbon stock were  $11.74 \pm 2.35$  and  $5.63 \pm 1.13$ , respectively and were not significantly differed ( $p = 0.378$ ). A total of 14.2 MgC was accumulated whereas 52.06 Mg CO<sub>2</sub> was sequestered. Mean carbon stock was  $5.63 \pm 1.13$  MgC $ha^{-1}$  whereas  $20.66 \pm 4.13$  MgC $ha^{-1}$  mean CO<sub>2</sub> was sequestered. This study highlighted the importance of promoting multiple tree species to increase biodiversity and their careful selection in carbon regulation.

**Keywords:** ANR, Carbon Sequestration, Dry zone, Tree biodiversity, Tropics

# Analytical Hierarchical Process Approach based Assessment of Land Suitability in the Face of Climate Change in Coconut Cultivation in Sri Lanka

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The temporal variations in rainfall and temperature, as well as soil characteristics, were investigated to confirm the spatiotemporal evolution of land suitability for coconut cultivation in Sri Lanka. Factors influencing the land suitability for coconut cultivation were identified based on literature and expert discussions. Subsequently, weights for suitability factors were obtained using the analytical hierarchy process (AHP), a multi-criteria decision-making technique. Then, land suitability maps were generated by overlapping soil maps and climatic factor maps within three-time frames, 1991-2000, 2001-2010, and 2011-2021, using ArcGIS (version 10.8) software. Results from the AHP show that the most important factors in land selection for coconut cultivation are rainfall, soil type, and temperature. The weights obtained for rainfall, soil type, and temperature were 0.24, 0.24 and 0.19, respectively. The suitability maps show that during the 20-year period from 1991 to 2021, Kurunegala, Gampaha, Colombo, Kaluthara, Galle, Matara and Kegalle districts remained highly suitable. One major district in the coconut triangle, Puttalam remained moderately suitable, while Anuradhapura and Polonnaruwa changed from low to moderately suitable in the 20 years from 1991-2021. As the suitability of coconut cultivation is shifting over time, with the changes in climate, the finding indicated that the importance of adaptation strategies and best management practices to hedge against the negative impacts of climate change in the future is a prudent way forward.

**Keywords:** Analytical hierarchy process, ArcGIS, Climate change, Coconut, Land suitability

## Evaluation of Soil Biota as Bio Indicators of Soil Quality in Organic-Amended Maize Cultivation

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The study was aimed to assess the impacts of different types of organic manure application on the abundance and diversity of soil invertebrates on soil quality in maize cultivation. The research was carried out at Sudumalli in Jaffna district, Northern Province of Sri Lanka. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replicates and six treatments which included five different types of organic amendments such as cow dung ( $T_1$ ), goat manure ( $T_2$ ), poultry manure ( $T_3$ ), enriched compost ( $T_4$ ), commercial goat manure compost ( $T_5$ ) and control ( $T_6$ ). The maize Sampath F1 hybrid was sown with a recommended spacing of 30 x 60 cm. Soil samples were collected after 45 days of seed germination to a depth of 10 cm to analyze physical and chemical properties of soil in each treatment. The volume of 15 x 15 x 10 cm block of soil was excavated to separate soil macro fauna by hand sorting and soil meso fauna were extracted from soil samples by using a simple handmade Berlese-Tullgren funnel. Soil pH, Electrical Conductivity (EC), Soil Organic Matter percentage (SOM%), total nitrogen (N), exchangeable potassium (K), available phosphorus (P), soil moisture and soil texture were analyzed by following the standard laboratory methods and invertebrate community indices (Shannon (H), Simpson (D), Menhinick (M), Pielou (P)) and soil biological quality index (QBS) were calculated to assess the soil quality. One-way Analysis of Variance (ANOVA) was performed to identify significant differences ( $p < 0.05$ ) among the treatments with respect to the community diversity, density, soil chemical and physical properties. Mean density and taxa richness were significantly higher with organic amendments treated plots compared to the control plot. Further, QBS index were significantly higher and similar in  $T_1$ ,  $T_2$  and  $T_3$  and significantly lowest was recorded in control. Therefore, this study found that soil application of organic amendments enhanced the biological quality of the soil. Organic amendments application significantly increased the soil pH, EC, SOM%, total N, exchangeable K, available P, and soil moisture. Changes in soil invertebrates' abundance, diversity and community composition were associated with changes in soil chemical and physical properties.

**Keyword:** Biodiversity indices, Organic manure, Soil invertebrates, Soil properties, Soil quality

# **“Livestock, aquaculture, and fisheries for nutritious food production”**

## **Factors Affecting the Reduction of Milk Production under the Nomadic Pastoral System in Murunkan Veterinary Region from 2018-2020**

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Murunkan veterinary region in Mannar district is one of the leading milk-producing regions in the Northern province. However, data shows a drastic reduction in milk production in the area from 2018-2020. A survey was conducted involving 100 dairy cattle farmers selected from Murunkan veterinary region using a questionnaire to explore the causes of the drop in milk production. Additionally, Murunkan Veterinary Officer and the Livestock Development Officer were also interviewed for more information. According to the results, 78% of the farmers reared cattle under an extensive system. The sources of feeding grounds were roadsides (77%), government lands (45%), uncultivated paddy fields (28%) and marginal forest areas (27%). One farmer may have used more than one source of feeding ground. According to the data obtained from the Murunkan Veterinary Office, the estimated drops in milk production in 2018-2019 and 2019-2020 were 146% and 17% respectively. Similarly, annual per cow and daily per cow milk production were also reduced by 133% respectively during the 2018-2019 period. The ultimate reason for the production drop in 2018-2019 was the flood that occurred during this period that affected the available grazing lands. Moreover, the total number of milking cows declined by 6% in 2018-2019 compared to the 2017-2018 period due to the death of cows from an unidentified disease outbreak, worm infestations, bloat and foot and mouth disease. During the 2019-2020 period, the COVID-19 pandemic affected milk production as a result of mobility restrictions. The cattle reared in the extensive management system were restricted to grazing lands in Manthai-west which was far away from farmer dwellings and cows were not milked. In addition, labour shortage, less availability of medicines and other supplements, lack of transportation facilities and difficulty in selling milk were the other problems faced by livestock farmers during 2019-2020 period. All these factors together affected cow milk production leading to a drastic drop in milk production during the period from 2018 to 2020 in Murunkan Veterinary region.

**Keywords:** COVID-19 pandemic, Extensive management system, Grazing lands, Low milk production, Scarcity of feeds

## **Preliminary Study on Factors Affecting the Keeping Quality of Milk in Batticaloa District of Sri Lanka**

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Raw milk is a rich source of nutrients which comprises protein, fat, carbohydrate, vitamins, and minerals. This study investigates the risk factors associated with keeping quality of raw milk in lactating cows and finds appropriate recommendations to improve the milk quality in Batticaloa district of Sri Lanka. For this study, 120 raw milk samples were randomly collected from dairy farmers at four milk collecting centers, and details on milking practices were collected from the farmers through a pre-tested questionnaire and interview. Accordingly, 31 raw milk samples from Kiran, 32 samples from Sittandy, 32 samples from Iluppadichenai, and 25 samples from Thumbankerny were collected aseptically from the containers used for milk collection process and transferred to the laboratory for keeping quality test. Results revealed that 40 % of the collected milk samples from dairy farmers had poor keeping quality. In terms of Odds Ratio (OR) value, buffalo milk had more chances for poor keeping quality than cattle milk, the OR value for buffalo milk was 21.4 times higher than cattle milk. When foreign materials had present in milk, the OR value was 14.4 times higher chances for poor keeping quality. The OR value for long duration after milking was 12.4 times greater poor keeping quality than short duration after milking. The OR value for the use of plastic milk collection cans had 10.6 times more chances compared to the use of metallic milk collection utensils. When the fat content had high compared to low-fat milk, OR value for higher milk fat content was 14.5 times more chances for poor keeping quality. Further, poor hygienic conditions had the highest incidence of poor keeping quality, the OR value for poor hygienic practices was 21.6 times more than good hygienic practices. A hygienic quality based incentives system can be imposed to motivate farmers to produce high quality milk in Batticaloa district of Sri Lanka.

**Keywords:** Batticaloa, Keeping quality, Raw milk, Risk factors

## Development of a Milk Based Condensed Curd

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The dairy sector requires value added and quality enhanced dairy products. Therefore, this study was conducted to develop a value added condensed curd from fresh milk. There were 20 undergraduates (semi-trained panelists) used to evaluate the product sensory characteristics using the descriptive analysis method. Acceptability of the prepared sweetened buffalo curd ( $T_1$ ) and cow milk curd ( $T_2$ ), were evaluated sensorily ( $ST_1$ ) compared to the traditional cow milk curd ( $T_3$ ). Accordingly,  $T_1$  was the most preferred ( $p < 0.05$ ) curd. Sugar levels: very low ( $L_1$ ), low ( $L_2$ ), medium ( $L_3$ ), and high ( $L_4$ ) were tested sensorily ( $ST_2$ ) in  $T_1$  to identify the most preferred sweetness level, which was  $L_3$ . Third sensory test ( $ST_3$ ), was conducted using  $T_1L_3$  to check the most preferred texture due to three condensation levels of fresh milk; low ( $C_1$ ), medium ( $C_2$ ), and high ( $C_3$ ), where  $C_2$  had the most preferred texture. The non flavoured curd was sensorily much preferred than the flavoured curd with strawberry ( $V_1$ ), vanilla ( $V_2$ ), and chocolate ( $V_3$ ) flavours. According to the proximate analysis, the most preferred curd contained  $5.1\% \pm 0.4\%$ , protein,  $4.4\% \pm 0.2\%$  fat, 126.3 kcal/100g energy, 0.1 % ( $\pm 0.05\%$  Ca) and  $71.4\% \pm 1.2\%$  moisture. The shelf life of the  $T_1L_3C_2$  was over 14 days under refrigerated conditions with titratable acidity 0.83%. The shelf life was extended over 28 days with a titratable acidity of 0.85% under refrigerated conditions by adding Potassium sorbate as the preservative. The market survey conducted on the new product using 300 undergraduates (untrained panelists) at the university premises revealed that a sweetened condensed curd with non flavor, a medium level of sweetness and condensation that can be successfully prepared by buffalo milk was the most acceptable condensed sweet curd for dairy customers.

**Keywords:** Buffalo milk, Dairy products, Sweet curd, Sensory analysis

**“Eco-friendly plant protection  
and novel approaches in crop  
breeding for universal food  
production drive”**

## Preliminary Study of Odonates in Kilinochchi Premises of University of Jaffna, Sri Lanka

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Kilinochchi district is one of the major developed cities located in the northern part of Sri Lanka. This study mainly focused on the diversity of Odonates in Kilinochchi premises. Northern province has a unique flora and fauna diversification compared to other regions. But the records of Odonates poorly documented due to the lack of proper studies and research in this area for a long time. This survey was conducted in the Kilinochchi premises of University of Jaffna, using the opportunistic survey method in a randomly selected area. The main objective is to study the species diversity and population density of the Order Odonata. Data were collected from March to August 2022 within a selected area near to a water reservoir. The observation was made by naked eye and the photographs were taken using a DSLR camera. The data was obtained from 10.00 to 17.00 at day time. Odonates were identified using standard guides. The 'Place' app was used for the mark the GPS locations. According to the results 19 species of Odonates were recorded during this study period. Among them 13 dragonflies (Anisoptera) and 6 species were damselflies (Zygoptera). Families *Libellulidae*, *Gomphidae*, *Coenagrionidae* and *Platycnemididae* were reported in this study. Dancing Dropwing (*Trithemis pallidinervis*) was mostly recorded species in this study area and the Wandering Glider (*Pantala flavescens*) was recorded in resident population. The Black-tipped Percher (*Diplacodes nebulosa*) and the Asian Slim (*Aciagrion occidentale*) were recorded only once during the study period. During these months the Wandering Glider (*Pantala flavescens*) was recorded in very high amount of abundance but it was gradually decreased and in the later parts of this study. With the changing precipitation patterns, a remarkable changes were observed in the abundance of Odonates.

**Keywords:** Odonata, Diversity, Kilinochchi, Species

## Remunerative Intercropping Systems for Fall Army Worm Management in Maize

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Maize (*Zea mays* L.) is the most promising cereal crop in India after rice and wheat in respect of area and production owing to its wide ecological adaptability. It is grown throughout the year in almost all parts of India with an area and production of more than 8.5 million ha and 20 million tones, respectively. Nevertheless, the productivity of Maize in India is 2345 kg ha<sup>-1</sup>, which is very low. This is ascribed to frequent occurrence of drought, inadequate soil moisture storage, imbalanced application of manures and fertilizers, widespread occurrence of pest and diseases. Among them, Fall armyworm (FAW), *Spodoptera frugiperda*, an invasive pest has become a serious threat in influencing the productivity of maize. Hence, a study was conducted during *Kharif*, 2020 to study the influence of different intercropping systems for FAW management in Maize. The soil was sandy clay loam and low in available N, medium in available P and high in available K with a pH of 8.21. The experiment was laid out in a Randomized Complete Block Design (RCBD) with the following treatments viz., T1 – Maize + Tephrosia, T2 - Maize + Fenugreek, T3 - Maize + Coriander, T4 - Maize + Marigold, T5 – Maize alone and replicated thrice. A row of C: N hybrid grass was planted in the brim of the field. Based on the results of experimentation, it is concluded that among the intercropping systems in Maize, Maize + Marigold was found to be superior for the management of FAW in Maize which recorded higher Maize equivalent yield (6215 kg ha<sup>-1</sup>), net return (Rs. 47,181/ha) and BC ratio (1.87).

**Keywords:** Maize, intercrops, FAW infestation

## Characterization of the Volatile Organic Compounds of Traditional Maize Accessions present in Sri Lanka using GC-MS

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Chemical communication plays a crucial role in insect life as it enables them to recognize and respond to environmental stimuli. Volatile organic compounds (VOCs) released by plants mediate, conveying information about a plant's growth stage, health, and presence of predators or prey. Fall armyworm (FAW), a destructive pest that feeds on corn plants, uses plant VOCs to find suitable hosts for feeding and reproduction. Traditional pest control methods have limited effectiveness against FAW, making it crucial to explore alternative strategies, such as semiochemical-based approaches that use chemicals that mimic natural communication signals. This study aimed to identify the VOCs released from six traditional maize accessions with commercial variety Bhadra to identify potential semiochemicals for use in FAW management. Four of them (SEU02, SEU16, SEU14, and SEU15) were susceptible to FAW, while two (SEU18 and SEU21) were moderately resistant. VOCs were extracted from the plants in the vegetative stage using two methods: solvent-assisted extraction and dynamic headspace sampling. The extracted VOCs were analyzed using gas chromatography-mass spectrometry (GCMS). The analysis identified several hydrocarbons, esters, aldehydes and alcohols. SEU18 and SEU21 had particularly high levels of specific compounds, such as 9-eicosene, (E)-, hexadecen-1-ol, trans-9-, 3-octadecene, (E)-, 3-tetradecene, (Z)-1 -nonadecene, hexacosane and 1-docosene. Whereas, SEU02, SEU06, SEU14 and SEU15 showed high concentrations of 3-hexen-1-ol, acetate, (Z)-, hexanal, 5,5-dimethyl-, -myrcene, phthalic acid, butyl-2-pentyl ester, 1-hexanol, 2-ethyl, decanal, methyl salicylate, decane, heneicosane, 9,12,15-octadecatrienoic acid, (Z,Z,Z)-, octacosanol, hentriacontane, phytol and n-hexadecanoic acid. Principal component analysis showed that SEU18 and SEU21 were separately clustered in factorial space, consistent with their previously observed resistance to FAW. Identified VOCs can be further investigated for their potential use in GC/Electroantennography (EAD) detection and behavioural bioassays to assess their effect on FAW antennae response and oviposition. In conclusion, the current study provides new insights into the VOCs profiles of traditional maize accessions and highlights the potential use of semiochemicals for FAW management.

**Keywords:** Fall armyworm, Maize, Traditional accessions, Volatile organic compounds

## **Variation in the Production of Leafroller-induced and Constitutive Plant Volatiles in Two Rice Varieties in Tamil Nadu, India**

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Rice (*Oryza sativa*, L.) which is cultivated in 112 countries all over the globe and consumed by 2500 million people in developing countries, faces many constraints in production. Rice leaf folder (RLF) (*Cnaphalocrocis medinalis* Guenee) has been reported as one of the most destructive pests affecting almost all rice growing areas in Asia. Currently this pest is managed by using insecticides and other management practices such as biocontrol agents to some extent. Herbivore induced plant volatiles (HIPVs) plays an important role in plant defence by attracting the natural enemies of the herbivores (Tritrophic interactions). This study was aimed to detect leaf folder induced plant volatiles in rice. HIPVs collected from healthy and RLF infested potted rice plants with three replications of varieties ASD 16 and Co 51 were analysed using Gas Chromatography – MS/MS. Both quantitative and qualitative variations of volatiles compounds (VCs) were noticed between healthy and RLF infested plants. In RLF damaged and healthy plants, had higher level of eicosane in common. It was 16 times higher in damaged ASD 16 rice plants than that of the uninfested ones. The volatile profile of rice variety CO 51, dodecane was recorded to have a higher peak difference i.e., eight times more than the healthy plants followed by eicosane with six times variation. Eicosane, a 20 carbon compound showed higher variation in the volatile composition of RLF damaged plants as compared to volatiles emitted by healthy plants. It was already reported that eicosane was one among the compounds responsible for the orientation of trichogrammatids and acted as ovipositional stimulants and increased the parasitization rate. Only nine and seven VCs are were detected in healthy ASD 16 and CO 51 rice varieties, respectively while crude volatiles from RLF – infested plants recorded 22 (ASD 16) and 16 (CO 51) compounds. Eicosane can be included in bio intensive management of rice folder in future.

**Keywords:** Egg parasitoid, Herbivore Induced Plant Volatiles, Infested rice plant

## Studies on Olfactory Response of Egg Parasitoids' to info Chemicals of Infested Rice Plant

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Rice (*Oryza sativa*, L.) which is cultivated in 112 countries all over the globe and being consumed by 2500 million people in the developing countries faces many constraints in production. The two important lepidopteran pests in the rice ecosystem are rice leaf folder (RLF) *Cnaphalocrocis medinalis* Guenee and yellow stem borer (YSB) *Scirpophaga incertulas* (Walker) that cause severe damage to the crop. The volatiles released by the plants play a vital role as signals in tritrophic interactions. The induced plant volatiles play a major role in alteration of plant interaction with the environment. With this aim the present study is undertaken to study the orientation of *Trichogramma chilonis* (Ishii) and *T. japonicum* (Ashmead) adults towards the crude volatiles of healthy and rice leaf folder and yellow stem borer damaged plants. The responses of parasitoid to the Herbivour Induced Plant Volatiles were analysed using a four way olfactometer. Each run was carried out with 70 adult parasitoids of *T. chilonis* and *T. japonicum*, exposed to RLF and YSB induced plant volatiles. The data were recorded based on the number of adult preferences to volatiles at 2 hours and 4 hours from the start of the experiment. The number of *T. chilonis* adults oriented towards volatiles from RLF damaged plants were 36.21 and only 10.21 adults oriented in the vicinity of volatiles from healthy plants. The orientation of *T. japonicum* (34.79 nos.) towards YSB induced volatiles was almost 3.5 times higher compared to volatiles derived from healthy or undamaged plants. It was found that higher orientation towards infested plant in comparison to healthy plants' volatile.

**Keywords:** Plant volatiles, Rice leaf folder, Rice stem borer and Tritrophic interaction.

## **Cost-effective DNA Extraction Method Suitable for Downstream Applications and Molecular Identification of *Salicornia brachiata***

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Sri Lanka is blessed with diverse vegetation types, and *salicornia* is one of the most frequently reported genera. Some *Salicornia* spp. has a high potential to be introduced as a crop suitable for marginal soils. The first step in such an attempt is accurate species identification. However, due to strong phenotypic plasticity, morphology-based species identification is challenging. The plant tissue rich in secondary metabolites also challenges molecular-based identification. This signifies the requirement for a high-quality DNA extraction technique suitable for PCR and sequencing. Since the affordability of commercial DNA extraction kits is questionable for a developing country like Sri Lanka, this study was done to assess a low-cost DNA extraction protocol suitable for *Salicornia* spp., to determine the suitability of extracted DNA for downstream applications, and to identify the genus up to the species level. Samples were collected from Karative, Puttalam district, and stored at -80 °C.. Three Cetyltrimethylammonium bromide (CTAB) based DNA extraction methods were used with several modifications, and the DNeasy Plant Pro kit (Qiagen) was used as the standard method. DNA quantification was done using spectrophotometric methods. There was no significant difference in DNA quantities extracted with the commercial kit, and Contreras et al., (2018) method ( $p < 0.01$ ). To determine the species identity, rDNA-ITS region, and chloroplast matK region were PCR amplified with universal primers. PCR was successful only for the above two methods and when Bovine Serum Albumin was added (50µg/ml) to the PCR mixture, the rest of the DNA samples also produced clear amplification. Clean PCR products were subjected to Sanger di-deoxy sequencing. The NCBI GenBank database lack reference sequences for ITS and ETS regions and BLASTn searches of matK sequence confirmed that the species was 99% similar to the previously published *S. brachiata* species. Extracted DNA was suitable for SCoT marker analysis as well.

**Keywords:** *Salicornia*, DNA extraction, Species identification



# **“Food technology and nutritional sciences for a healthy generation ”**

## Effect of Traditional Cooking and Frozen Storage on Phenolic, Tannin and Flavonoid Content of Selected Vegetables

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Vegetables are good sources of natural antioxidants such as vitamins, carotenoids, flavonoids and other phenolic compounds. Cooking and frozen storage causes considerable changes in the nutritional and structural properties of the phenolic compounds and antioxidants of vegetables. The objective of this research was to compare the total phenolic, tannin and flavonoid content of selected raw vegetables such as Leeks, Carrot, Red onion, Beetroot, Brinjal, Tomato, Beans and Green chilli with traditionally cooked and frozen ones by petroleum ether and ethanol extraction methods. Total phenolic content (TPC) of raw carrot showed highest amount ( $29.25 \pm 1.2 \mu\text{g mL}^{-1}$ ) in petroleum ether extraction but in ethanol extraction highest amount of TPC was present in chilli ( $461.29 \pm 0.92 \mu\text{g mL}^{-1}$ ). In ethanol extraction, all selected traditionally raw and frozen vegetables showed higher amount of TPC compare to traditionally cooked. The highest amount of tannin ( $0.37 \pm 0.92 \mu\text{g mL}^{-1}$ ) was present in raw carrot in petroleum ether extraction but in ethanol extraction raw beans ( $5.17 \pm 0.69 \mu\text{g mL}^{-1}$ ) showed highest amount of tannin. Ethanol extraction showed that traditional cooking and frozen condition reduced the tannin content in all the selected vegetables. There was no significant difference among traditionally cooked Carrot, Leeks and Beetroot in terms of tannin in petroleum ether extract. Traditional cooking condition increased the flavonoid content in all selected vegetables compare to raw and frozen condition in petroleum ether extraction. Frozen condition increased the flavonoid content in beetroot and onion in terms of ethanol extraction rather than raw and traditionally cooked vegetables. The study recommended that ethanol extraction is good for extract the total phenolic and tannin content and petroleum ether is good for extraction of flavonoids from vegetables. Traditional cooking is the suitable method for increase the flavonoid content in vegetables.

**Keywords:** Phenoles, Tannin, Flavonoids, Vegetables

## Quality Evaluation of Pregelatinized Palmyrah Tuber Flour-Based Bread Using Response Surface Methodology

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Palmyrah tuber flour (PTF) is a locally available cheap raw material with many nutritional and medicinal properties. However, the PTF does not contain gluten which is essential to improve the texture of the bread. Hence, the pre-gelatinization technique is used in the development of PTF bread to improve the texture of the bread. This research was conducted with the intention of developing a composite flour bread with the combination of pre-gelatinized PTF and wheat flour. Response surface methodology (Box-Behnken design) was used to analyze the responses of specific volume, crumb pH, moisture content, and hardness for the variables of PTF content (10, 25, 40 %), pregelatinized PTF content (2.5, 3.75, 5.0 %), and water content (25, 30, 35 %). The best formulation of 10 % PTF, 5 % pregelatinized PTF, and 35% water content was identified as the optimized parameters for bread manufacturing. The results showed that the optimized PTF bread had significantly ( $p < 0.05$ ) high crude fiber ( $4.60 \pm 0.01$  g/100g), sodium ( $423.77 \pm 3.72$  mg/100g), calcium ( $61.33 \pm 6.11$  mg/100g), potassium ( $243.9 \pm 22.00$  mg/100g) and total polyphenol ( $1.307 \pm 0.11$  mg GAE/g) compared to the control treatment according to AOAC, 2019 method. The physico-chemical properties of PTF bread, such as water activity, ash content, acid-insoluble ash, and the crust and crumb colour, differed significantly from the control. However, there is no significant difference in pH, moisture content, and sensory properties between the two treatments. Hence, the pre-gelatinized PTF can be used as a major ingredient to reduce the quantity of wheat flour in the manufacturing of bread.

**Keywords:** Box-Behnken design, Palmyrah tuber flour bread, Pre-gelatinization, Specific volume, Wheat flour

## **Effect of various Processing Techniques on Nutritional, Biological, Techno-functional, Structural, and Molecular Interactions of Fingermillet (*Eleusine coracana*)**

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The impact of different processing techniques on the characteristic changes of Finger millet flour was assessed. It provides additional knowledge of the functionality of Finger millet and will increase its utilization and potential in the food industry and contribute to a better food security. Anti-nutritional factors, *in vitro* protein and starch digestibility and *in vitro* protein bio-accessibility, molecular and structural interactions of soaked, germinated, fermented and a combination of aforesaid treatments of grains were studied. Alterations of processed Finger millet's techno-functional properties were determined as water absorption capacity, water solubility index, oil absorption capacity, paste clarity, swelling power, emulsion activity, emulsion stability, and viscosity. Scanning Electron micrographs and Fourier Transform Infrared spectroscopy revealed structural variations and macromolecular arrangement of processed Finger millet. Soaking, germination, and the treatment combination showed a reduction pattern of tannin and phytate contents. But saponin content was increased ( $p < 0.05$ ) with time in the germinated Finger millet sample (2.03 – 2.50%). All bioprocess techniques increased *in vitro* starch digestibility (6.18 to 9.95 g/100 g) and *in vitro* protein digestibility (65.68 to 90.56 g/100 g). Soaking, germination, fermentation, and treatment combination significantly increased ( $p < 0.05$ ) water sorption isotherm and oil absorption capacity than the control sample and slightly modified the swelling power, emulsion capacity, and emulsion stability of finger millet flour while water absorption capacity, paste clarity and viscosity were decreased. Among all treatments, the combination of soaking, germination, and fermentation greatly improved most of the functional properties of flour with reduced antinutrients. A combination of treatments could enhance the use of finger millet in novel food products development. And the results are suggesting that processed flour could serve as potential ingredients with improved techno and bio functionality in value-added cereal products such as noodles, cookies, biscuits, and muffins.

**Keywords:** Fermentation, Germination, Saponin, Soaking, Tannin

## Development of an Instant Fried Rice and Suitable Seasoning Powder Mix, Incorporated with Powdered Leaves of *Moringa oleifera*

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Rice is the staple food and the main energy source in most Asian countries, including Sri Lanka. Modern people are having hectic daily schedules and do not spend much time preparing their food. This accelerated pace of modern life has promoted new quick-cook type rice products, which can rehydrate or thaw within a few minutes. This research was conducted to develop instant fried rice which could be stored under frozen conditions (-18 °C) and a suitable seasoning powder mixture to incorporate into fried rice by using powdered leaves of *Moringa oleifera* and oyster mushrooms as the main ingredients. Moringa leaf powder incorporated (1.92%) 15 g of seasoning powder was added to 250 g of rice. The amount of added constituents was determined based on sensory data, which was determined using a 9-point hedonic test involving 50 untrained panelists. A suitable cooking procedure for Bg 360 (Keeri samba) was determined according to cooking yield using an electric rice cooker, an electric multi-cooker and the steaming procedure, then cooking in the rice cooker was selected. The prepared fried rice was vacuum packed and stored at three different temperatures (4 °C, 12 °C and 25 °C) for the prediction of the shelf life using the accelerated shelf life test with an Arrhenius model. The moisture content varied between 62 - 67% and there was no significant difference in colour ( $P > 0.05$ ). According to the acid and peroxide values, the shelf life was 29 and 36 days, respectively. After 30 days of frozen storage total plate count was measured upon thawing using, 74 °C in the microwave oven,  $\leq 100$  °C at boiling water and 100 °C at steaming and the product was acceptable for consumption and has a potential to be marketed.

**Keywords:** Accelerated shelf life, Instant fried rice, *Moringa oleifera*, Oyster mushroom, Seasoning powder

## Formulation of a Syrup having Functional Properties using Leaf Extract of *Costus igneus*

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Thebu plant (*Costus igneus*) is commonly available in Sri Lanka and is underutilized though it is reported to have different health benefits. In this study, a herbal syrup was formulated using a hot water extract from Thebu plant's leaves, and its antioxidant and antidiabetic potentials were assessed. Leaves were dried in a hot air tray dryer (50 °C), powdered and stored in air-tight containers at 4 °C. Presence of alkaloids, saponins, flavonoids, terpenoids, tannins, steroids and cardiac glycosides in the powder was identified while alkaloid and saponin levels were quantified. The powder was extracted using hot water (5 g of powder in 500 mL) at 40 °C for 30 min with continuous stirring. Syrup formulations with different excipients were prepared initially and three formulations were tested for preference by a ranking test using a semi-trained panel. The selected formulation was observed for organoleptic properties and tested for physicochemical properties. Both the syrup and the extract were subjected to quantify antioxidants and anti-amylase activity of the syrup was determined. The powder was found to be positive for all the tested phytochemicals with 10.0 and 24.3 mg/g of alkaloids and saponins respectively. The formulation developed using methylcellulose (8 g), sorbitol (4 g), glycerine (1 mL), lime solution (4 mL) and benzoic acid (0.2 g) with 150 mL of the extract was found to be preferred mostly. The syrup is a viscous liquid with a light yellowish colour and a slightly sweet taste. The viscosity, specific gravity and pH values of the syrup were  $1.61 \times 10^{-3}$  Pa S, 1.2 and 5.6 respectively. The total polyphenolic content of the extract and syrup were found to be  $210.6 \pm 0.3$  and  $75.7 \pm 0.1$  mg gallic acid equivalents/mL respectively. Total flavonoid contents of them were  $148.6 \pm 0.1$  and  $68.4 \pm 0.1$  mg quercetin equivalents/mL respectively. The syrup was positive for anti-amylase assay with an  $IC_{50}$  value of  $740.1 \pm 0.3$  mg/L.

**Keywords:** *Costus igneus*, Herbal syrup, Phytochemicals, antioxidants activity, anti-amylase activity

## Comparison of Proximate Composition, Phenolic Content and Flavonoid Content of Raw and Malted Foxtail Millets Grown in Northern Province of Sri Lanka

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Foxtail millet is the one of widely planted species of millet in most parts of East Asia. It is a small seeded grain with a major source of calories, essential micronutrients, phytochemicals, vitamins, phenolic compounds, minerals and nutraceuticals, constituting a vital component of food security in developing countries. The grain is processed in many ways for preparation of various food products. Malting is one of the processing methods which enhance the nutritive value of the Foxtail millets by its hydrolytic activity. In this study, the effect of different malting duration such as 12 h, 24 h and 48 h on the proximate composition, total phenolic content (TPC) and total flavonoid content (TFC) of the foxtail millets were evaluated. For this purpose, foxtail millet (600g) was steeped for 24 hours in water (grain: water at the ratio of 1:2) at room temperature (28 °C) in a stainless-steel bowl. To prevent fermentation, the water in the bowl was replaced every 6 h with fresh water. Finally, the water was drained and grains were spread as thin layer over a moist muslin cloth for germination for different durations as treatments (12 h, 24 h, and 48 h). The germinated grains were sun-dried for 3 days, and manually cleaned to remove the foreign particles and the malted grains were ground and sieved to obtain the flour. The samples were analyzed for moisture, protein, carbohydrate, fat, ash and fiber contents and TPC and TFC. The proximate analysis revealed that the moisture content was significantly ( $p \leq 0.05$ ) increased from  $4.620 \pm 0.88$  to  $7.54 \pm 0.03\%$ . The total sugar content of the Foxtail millets ranged between  $0.1200 \text{ mg/mL}$  to  $0.1595 \text{ mg/mL}$  with no significant difference ( $p \leq 0.05$ ) for raw and malted flours. The reducing sugar content and fiber content had increased significantly ( $p \leq 0.05$ ) with malting duration from  $0.0866 \text{ mg/mL}$  to  $0.1859 \text{ mg/mL}$ ,  $10.55 \pm 0.187\%$  to  $13.556 \pm 0.113\%$  respectively. The crude protein content of foxtail millets significantly increased ( $p \leq 0.05$ ) from  $5.045 \pm 0.028\%$  to  $11.825 \pm 0.070\%$  with increased malting duration. The significant increase ( $p \leq 0.05$ ) in TPC from  $0.2747 \pm 0.0026 \text{ mg gallic acid equivalent/100g}$  to  $0.334 \pm 0.0044 \text{ mg gallic acid equivalent/100g}$  was reported during malting, whereas the TFC was increased significantly ( $p \leq 0.05$ ) during malting with higher value ( $0.0369 \pm 0.001 \text{ catechin equivalent mg/100g}$ ) reported at 24h of malting. The findings of this study demonstrated that malting for 24 h could be employed as a processing technique to improve the nutritional value of Foxtail millets-based foods.

**Keywords:** Foxtail millets, Malting, Nutrient



**“Agricultural economics,  
extension, and agribusiness  
management in optimizing the  
production”**

## **Consumers' Demand for Different Types of Rice, Wheat and Rice Flour in Western Province of Sri Lanka**

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This study investigates consumers' demand for different types of rice, wheat and rice flour in Western Province, Sri Lanka by using the data obtained from Household Income and Expenditure Survey (HIES) carried out in 2016. The Quadratic Almost Ideal Demand System (QUAIDS) model was developed to estimate the demand for the products concerned, using the Shonkwiler and Yen method to account for zero consumption. The findings of this study show that expenditure elasticities of all types of rice and wheat and rice flour at means are positive. It indicates that these commodities are normal goods for most of the households. However, the minimum value of expenditure elasticity for white kekulu nadu, red kekulu nadu and white nadu are negative. It shows that, for some households, these commodities are inferior goods. Among these commodities, samba, wheat flour, rice flour and basmati are considered as luxury goods and white kekulu nadu and red kekulu nadu are considered as necessity goods. Uncompensated price flexibilities indicate that white kekulu samba and wheat flour have inelastic demand. Cross-price elasticities indicate that wheat and rice flour are complementary goods. Estimates of these Price and income elasticities would be useful to the policy makers to develop an appropriate policy to increase households' welfare in this province.

**Keywords:** Expenditure Elasticity, Price Flexibility, QUAIDS Model, Shonkwiler & Yen method

## **Inter Linkages among Agriculture, Industry and Service Sectors: Empirical Evidence from the Provinces of Sri Lanka**

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Three main pillars of the Sri Lankan economy are agriculture, industries and service sectors. This study examines the causal linkage among agriculture, service and industry sectors. The service sector was the highest contributor to GDP of 58.3 percent, followed by the industrial sector at 25.9 percent and the agricultural sector at 6.9 percent by the end of 2021. Sri Lanka is striving to achieve upper middle-income status while maintaining a positive growth rate and low inflation. GDP growth rate for the year 2022 has been reported as 7.8 percent of negative growth rate. Agriculture, Industry and Services activities declined by 4.6 percent, 16.0 percent and 2.0 percent respectively, in the year 2022. A negative GDP growth rate, often referred to as an economic contraction, is a significant economic challenge for the country. To address these problems, governments often implement various economic policies such as fiscal stimulus, monetary easing, and structural reforms to stimulate economic activity and promote recovery. By capitalizing on the interlinkages between the agriculture industry and the service sector, countries can create a resilient and diversified economy that is better equipped to withstand negative GDP growth periods and promote overall economic well-being. Annual data from 1999 to 2020 for nine provinces of Sri Lanka were used to develop a Panel Vector Error Correction Model for this study. The results of this study show that there is a positive relationship between the agricultural sector and manufacturing sector and a negative relationship between the agricultural sector and service sector. It indicates that agriculture and manufacturing sectors contribute each other for their growth. Agriculture and service sectors compete each other for labor and capital goods. Manufacturing and service sector contribute each other for their growth. These findings will aid in the development of sound strategies for promoting economic development across all provinces by central government and local governments.

**Keywords:** Economic growth, Gross domestic product (GDP), Panel vector error correction model, Relationships among sectors, Sectors of Sri Lankan economy.

## Factors Influencing Exporters' Shares on Value-Added Tea Exportation in Sri Lanka

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Sri Lankan tea exporters face numerous challenges when they reach international-markets. The country has the highest cost structure among major tea producers, lack of market information, intense competition from international players, and insufficient knowledge of trends. Due to this issue, international-market exploration for the 'value-added tea' (VAT) is less and the creativity of new products will not gain the due recognition. This results in profit can be gained from value-addition is a lessen. The study aimed to analyze the factors influencing exporters' shares of VAT exportation, to determine the impact, and propose strategies to improve the country's VAT production and exportation. Ten factors identified from the literature survey and the questionnaire was pretested to collect primary data by selecting 60 VAT export companies registered in Sri Lanka Tea Board representing categories of large, medium, and small using stratified sampling technique. Correlation and multiple-regression analysis were applied to determine the relationship among variables and to estimate its impact on value-addition. The results of the Pearson-correlation analysis showed number of market-destinations ( $r=0.607$ ), international-certifications ( $r=0.594$ ) and skilled-labours in VAT operations ( $r=0.549$ ), adaptation on trade restrictions ( $r=0.544$ ) have strong positive linear relationship with the exporter's share on value addition whilst market and technological approaches ( $r=0.372, 0.432$ ), and company experience ( $r=0.482$ ) have a moderate positive linear relationship ( $p<0.05$ ). Multiple-regression analysis revealed that the number of market-destinations, technological approaches, international-certifications, and adaptations on trade restrictions have significant positive influence on exporters' share on VAT exportation ( $p<0.05$ ). For improving the industry, research and development facilities, VAT production, marketing, and technological strategies should be developed. Government and policymakers should intervene, consider such relationships in planning strategies, and provide training exposure on international-marketing policies, opening up new market avenues, tea promotional campaigns overseas, and strengthening bilateral relationships between tea-importing countries.

**Keywords:** Value-added, Tea, Multiple regression analysis, Tea exporter's share

# Impact of Dynamic Employment Preferences of the Youth on the Agricultural Labour Force in Kegalle District, Sri Lanka

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The agriculture sector of Sri Lanka is increasingly challenged to meet the increasing demand for essential food items. The recent economic crisis, COVID-19 pandemic, and resource rivalry have had impacts on sharpening the current situation of the local food industry. Migration of people for employment in foreign countries has increased dramatically due to the prevailing unfavorable economic conditions in the country where agriculture is the main local employment of the population. This study aims to compare the employment preferences of the Sri Lankan youth population by considering agriculture, further education, non-agricultural local employment, and foreign employment into account. The objectives of the study are to find the choice of the younger generation between foreign employment and engagement in agriculture and to find the factors that affect youth preference. A sample of 150 youth participants (15-29 age range) was taken from four DS divisions of the Kegalle district in 2022 by using a convenient sampling technique and a choice experiment method was used for the experiment. In-depth interviews and focus group discussions were conducted to gather primary data. The questionnaire was designed with socio-economic and attitudinal questions important for analyzing, interpreting, and validating results. SPSS software was used to analyze the data. Results revealed that the youth population highly prefers foreign employment over engaging in agriculture based on the perception of the current situation of the country, the education level of youth individuals, the recent work of the respondents, and insufficient government support for agriculture. The study found that, the preference of youth for engaging in foreign employment has a significant impact on the reduction of the agricultural labour force in the study area. The potential of absorbing youth in agriculture must be exploited to increase agricultural production in the country.

**Keywords:** Agriculture, Choice Experiment, Employment, Labour Force, Perception, Youth

## **Problems in Adoption of Scientific Agricultural Practices in Agroforestry Home Gardens with Special Reference to Weligama, Sri Lanka**

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Agroforestry home gardens are efficient and sustainable land use strategies. There are few evidences for detailed analysis of agroforestry homegardens in the literature. Therefore, the present study attempts to assess problems encountered in adopting the scientific practices in agroforestry home gardens with special reference to Weligama Divisional Secretariat (DS), Sri Lanka. Three (03) Grama Niladari (GN) divisions were selected from the DS based on the availability of highest number of agroforestry home gardens. The primary data were collected from randomly selected 30 households from each GN division (n = 90) by personal interviews through the use of a structured questionnaire. Their concern on problems in scientific agriculture practices was measured by 5 point Likert scale ranging from 1 to 5 where 1= Extremely easy, 2= Easy, 3=Neutral, 4=Difficult and 5= Extremely difficult. Descriptive and Wilcoxon signed rank test analysis were used to analysis data. The results revealed that majority of households have difficulties in access to scientific knowledge (38.9%), ability to understand scientific knowledge and skills (33.3%), access to reach the government agricultural officers (42.2%) and sufficient facilities to improve scientific knowledge (45.6%). Households mentioned that they are easily (34.4%) acquire scientific knowledge and somewhat difficult (52.2%) to involve government home gardening projects like other requirements. Further, access to scientific knowledge, ability to have knowledge and skills to understand scientific things, access to reach government agricultural officers, sufficient facilities to improve scientific knowledge, interest to acquire scientific knowledge and other requirement are significantly influenced the problems access score. This study emphasizes the need for well-planned extension programs to promote adoption of scientific agricultural practices in agroforestry homegardens.

**Keywords:** Agroforestry, Home gardens, Problems

**“Agricultural modernization,  
mechanization, and water  
management strategies for  
increased food reserve”**



## **Pesticide Residue Deposits in Crop and Environmental Samples of Rice Field Sprayed using Unmanned Aerial Vehicle**

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The application of pesticide using Unmanned Aerial Vehicle (UAV) is gaining impetus across the world and there is a need for assessing its efficacy and spray drift assessment. The study aims to address the knowledge gap in pesticide residue deposit in rice crop ecosystem with UAV application in comparison with conventional spray system. Field experiments were conducted in rice crop to study the initial deposits of the insecticide Fipronil % SC @ 50 g ai/ha applied through UAV in rice crop and also the residues that drift-deposited in field soil and water. Spray was taken during morning hours with the wind speed < 2.5 km/hr. The flight height was 3m, flight velocity was 4m/s and swath width was 3 m. The paddy leaf samples, soil and water were processed and analysed for quantifying the residue deposit of the pesticide using Liquid chromatography coupled with tandem quadrupole Mass spectrometry system. The deposition of Fipronil applied through UAV spray system (with atomizer or jet nozzle) was compared with high volume (knapsack sprayer) and low volume (power sprayer) application. The results revealed that initial deposits of the applied pesticide vary with different spray systems. Residue deposit was higher in UAV spray system than that of high volume spraying. Also, in UAV spray system, application through atomizer nozzle resulted in more initial deposit than with jet nozzle. Efficacy wise UAV performed comparatively better than high and low volume sprayers. Residue deposit was more in top leaves, followed by middle and lower leaves of rice crop. Residues of Fipronil were below detectable limit ( $0.01 \mu\text{g g}^{-1}$ ) in soil while detectable residues were found in paddy field water samples ( $0.01$  to  $0.033 \mu\text{g L}^{-1}$ ). The results revealed the suitability of unmanned aerial vehicles in application of pesticides in rice under the tested conditions while cautioning the direct drop-down and drift effect in paddy field water.

**Keywords:** Fipronil, Initial deposit, Residues, Rice, UAV

## **Optimizing Turmeric (*Curcuma domestica*) Production through Digital Monitoring and Precision Agriculture: A Study on the Usage of Smart-climatic Agricore Platform**

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Turmeric is a crucial crop, and optimal water quantity and a temperate environment are vital for rhizome production and plant metabolism. This research study was conducted in Negombo region to investigate the potential of precision agriculture in optimizing turmeric (*Curcuma longa*) production. This study utilized the Smart-climatic SenzAgro Agricore platform to monitor various parameters including relative humidity, temperature, electron conductivity, and soil moisture in the deep root system, which is critical for managing water. SenzAgro platform builds for general precision agriculture specifications. However, to prove a high impact, SenzAgro mainly focuses on high-value crops. The research design involved a randomized complete block design with three replicates. The study area was divided into three blocks, each containing a treatment plot (1,011.71m<sup>2</sup>) and a control plot, where common agronomic practices were carried out manually. The local turmeric variety was selected for cultivation, and plant behavior was monitored from the vegetative stage to the harvesting stage between September and December 2022. The initial plant density was 0.59 plants per square meter, and the entire experimental setup was located in the same geographical region. During the study period, the Smart-climatic SenzAgro Agricore platform continuously recorded climatic and soil moisture data for the treatment plots, while manual readings were taken for the control plots. The data collected from the experiments were statistically analyzed using 'python software'. The results revealed that the harvest obtained from the treated plots was 66.9%, significantly higher than the harvest obtained from the control plots. This research demonstrates the importance of precision agriculture methods in optimizing turmeric production. The SenzAgro Smart-climatic Agricore platform provides an effective solution for monitoring and managing critical parameters in turmeric cultivation. Moreover, the study proposes a cloud platform with a web-based interface and a simple sensor-based method for real-time and accurate climatic investigations. The new knowledge created in this study emphasizes the potential benefits of modernized digital monitoring and precision agriculture for optimizing crop production.

**Keywords:** Automated irrigation, Digital monitoring, Micro-climatic data, Turmeric

# **Teleconnection between Ocean-Atmospheric Oscillations and Extreme Rainfall: A Case Study for Jaffna Peninsula during 2015 and 2020**

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Indian Ocean Dipole (IOD) and El-Nino Southern Oscillation (ENSO) are identified as two ocean-atmospheric oscillations that impact over rainfall of Sri Lanka and cause extreme rainfall events. However, recent studies on teleconnection between ocean-atmospheric oscillations and rainfall over Sri Lanka are lacking. Despite that, this study aimed to identify the IOD and ENSO impacts of the extreme rainfall that caused flooding at the end of 2015 and 2020 in Jaffna Peninsula, Sri Lanka. The daily rainfall (from 2000 to 2020) for the Jaffna Peninsula and monthly sea surface temperature (SST) data (1960 to 2020) over IOD and Nino regions were used for the study. The climatological mean was calculated for monthly rainfall and SSTs, and anomalies were derived. The warm and cold ENSO months were identified based on the SST anomalies at the threshold of  $\pm 0.5$  and for the Dipole Mode Index which derives IOD, the threshold levels were as  $\pm 0.4$ . According to the results, the maximum above-average monthly rainfall was received during November 2015 and December 2020. Nevertheless, IOD was at the neutral phase for both the identified months. Interestingly, except for the Nino 3.4 region, all other regions were in the warm ENSO phase in November 2015. A cold ENSO phase was observed for all the Nino regions in December 2020. Furthermore, the presence of cyclone Burevi in the Bay of Bengal could alter the effect of ENSO during December 2020. Hence, further studies are suggested to understand the relationship between above-average rainfall in Jaffna with the cold ENSO phases, because previous studies identified warm ENSO phases facilitate the above-average rainfall over India.

**Keywords:** Extreme rainfall, Jaffna, Ocean-atmospheric oscillations

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