M S Swaminathan Research Foundation
SCIENCE FOR SUSTAINABLE DEVELOPMENT

First Cohort

M. S. Swaminathan Fellowship Programme 2024-2026

Investing in future Scientists



Foreword



The MSS Fellowship was conceived by the M.S. Swaminathan Research Foundation (MSSRF) as a pioneering initiative to invest in the next generation of scientific leaders. Designed as a transformative twenty-four-month programme, the Fellowship sought to nurture young scientists by connecting them with senior researchers at the Foundation who served as mentors. Through hands-on engagement in research projects, the Fellows were provided with opportunities to learn directly from experienced scientists and develop the skills required to drive meaningful and impactful development programmes.

The inaugural cohort brought together six outstanding young women and men with postgraduate qualifications in diverse disciplines, including Botany, Biotechnology, Ecology and Environmental Sciences, and Aquaculture Engineering, from premier scientific institutions across the country. Their varied academic backgrounds enriched the programme and fostered an interdisciplinary approach to scientific inquiry.

Working both in laboratories and in the field, the Fellows identified research questions of practical and scientific significance and pursued projects spanning Microbiology, Biotechnology, Food Science, Biodiversity, and Entomology. Guided closely by their mentors, they developed solutions addressing critical challenges in nutrition, plant genetics, conservation of rare and endangered species, and insect pollination for horticultural crops. In addition to their research work, the programme encouraged their participation in scientific conferences and other professional forums, enabling them to engage with broader scientific thought and developments in their respective fields.

I am pleased to note that the promising work undertaken by the MSS Fellows has contributed significantly not only to the work of MSSRF but also to the broader body of scientific knowledge in these fields. Their research has generated practical solutions to challenges currently faced in agriculture and development practice, demonstrating the value of nurturing young scientific talent.

As Chairperson of MSSRF, I would like to express my sincere gratitude to all the donors whose support made this initiative possible. Their commitment has enabled these young scientists to think critically, work rigorously, and grow professionally during their twenty-four-month journey with us. As they move forward in their careers, we are confident that their time at MSSRF has strengthened their understanding of how science can be effectively harnessed in the service of society.

Soumya Swaminathan

Dr. Soumya Swaminathan
Chairperson, M.S. Swaminathan Research Foundation

Acknowledgement

M.S. Swaminathan Research Foundation (MSSRF) gratefully acknowledges the generous support of **M/s Five Star Business, M/s. ASPEE Foundation, Asia Initiatives, USA and Dr. Surajit Kumar De Datta** for funding the **M.S. Swaminathan Fellowship (2024-2026)**. This support enabled the establishment of a cohort of six young scientific leaders who completed their research over two years in Microbiology, Biotechnology, Food Science, Biodiversity, and Entomology. Through their work, the Fellows have developed practical solutions to challenges in agriculture and sustainable development.

We also extend our sincere appreciation to our collaborating institutions, the **Institute of Transdisciplinary Health Sciences and Technology (TDU)**, the **University of Reading**, the **French Institute of Pondicherry and the Indian Institute of Technology (IIT) Madras**, for their valuable contributions to the Fellowship. The guidance and mentorship from their scientists and access to laboratory facilities have been instrumental in strengthening the research capacity and learning experience of the Fellows.

Finally, we express our heartfelt gratitude to the farmers and community members across our field sites in Tamil Nadu, Pondicherry and Kerala. By generously sharing their knowledge, experiences, and insights, they have helped the Fellows deepen their understanding of local challenges, refine their research questions, and ensure that their research remains relevant, grounded, and responsive to community needs.

This Fellowship reflects the collective commitment of donors, research institutions, communities, and MSSRF to nurturing the next generation of scientists and advancing innovative solutions for sustainable agriculture and rural development.

Section I- About the MSSRF Fellowship and Fellows

Introduction

The M.S. Swaminathan Fellowship has been conceived as a transformative program to bring together young[1], talented postgraduate students in the fields of agriculture, ecology, economics, marine biology, nutrition and social sciences to do impactful research over 24 months that would serve the needs of the communities that the M.S. Swaminathan Research Foundation works with, as well as the larger population in the country, resulting in science – society interactions through translational research work tailored towards addressing the Sustainable Development Goals. The fellowship is Rs 50,000 per month, plus support for travel and procurement of inputs/raw materials for the research.

The Process Adopted

The fellowship was kick-started in December 2023 by requesting applications from students with a postgraduate degree in Agriculture/Animal Sciences/Life sciences/Ecology/ Developmental Studies/Fisheries/Environmental sciences/Developmental Economics /Anthropology/Nutrition with good academic performance and an interest in the 'science-society' interface to address current challenges of climate change impact on sustainable development goals. As an organization committed to social equity, the fellowship provided special age relaxation up to 3 years for women and candidates from disadvantaged socio-economic groups.

The initial response was tremendous, with about 500 candidates sending in their applications. Their CVs and proposals were reviewed internally by a team of senior scientists from the areas of Ecotechnology, Biotechnology, Biodiversity, Molecular Biology, and Economics. At the second level of filtration, where the profile and the statement of purpose were reviewed, 170 applicants qualified. This group was further shortlisted to 30 suitable candidates who were then interviewed by the senior team members, and the following 6 candidates were found suitable for fellowship[2].

Table 1 – Profile of the Candidates selected for the Fellowship

S.No	Name	Qualification and highlights of previous experience	Research topic chosen for fellowship- Statement of purpose highlights [3]
1	Ms Angel Abraham	M.Sc in Botany from Calicut University (2019) Worked in the Community and functional ecology lab, CSIR - Centre for Cellular & Molecular Biology	To gain insights into an ecosystem that mitigates human-animal conflicts in Wayanad and investigating the coexistence of plants within this ecosystem to address and mitigate issues between monkeys and humans that will ultimately empower me to extend the benefits of this system to other barren lands.
2	Ms Ezhil Dhanasekaran	M.Sc Biotechnology from the Stella Maris College Chennai (2021) Worked on the approaches in the area of plant microbiome research supported by Prof. Hema Ramachandran Fellowship for Women scientist, MSSRF, Chennai in 2023	To work on exploring soil microbiome communities, plant and soil heath, soil fertility and bioremediation.

[1] In the age group 23-32 years

[2] Names arranged alphabetically

[3] This was the initial SOP submitted with the application, which has since undergone changes

S.No	Name	Qualification and highlights of previous experience	Research topic chosen for fellowship-Statement of purpose highlights [4]
3	Ms Gopika Jawahar	M Tech in Agriculture Bio technology from Indian Institute of Technology, Kharagpur (2023) As part of a post graduate project worked on Bioinformatics analysis of tomato calmodulin proteins and optimization of *Agrobacterium*- mediated transformation protocol in tobacco (June 2022-May 2023)	To develop knowledge of plant abiotic stress tolerance and gaining research experience in increasing the expression of stress-responsive genes in plants.
4	Ms Indhu	M.Sc in Ecology and environmental sciences from Pondicherry University (2020) Citizen science fellowship from the Earth watch Institute on "Citizen Science-Nature Conservation-2022. Mina M. S Swaminathan Doctoral Fellow (Sep 2022-June 2024)	Conservation of Native Pollinator biodiversity and sustainable management of Pollination services in agroecosystems
5	Mr Prakash Saravanan	Master of Technology in Aquaculture Engineering, Department of Agricultural and Food Engineering, IIT Kharagpur (2021-2023) As part of Post Graduate project worked on Identification and enzymatic characterization of marine microbes associated with seaweeds and their potential for causing ice-ice disease and producing bioethanol	Exploring the Potential of Seaweed by Innovating Value-Added Products for Sustainable Development
6	Ms Praise Alex	M.Sc Food Science and Technology from Kerala University of Fisheries and Ocean studies (2021-2023) Worked on Improving the functional and health attributes of chicken meat balls by the incorporation of Jackfruit powder under ICAR National Research Centre on Meat, Hyderabad, India-2023.	Preventing underutilization of Wild Banana by i) evaluating the proximate composition of dried wild banana seeds ii) Assessing the phytochemical properties of dried banana seed extract. Iii) Encapsulating the bioactive in dried seeds extract iv) Phyto-chemical evaluation and characterization of encapsulated extract v) Development of enriched milk products and its shelf-life study.

Allotment of a Mentor for guidance

Each selected fellow was allotted to a senior scientist from MSSRF as a mentor with whom they had discussions on the projects that they wanted to do. The final projects were decided based on

- The relevance of the projects towards MSSRF's impact areas

[4] This was the initial SOP submitted with the application, which has since undergone changes

- The focus area of the project submitted. In some cases, the proposal was too broad, and the focus was sharpened so that it could have clear outcomes within the two years of the fellowship

Given below are the Mentors with whom the fellows worked, along with the title of the project that was finalized

Table 2- Project Details of selected Fellows and their Mentors

Name of the Fellow	**Name of the Mentor and Designation**	**Title of finalized project**
Ms Angel Abraham	Dr Israel Oliver King-Director Biodiversity and Ms Dhanya, Scientist, CAbC, Wayanad	Assessment of Carbon Stock in Arboretum and Coffee Agro ecosystems: A Case Study from MSSRF
Ms Ezhil Dhanasekaran	Dr Prabhavathy V.R-Director Biotechnology	Deciphering Rice-Associated Microbiome: Heterotrophs, Methanotrophs, And Methylotrophs Communities
Ms Gopika Jawahar	Dr Gayathri Venkataraman-Principal Scientist	Examining the influence of *Oryza glaberrima* - SUVH7, BAG4, MYB106 complex on HKT1;5 expression during salinity stress
Ms Indhu	Dr R. Rengalakshmi – Executive Director, ED R&D, Policy	Conservation of Native Hymenopteran Pollinator biodiversity and sustainable management of Pollination services in agroecosystems- Linking Entomopalynological approach and citizen science
Mr Prakash Saravanan	Dr S. Velvizhi Director – Fisheries and Livelihoods	Exploring the Potential of Seaweed by Innovating Value-Added Products for Sustainable Development
Ms Praise Alex	Dr Rama Narayanan-Senior Fellow, Food and Nutrition	Exploring the Nutritional Richness of Wayanad's Wild Greens: A Value Addition Approach for Mainstreaming

Final submission: The fellows submitted the thesis of the work done and presented their findings and learning at a seminar organized at MSSRF, Chennai. Simultaneously the fellows are working with their mentors to publish the results in peer reviewed journals. Finally, the team shared their work with the donor and a certificate was awarded to all the fellows.

Section II. Summary of the work

1. Ms Angel Abraham

Title: Assessment of Carbon Stock in Arboretum and Coffee Agro-ecosystems: A Case Study from Community Agro biodiversity Centre, Wayanad, MSSRF



The work aimed to compare the carbon stock of the Arboretum and Agro-ecosystems , including tree biomass, dead wood, leaf litter and soil organic carbon, in CAbC, MSSRF, Wayanad, Kerala. The arboretum selected is spread over an area of 1 acre, including Rare, Endangered and Threatened species from the Western Ghats. The coffee plantation selected is spread over 40 acres in a plantation in a nearby area. The main objective is to study the carbon stocks in the tree biomass, dead wood, leaf litter and soil, which will help in informed decision-making for conservation plans.

Three land use patterns from the Western Ghats were chosen for the carbon stock assessment study. A contiguous forest patch, a coffee agroecosystem and an arboreta in the Western Ghats, an ecological world heritage in the southwestern side of India. These three land use patterns also showed shared land-use history which allowed the study to assess how land use changes can affect carbon storage efficiency. The importance of analyzing the carbon storage efficiency of different land- use patterns in the Western Ghats lies in understanding how land-use changes can influence carbon storage. Land use changes can also impact the standing carbon stock and soil organic carbon stock. This can further influence the carbon cycle dynamics as well. This study aimed to assess and compare the carbon stock of different land use patterns and identify the factors responsible for differences in carbon stocks. The carbon storage efficiency of three sites with shared land use history such as contiguous forest patch, coffee agroecosystem and arboretum were studied through non-destructive carbon stock assessments using allometric equations. The procedure involved the calculation of biomass using diameter per breast height, height and wood density followed by the total biomass estimation and converting this to carbon stock values. Leaf litter and dead wood are also contributing to the carbon stock of the ecosystem. The fallen leaves of a tree enter the detritus cycle to become part of organic carbon and complete the carbon cycle. Moreover, the soil organic carbon plays a role in ecosystem carbon stock. Hence, the litter and soil biomass were also calculated, and the values were added to get the total carbon stock of the three land use patterns to compare the ecosystem carbon stock.

Among the three-land use patterns, contiguous forest patch showed the highest carbon stock, followed by coffee agroecosystem and arboretum. This result of contiguous forest can be attributed to the age and structure of the forest. The comparatively high carbon stock of the coffee agroecosystem, second among the three land uses, can be explained by the presence of large retained shade trees such as *Artocarpus heterophyllus*, which contribute substantially to tree biomass despite the coffee shrubs themselves holding very little carbon individually. The lowest carbon stock of the arboretum may be attributed to its relatively recent establishment, as its trees have had comparatively less time to accumulate standing biomass despite the site's high species richness.

Key Results

- Quantification of carbon pools, including tree biomass, dead wood, leaf litter and soil organic carbon, in the three land-use systems studied.
- Generation of baseline data for long term monitoring of carbon stock in the RET and coffee agroecosystems.

This study provided a framework and baseline dataset for understanding the long-term carbon-storage potential of conservation plantings, particularly RET species, and for monitoring changes in carbon stocks over time. The findings can support long-term ecological monitoring, conservation planning and assessment of the ecosystem benefits of RET species conservation.

2. Ms Ezhil Dhanasekaran

Deciphering Rice-Associated Microbiome: Heterotrophs, Methanotrophs, And Methylotrophs Communities



Rice cultivation is a major agricultural source of methane (CH_4), while the plant-associated microbiome plays an important role in nutrient cycling, plant growth, stress adaptation, and greenhouse gas dynamics. The present study integrated culture-dependent and metagenomic approaches to characterize beneficial microbial communities associated with traditional and improved rice varieties and to identify functional microbial candidates with potential applications in sustainable and climate-smart rice production. Metagenomic analysis provided comprehensive insights into microbial diversity, taxonomic composition, relative abundance, community structure, and functional potential across different rice varieties and plant compartments, enabling the identification of core, variety-associated, and potentially beneficial microbial taxa.

Complementary culture-dependent screening yielded more than 75 heterotrophic bacterial isolates with multiple plant growth-promoting traits, including nitrogen fixation, phosphate and zinc solubilization, and indole-3-acetic acid production. In addition, we isolated and characterized pink-pigmented facultative methylotrophs and non-pink-pigmented methylotrophs with methanol-utilization potential. Selected methylotrophic isolates exhibited multiple plant growth-promoting traits and drought tolerance, demonstrating their potential as multifunctional bioinoculant candidates. Methanotrophic bacteria were further explored for their potential to oxidize CH_4 through methane monooxygenase-mediated metabolism, with functional characterization targeting genes associated with C1 metabolism, including *pmoA*, *mmoX*, and *mxaF*. *Methylorubrum populi* (MSSRFCCB214) and *Methylorubrum aminovorans* (MSSRFCCB219) were positive for *mxaF*, indicating methanol oxidation potential, while selected isolates also demonstrated plant growth-promoting traits and tolerance to 20% drought stress. The complementary functions of heterotrophs, methylotrophs, and methanotrophs provide a basis for developing multifunctional microbial consortia that combine plant growth promotion, nutrient mobilization, abiotic stress tolerance, and potential

CH_4 mitigation. Integration of metagenomic profiles with culture-based functional screening further enabled the identification and selection of functionally relevant microorganisms that may not be captured through either approach alone. The integration of methanotroph-based bioinoculants with sustainable rice production practices may contribute to reducing dependence on chemical inputs while supporting climate-resilient and environmentally sustainable rice cultivation. Overall, the study establishes an integrated framework for linking rice-associated microbial diversity with functional traits and provides a scientific basis for developing crop- and variety-associated microbial bioinoculants aimed at improving plant productivity, soil microbial functioning, and environmental sustainability in rice agroecosystems.

Key Results

- Understanding the diversity and distribution of the microbiome using a metagenomic approach (the study of entire nucleotide sequences in a given sample)
- Development of a methanotroph bio-inoculant to reduce methane gas emission in the paddy field
- Development of suitable bio-inoculant formulations to promote plant growth and yield in Rice.

The work will potentially lead to improvement in rice productivity under drought stress (through PGPR bio-inoculant) with reduced methane emission in the fields.

3. Ms Gopika Jawahar

Examining the influence of *Oryza glaberrima* SUVH7, BAG4, MYB106 complex on HKT1;5 expression during salinity stress



Soil salinity affects rice production adversely. Tolerance to soil salinity therefore has a significant impact on good yields. Salinity tolerance in rice is controlled by the sodium transporter, OsHKT1;5, which expresses itself in an increased levels in the roots under conditions of salinity.

The Research focuses on understanding the expression of the sodium transporter gene, OsHKT1;5, during salinity stress. The quantitative trait loci analysis for salt tolerance in Asian cultivated rice, *O. sativa*, identified the *SKC*1 locus, corresponding to the *OsHKT1;5* gene, which encodes a Na+-selective transporter that retrieves Na^+ from the root xylem sap, preventing its excessive accumulation in the shoot. Unlike *O. sativa*, *Oryza glaberrima*, African cultivated rice, remains underexplored for salt tolerance and *HKT1;5* transcriptional activation mechanisms.

In this study, we comparatively evaluated salinity tolerance and associated physiological and molecular traits in *O. glaberrima* relative to known sensitive and tolerant *O. sativa* genotypes. Comparative phenotyping and elemental analysis revealed that *O. glaberrima* exhibited higher sensitivity to salinity, with noticeable growth inhibition, leaf drying and higher Na^+ accumulation in both root and shoot. In contrast, salt-tolerant *O. sativa* genotypes maintained a higher shoot K+ /Na+ ratio under stress, effectively excluding Na+. At the molecular level, *HKT1;5* was sequenced from the selected accessions, revealing five non-synonymous amino acid substitutions along with a threonine

insertion in *O. glaberrima* HKT1;5 (OgHKT1;5) compared to *O. sativa*. Temporal expression profiling further demonstrated that while tolerant varieties exhibited a progressive increase in *HKT1;5* expression under salinity, with FL478 and Pokkali-4 showing approximately 10-fold and 3-fold increases, respectively, *O. glaberrima* showed only a 2.5- fold induction at 46 h of salt stress.

Additionally, an inherent diurnal rhythm with peak *HKT1;5* expression in the morning and lowest levels during the night is observed in roots of all *Oryza* species and exists independent of salinity. Promoter sequence analysis confirmed the presence of an additional 236 bp miniature inverted-repeat transposable element (MITE) insertion unique to *O. glaberrima* and a single nucleotide polymorphism within the conserved *MYBE* cis-regulatory element previously implicated in MYB106-mediated activation of *HKT1;5*. To investigate the regulatory mechanism, yeast one-hybrid bait and prey constructs were successfully generated and validated; however, recurrent microbial contamination prevented completion of the interaction assay within the study period.

Overall, the findings indicate that the salt-sensitive phenotype of *O. glaberrima* is associated with higher Na^+ accumulation, limited induction of *HKT1;5,* and distinct coding and promoter sequence variations. These results provide new insights into the molecular basis of salinity sensitivity in African cultivated rice and establish a foundation for future studies targeting the regulatory mechanisms of *OgHKT1;5* to facilitate the development of salt-tolerant rice varieties.

Key Results

- Development of a good understanding of the expression of the sodium transporter, OgHKT1;5 during salinity stress due to the influence of the O. glaberrima SUVH7, BAG4, MYB106 protein complex
- Building a prototype to examine the same in many O.glaberrima genotypes and look for variation in HKT1;5 expression

This study developed a base for the development of new saline-tolerant varieties of O.glaberrima, creating more options for farmers cultivating rice in saline areas or vulnerable to the same in the future

4. Ms Indhu A

Conservation of Native Hymenopteran Pollinator biodiversity and sustainable management of Pollination services in agroecosystems- Linking Entomopalynological approach and citizen science



Pollinator decline resulting from agricultural intensification and habitat simplification threatens both biodiversity and the sustainability of crop production. In tropical agroecosystems, flowering weeds are increasingly recognized as valuable non-crop floral resources, yet their role in sustaining native Hymenopteran pollinators remains insufficiently understood. This study investigated the contribution of seasonal flowering weed communities to native pollinator diversity and pollination ecosystem services in smallholder brinjal (*Solanum melongena* L.) agroecosystems in Chengalpattu District, Tamil Nadu, India, during 2023–2026 (*The dataset includes observations collected from 2023, as the study commenced as part of my doctoral research before the award of the*

fellowship). Twelve brinjal fields representing high, moderate, and low weed intensity were monitored across the Aadi and Thai cultivation seasons. Monthly surveys quantified weed diversity, flowering weed richness, floral density, and floral cover using quadrat-based sampling, while native Hymenopteran pollinators were documented through standardized visual observations and sweep-net collections. Community composition, diversity indices, and relationships between floral resources and pollinator assemblages were evaluated using correlation and regression analyses.

Seasonal variation strongly influenced weed community composition, with post-monsoon periods exhibiting the greatest flowering weed richness and floral resource availability. Weed-rich fields consistently supported significantly higher abundance, species richness, and diversity of native Hymenopteran pollinators than fields with lower weed intensity. Native solitary bees constituted the dominant pollinator group, highlighting their ecological importance in tropical cropping systems. Floral density and flowering weed richness showed strong positive relationships with pollinator abundance and diversity, demonstrating that flowering weeds provide essential nectar and pollen resources throughout the cropping season. The study identified several key flowering weed species that function as biodiversity reservoirs by sustaining native pollinator communities when crop floral resources are limited. Beyond ecological assessments, the project incorporated citizen science through farmer participation, pollinator awareness programmes, and collaborative biodiversity monitoring, promoting local stewardship of pollination services. The findings demonstrate that selective retention of beneficial flowering weeds can enhance native pollinator conservation without compromising agricultural production. By integrating ecological research, entomopalynology, and community engagement, this study provides a scientific foundation for biodiversity-friendly weed management and pollinator conservation strategies in tropical agroecosystems. The resulting evidence supports the incorporation of pollinator-friendly practices into sustainable agriculture and contributes baseline information for future research, policy development, and conservation planning aimed at strengthening ecosystem services and agricultural resilience.

Key Results

- Identification of economically valuable pollinators and the factors affecting their abundance.
- Development of habitat management practices to improve crop pollination.
- Determining performance of alternative managed bees as specialty crop pollinators.

Overall, the study supports designing improved cropping practices with a balance of crop – weed that encourage bee abundance, resulting in better pollination and higher yields

5. Mr Prakash Saravanan

Exploring the Potential of Seaweed by Innovating Value-Added Products for Sustainable Development

Seaweeds have emerged as promising sustainable food resources owing to their rich nutritional composition, bioactive compounds, and potential contribution to food and nutrition security. The present study explored the nutritional characteristics, food application potential, and community relevance of two marine macroalgae, *Sargassum wightii* and *Ulva lactuca*, collected from the Gulf of Mannar region, India.



In addition to laboratory investigations, field visits and community interactions were conducted across major seaweed-harvesting villages of the Rameswaram region to understand traditional knowledge, utilization patterns, and opportunities for value addition.

Comprehensive nutritional characterization of *Sargassum wightii* revealed that the seaweed is a rich source of dietary fibre (28.44%), ash (21.12%), protein (11.20%), essential amino acids, polyunsaturated fatty acids, and important minerals such as calcium, magnesium, and potassium. The seaweed also exhibited appreciable levels of total phenolic compounds, flavonoids, and antioxidant activity, indicating its potential as a functional food ingredient. Heavy metal concentrations were within acceptable safety limits, while inorganic arsenic remained below the limit of quantification. Functional property evaluation demonstrated that seaweed incorporation significantly improved water-holding capacity, emulsifying activity, and solvent retention characteristics of composite flours. The food application potential of *Sargassum wightii* was evaluated by developing seaweed-enriched cookies, crackers, and rice chips. Incorporation of seaweed enhanced the nutritional profile of the products, particularly in dietary fibre and mineral content.

Sensory evaluation indicated that inclusion levels of 10–20% achieved the best balance between nutritional enhancement and consumer acceptability, whereas higher levels were associated with stronger marine flavors and reduced preference. The nutritional potential of *Ulva lactuca* was also investigated. The seaweed contained a relatively high protein content (20.71%), substantial mineral content, and an appreciable amino acid profile rich in essential amino acids. Notably, *Ulva lactuca* exhibited a high iron concentration (260.71 mg/100 g), highlighting its potential as a micronutrient-rich food ingredient. Product development studies demonstrated the successful incorporation of Ulva into dosa powder and fryums, resulting in nutritionally enhanced products with acceptable quality characteristics. Field surveys revealed that coastal communities possess valuable traditional knowledge regarding seaweed utilization; however, dietary consumption has declined due to commercialization, limited awareness, and a lack of value-added products. The findings demonstrate that *Sargassum wightii* and *Ulva lactuca* are safe, nutritious, and versatile marine resources with considerable potential for the development of functional foods, livelihood enhancement, and sustainable blue economy initiatives. Future efforts should focus on cultivation technologies, processing innovations, and consumer-oriented product development to support wider adoption of seaweed-based foods.

Key results

- Development of a Nutri rich sea weed cookie / Nutri powder /Nutri bar that is tasty and safe for consumption

The potential outcome of the study will be creating demand and livelihood strengthening for seaweed collectors

6. Ms Praise Alex

Exploring the Nutritional Richness of Wayanad's Wild Greens: A Value Addition Approach for Mainstreaming



Wild green leafy vegetables (GLVs) in regions like Wayanad hold immense untapped nutritional potential but remain hidden & underutilized. Green leafy vegetables are rich in iron, vitamin A, and essential micronutrients, providing an accessible solution to malnutrition. The Fellowship project focusses on the development of value-added products from underutilized green leafy vegetables (GLVs) used by Wayanad's tribal communities for their mainstreaming and conservation

This study aimed to obtain comprehensive nutritional and phytochemical information on four wild leafy vegetables collected from Wayanad, Kerala, including the mineral composition of their total Calcium, Zinc, lead and iron contents, antinutrient levels, antioxidant activity, phytochemical profile, and fatty acid composition.

Species examined were: Aliyanchappu (*Zehneria maysorensis* Wight & Arn.), Neelavela (*Cleome rutidosperma* DC.), Marakkerai (*Embelia tsjeriam-cottam* A. DC.), and Vayal Chulli (*Hygrophila schulli* Ham.). Iron concentrations in the leafy greens ranged from 236.52–425.6 mg/kg, with *Cleome rutidosperma* DC. showing a concentration comparable to the control (411.01 mg/kg), suggesting potential contribution to dietary iron intake upon inclusion in the diet.

The protein content of *Z. maysorensis* (24.55 ± 0.42g/100g) is comparable to that of commonly consumed leafy vegetables like drumstick leaves (25.1 g/100g), and the protein levels in *C. rutidosperma* are higher (37.84 ± 0.23 g/100 g).

All species exhibited relatively low antinutrient contents, particularly phytates and oxalates, and contained essential fatty acids, including omega-3 and omega-6. Overall, the nutritional and phytochemical attributes of these species underscore their potential for future commercial cultivation and the scope for value addition as promising underutilised leafy vegetables for improving nutritional security.

Key results

- Development of a Nutri powder made out of the 4 nutrient-rich GLV vegetables to be used as a nutritional supplement

This study created an option to address malnutrition with respect to specific nutrients like protein, iron and promoting antioxidant activity

Section III. MSS Fellowship Programme Feedback Report

The M. S. Swaminathan Fellowship Programme provides young professionals with opportunities to gain practical experience, strengthen their technical and professional competencies, and contribute to the Foundation's development initiatives. As part of the Foundation's commitment to continuous learning and programme improvement, feedback was collected from fellows anonymously to understand their experiences and perspectives on various aspects of the fellowship.

This report presents an analysis of the feedback received from fellows on key dimensions of the programme, including the onboarding process, mentorship, learning opportunities, organisational support, work environment, and overall satisfaction. The feedback provides valuable insights into the strengths of the fellowship experience while also highlighting areas where improvements can further enhance the programme.

The findings in this report are intended to inform mentors, the fellowship committee and other stakeholders by providing evidence-based insights from fellows' experiences. The recommendations emerging from the feedback can support continuous refinement of the fellowship programme and improve the experience of future cohorts:

1. Fellows' Feedback on Mentors

The average score for the mentoring experience was **4.2 out of 5**. Of the six respondents, three (50%) rated their experience **4 out of 5**, while three respondents gave a rating of **5 out of 5**. These ratings indicate that participants had a high-quality experience with their mentors.

2. Fellowship Expectations

All respondents reported that the fellowship met their expectations. They highlighted benefits such as ***professional development, research experience, field exposure, independence, and scientific growth.*** Overall, participants expressed a high level of satisfaction with the fellowship experience.

> *"This fellowship paved the way to explore the in-depth research, with multiple lab facilities access. This fellowship kindled my idea and curiosity with the close guidance of allotted mentors. Thus, I got a clear idea about research in vitro and field level aspect"-*

3. Key opportunities during fellowship

Synthesis of responses on learning opportunities: Fellows frequently identified opportunities such as ***participation in conferences, development of analytical skills, professional networking, mentoring, scientific writing, and field exposure***. These responses indicate that the fellowship provided strong opportunities for capacity development and professional growth.

4. Value of Periodic Review Meetings

All respondents reported that the fellowship had a review mechanism in place. They noted that review meetings provided constructive feedback, supported progress tracking, helped refine their research, and enabled them to address challenges effectively.

5. Areas for Improvement

The key suggestions focused on ***increasing collaboration, improving laboratory support, expanding field interactions, and strengthening institutional partnerships such as exchange program with international universities***.

6. What should MSSRF continue to do as part of the fellowship

Participants recommended that MSSRF should continue providing the fellows with opportunities for community engagement, ***field exposure, mentoring, logistical support, and opportunities for collaboration.***

7. Overall experience

The fellowship received a high overall satisfaction rating, with an average score of 4.7 out of 5. Among the 6 respondents, 71% rated their overall experience 5 out of 5, while the remaining 29% rated it 4 out of 5, reflecting a consistently positive and highly satisfactory fellowship experience.

8. Reflections and Recommendations

Overall reflections emphasized a positive learning experience, future career development, workshops, institutional support, and strengthening research capabilities.

"The fellowship strengthened my ability to troubleshoot and optimize experiments, simplify methodologies without compromising data quality, manage limited time and resources effectively, and process high-throughput samples accurately and efficiently. It also improved my problem-solving skills and adaptability in a research environment.

-Anonymous fellow





“The future belongs to nations with grains and not guns”

– Professor M.S. Swaminathan