



#### Pathways to strengthened agri-food research and innovation systems in Asia and the Pacific

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### EDITORIAL

Dear APAARI Members, Partners and Stakeholders,

Strengthening agricultural innovation systems (AIS) is at the heart of APAARIs' programmes, projects and activities with its members and partners. In the context of COVID 19 pandemic, national governments, which are still the main funders of research and development (R&D), are more than ever challenged to make smart investment decisions for different sectors. As such, many have started and many still need to experiment with new funding mechanisms, processes and tools for innovation. Besides, as this is a year of the UN Food System Summit, the importance of innovation in sustainable agri-food systems has been greatly highlighted at the global level.

Keeping in view the enhanced importance of agricultural innovation, the role of collective actions of the development community, including that of regional and global fora, is becoming increasingly more important and relevant. In this Newsletter, we attempted to provide highlights of such joint initiatives with a wide diversity of partners.

Firstly, through the Regional Consultation on Forgotten Foods that took place on 28 May 2021, APAARI joined the international efforts led by the Global Forum on Agricultural Research and Innovation (GFAR) to advocate for a new vision for research and innovation aimed at enhancing food diversification, farmers' income, and the environment. Neglected or under-utilized crops, also called 'forgotten food', are the less cultivated species that show a huge potential to help feed 9.7 billion people in 2050 through improved diversity and sustainable agricultural practices. Policy action to secure livelihoods of the producers of such crops is required to provide a safety net for NUS crop production and improved adaptation.

Secondly, APAARI continues its efforts to develop functional capacities in AIS in the region through scaling up the Tropical Agricultural Platform (TAP) Framework on Capacity Development for AIS. In collaboration with the Asia-Pacific Islands Rural Advisory Services Network (APIRAS) and the Food and Agriculture Organization of the United (FAO), APAARI is putting the foundation to a Regional Agricultural Innovation Forum to provide a platform for regular discussions of multi-stakeholders on the issues of capacity development, partnership and enabling environment for innovation. A series of webinars is intended to be organized, leading to the first big regional event on innovation jointly planned for 2022 – High-Level Regional Innovation Forum (HLRIF).

The third major effort to strengthen AIS in the region is to partner and collaborate with the Commission for Sustainable Agriculture

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### EDITORIAL TEAM

- Ms. Martina Spisiakova
- Dr. Peter Horne
- Dr. Ravi Khetarpal

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Intensification (CoSAI) of CGIAR, which has recently commissioned and published a report on the current level of investment in innovation for Sustainable Agriculture Intensification (SAI) in the Global South. The partnership is bringing together agricultural and food systems experts, and decision-makers to engage in a dialogue around the evidence of current investment in agricultural innovation, and explore how to address this gaps in taking up innovations for SAI through collaboration.

There are many interesting initiatives of APAARI supporting AIS in the region. For example, APAARI is playing the leading role in blending technical and functional capacity development in technical projects funded by the United States Development Agency (USDA) focused on phytosanitary development in Bangladesh, as well as the regional pesticide residue mitigation projects in Asia and Africa funded by the

Standards and Trade Development Facility (STDF) of the World Trade Organization (WTO). You can find the latest updates in the Newsletter, along with selected top stories from our members.

We hope you enjoy reading this issue of the Newsletter and continue to share with us your key R&D initiatives and innovations, which APAARI will help you disseminate.



**Dr. Ravi Khetarpal**  
Executive Secretary, APAARI

## HIGHLIGHTS FROM THE APAARI SECRETARIAT

### APAARI-APIRAS strengthened through the implementation of the Joint Action Plan in the Asia-Pacific region

**On 20 June 2021, APAARI started its new partnership with the Asia-Pacific Islands Rural Advisory Services Network (APIRAS) to implement the Joint Action Plan developed following the completion of the Joint Rapid Appraisal (JRA) of capacities for agricultural innovation systems (AIS). The JRA took place in 2020 and focused on assessing the regional landscape of capacities for AIS in Asia. The new partnership will lead the regional actions prioritized in this assessment.**

The Tropical Agriculture Platform (TAP), together with its partners and expert groups, has developed



approaches and tools to strengthen capacity to innovate in the agri-food sector. The Common Framework for Capacity Development for Agricultural Innovation System is the principal guide to the TAP approach for strengthening capacity to innovate at local and national levels. In support of the Common Framework, TAP has also developed various tools, assessment methodologies and operational guidelines, which have been tested, validated, and up-scaled successfully under the EU-funded project “Capacity Development for Agricultural Innovation System” (CDAIS) implemented by the Food and Agriculture Organization of the United Nations (FAO) and TAP partners.

Building on these experiences, TAP is further promoting and integrating these tools and approaches in selected regional and sub-regional research and extension organizations in Africa, Asia-Pacific and Latin America, under the EU-funded project “Developing capacities in agricultural innovation systems: scaling up the TAP Framework” also implemented by FAO and TAP partners. APAARI and APIRAS are TAP’s key regional partners.

The new partnership among APAARI and APIRAS will strengthen their capacity to integrate TAP tools and approaches in their work programme to promote innovation processes at the country level. It will also facilitate and strengthen collaboration and synergies between research coordinated by APAARI and extension coordinated by APIRAS. The joint activities will particularly focus on promoting capacity development (CD) materials, tools, multi-stakeholder dialogue and training on strengthening AIS through

enhanced functional capacities at various levels.

A concept note for a Regional Agricultural Innovation Forum for Asia-Pacific is being developed to provide a platform for regular discussions of multi-stakeholders on the issues of CD, partnership and enabling environment for innovation. A series of webinars will be organized into thematic working groups, which will lead to the first big regional event on innovation planned for 2022 – High-Level Regional Innovation Forum (HLRIF). Other supporting activities being currently planned in the context of this partnership include various awareness and advocacy events to promote CD for AIS concepts in the Asia-Pacific region targeting research, extension and higher education actors, as well as a launch for good practices and survey on research-extension interface.

All these planned activities will involve APAARI and APIRAS members and key partners, as well as other relevant stakeholders, which is envisioned to strengthen the collaboration and networking among them. The participants are considered to be key policy influencers, and the planned activities will enhance their functional capacities to better advocate for the integration of the AIS perspective in their national contexts and institutions.



### **APAARI signed a partnership agreement with the Commission for Sustainable Agricultural Intensification (CoSAI)**

**The Commission for Sustainable Agriculture Intensification (CoSAI) is bringing together agricultural and food systems experts, as well as decision-makers from the Global South. It is collaborating with scientists, innovators and partner organizations from across the globe. The objective is to investigate the current state of investment in agricultural innovation and explore how to overcome constraints to the development and uptake of key innovations for Sustainable Agricultural Innovation (SAI). Recently, CoSAI engaged in a partnership with APAARI to deliver a series of webinars to validate the findings of the studies that are currently being conducted with a range of innovation actors in the region.**

As the world looks to its future food systems, there is no doubt that innovation, through science and technology, policy, financing, institutional change, and capacity building, will play a key role in transforming AIS. Through the implementation of

commissioned studies and strategic engagement, CoSAI is currently collecting evidence on investment in agricultural innovation to support this case. These studies and engagement are building a portfolio of research-based evidence to support the much-needed investment in innovation for SAI in the Global South.

To boost global support to innovation in AIS that is urgently needed to reach the UN Sustainable Development Goals (SDGs), CoSAI's aim is to influence public and private support to innovation in order to rapidly scale up SAI in the Global South. This is envisioned to be achieved through CoSAI-APAARI dialogue series to enable the emerging evidence and tools to be discussed by key stakeholders of the region. The discussions will also influence the final products and recommendations of CoSAI, which concludes in December 2021.

The series would be structured with the following dialogues:

1. The innovation investment landscape and future food systems (September 2021)
2. Decision support tools to enhance the impact of innovation investment (October 2021)
3. The way forward in the Asia-Pacific for innovation investment (November 2021)

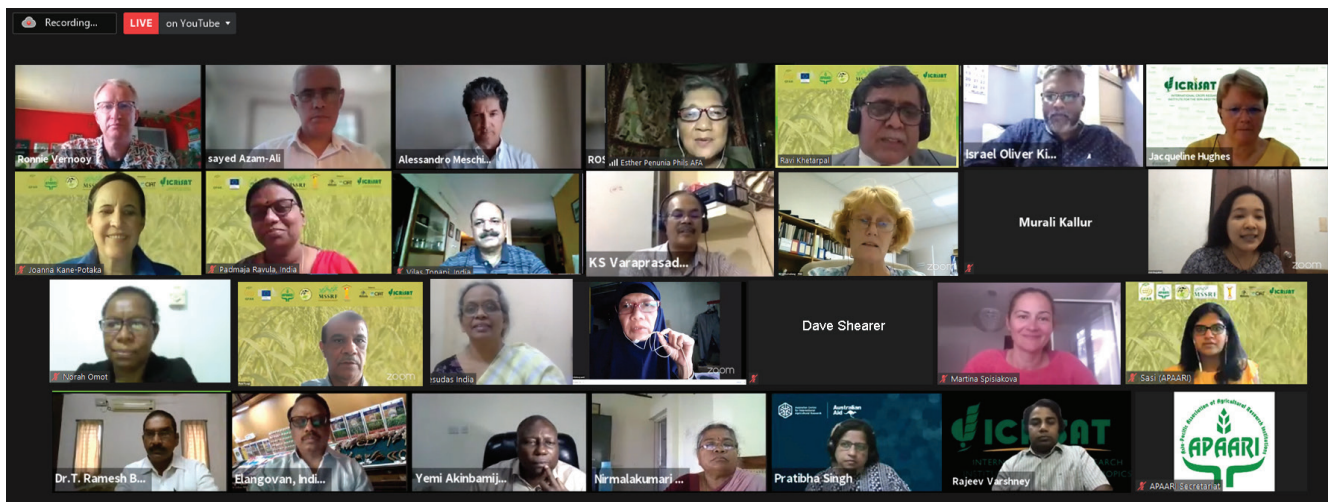
APAARI is currently identifying the suitable stakeholders – influencers – to participate in the series. Efforts are also being made to synergize these activities with other APAARI's activities on strengthening AIS, namely, the EU-funded project "Developing capacities in agricultural innovation systems: scaling up the TAP Framework".



### **Bringing forgotten food back to farmer fields and consumer tables**

**Forgotten foods or Neglected and Underutilized Crops (NUS), traditionally cultivated among many indigenous communities, are the family of crops that have over time suffered the wrath of food consumption trends and eating habits. However, the industrialization of agriculture pushed them away from the global agricultural and research systems. The Regional Consultation on Forgotten Foods in Asia-Pacific held on 28 May 2021 aimed to improve recognition of forgotten food by multi-stakeholders, and discuss collective strategies to mainstream this food at the regional level.**





*Participants of the Regional Consultation on Forgotten Foods*

Though popular for their nutrient-dense value and low input in production, crops, such as pseudocereals, small millets, grain legumes, tuber crops, sea buckthorn, and minor fruits, are referred to as ‘forgotten foods’. Such foods were the topic of discussion during the recent Regional Consultation on Forgotten Foods in Asia-Pacific. “Together with farmers and other innovation actors in the Asia-Pacific region, we need to define the change needed for research systems and value chain,” said Dr. Ravi Khetarpal, Executive Secretary, APAARI.

A regional Manifesto on Forgotten Foods emerged from the meeting attended by around 250 participants. The Manifesto will encourage a fundamental change from the current yield-for-immediate-profit structure towards a multi-functional, diversified agri-food structure that will reap benefits for the planet, farmers and consumers.

The diverse talks saw an active participation of farmers, development professionals, scientists, and government officials from South and Southeast Asia, Central Asia and the Pacific. Discussions centred around the importance of forgotten crops and the way forward to bring them back to farmers’ production, research and policy agenda, as well as consumers’ tables. “The next focus should be on combining food security, nutrition security and the need for sustainable diets,” said Joanna Kane-Potaka, Assistant Director General - External Relations, International Crops Research Institute for Semi-arid Tropics (ICRISAT). “This is going one step further with food that is good for you, the planet and the farmer,” she pointed out.

“There is a huge need to address productivity and quality in forgotten grains,” according to Dr. Birte Komolong, Program Director, Agricultural Systems,

National Agricultural Research Centre, Papua New Guinea. A recent regional survey found that majority of small farmers are in favour of bringing back such forgotten foods once given some financial support and market linkages. “The traditional seeds and the knowledge to grow them are very important. Our emphasis should be on preserving, growing and, conserving this knowledge around traditional seeds,” emphasized Ms. Salome, a farmer representative.

Equally important is investment in sustainable agricultural technologies, innovative processes for capacity development, as well as effective ways to lobby and advocate for innovation in food diversification that will reward small farmers and consumers in Asia-Pacific and beyond. “Food diversification is required to ensure climate-resilient nutrition,” stressed Prof. Sayed Azam-Ali, Chief Executive Officer, Crops for the Future.

The Regional Manifesto on Forgotten Foods in Asia-Pacific will create new opportunities for transforming local, regional, and global paradigm to enhance crop diversity and create new pathways for smallholder farmers. It will promote a participatory approach in building a resilient community that will acknowledge indigenous farmer’s knowledge to drive accelerators of change and bring together new practices of research. It also envisages a participatory system of seed that improves access, availability and promotes opportunities for conservation. Such regional manifestos are now being developed at different regions of the world, and will feed into a common shared vision of a ‘Global Manifesto’. It will be collectively presented in United Nations Food Systems Summit in September 2021, aiming at a global visibility and acceptance. Consequently a ‘Global Plan of Action on Forgotten Food’ is envisaged, which will be pitched to donors for

undertaking various activities for mainstreaming at the global level.

The webinar was led by APAARI in partnership with GFAR, Alliance Bioversity-CIAT and Crop for Future, as well as the Asian Farmers Association for Sustainable Rural Development (AFA), M. S. Swaminathan Research Foundation (MSSRF), International Crops Research Institute for Semi-arid Tropics (ICRISAT) and Barli Development Institute for Rural Women (BDIRW).



## APAARI's first Executive Committee Meeting for 2021 and General Assembly discussed strategic issues of the Association

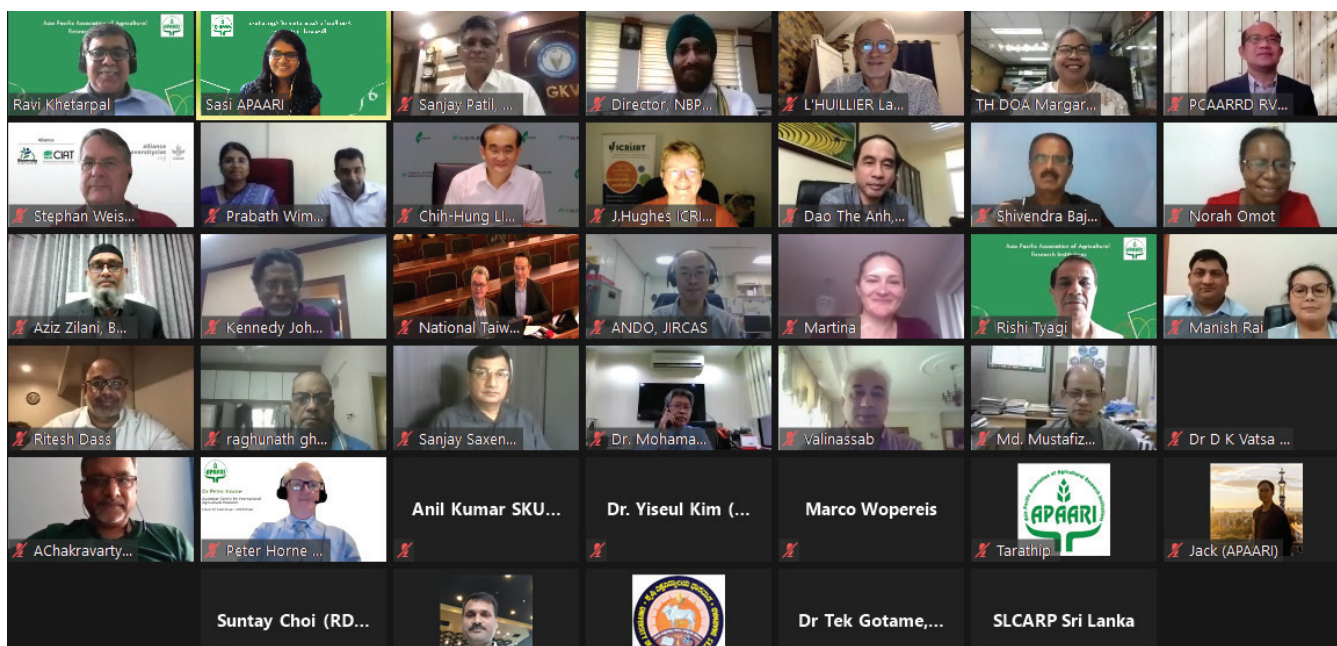
APAARI held its first virtual Executive Committee (EC) meeting for this year from 30 to 31 March 2021, followed by the 16<sup>th</sup> General Assembly Meeting (GAM) held from 6-9 April 2021. Dr. Peter Horne, General Manager, Global Programs, Australian Centre for International Agricultural Research (ACIAR), Australia, chaired the meeting.

The key strategic items discussed in the EC and GAM included: (i) the legal status; (ii) status of the Asia-Pacific Consortium on Agricultural Biotechnology (APCoAB); and the changes in the APAARI Constitution to be put forward in the General Assembly Meeting (GAM). The Committee acknowledged the strategic importance of these issues, and further elaborated these discussions in the context of the following points:

- Action-taken report and recommendations of the last EC meeting
- Technical progress report following the Monitoring, Evaluation, Reporting and Learning system of the Association (June 2020 - February 2021)
- Mid-term review of the implementation of the Strategic Plan 2017-2022
- Biennial work plan for 2021-2022
- Status of developed, submitted and secured projects
- Membership, fee payment status and membership benefit analysis
- Management standards for Chief Executive Officer (CEO)
- Risk register
- Filling up of new vacancies
- Administrative matters
- Audit and finance report

The Committee made further observations and presented recommendations against each item for smooth functioning of the Association. It also reiterated the need to expand APAARI's network of partners and donors/funders.

The meeting concluded with a vote of thanks to all its participants, especially to the Chair, Dr. Peter Horne, for his continued support and active engagement with APAARI and its Community. The Committee also recognized the staff's commitment towards APAARI and applauded their contribution to building an active and engaging workplace.

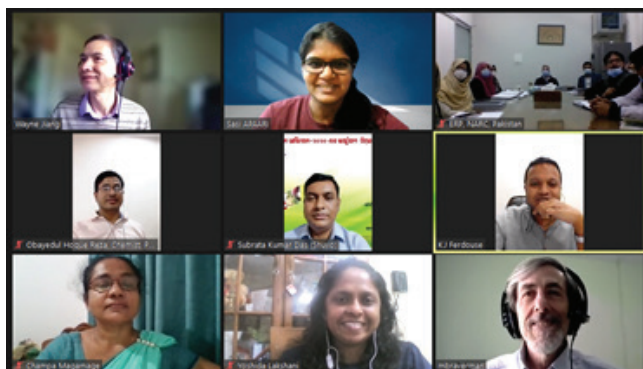


Participants of the ECM and GAM



## Progress made in the Asia Pesticide Residue Mitigation Project

The Asia Pesticides Residue Mitigation Project (APRMP) facilitates organized efforts to promote the inclusion of biopesticides in integrated pest management (IPM), with specific strategies on how biopesticides can be used to mitigate the residues of conventional pesticides. The project is being implemented in Bangladesh, Cambodia, Indonesia, Laos, Malaysia, Nepal, Singapore, Sri Lanka, Thailand, and Vietnam. In 2021, APAARI has undertaken a series of activities towards these objectives.



*Participants of the Laboratory Training*

### Intensive Virtual Laboratory Training

The project funded by the Standards and Trade Development Facility (STDF) of the World Trade Organization (WTO) aims to mitigate pesticide residues and facilitate trade by preventing export violations related to the Maximum Residue Levels (MRLs). It promotes the appropriate use of microbial-based pesticides to control key pests, especially at the end of the crop-growing cycle, reducing contribution to pesticide residue at the time of harvest.

In this context, the Laboratory Good Laboratory Practice (GLP) training was conducted virtually from 15 February to 11 March 2021. It was a two-week training held separately for two groups of countries. The first group included Bangladesh, Sri Lanka and Pakistan; and the second group included Cambodia, Laos, and Nepal. The training was delivered by Dr. Wayne Jiang, IR4 project Michigan State University, with technical support from Dr. Michael Braverman, Manager of Biopesticides, Organic and International Capacity Building Programmes, IR4 project, Rutgers University.

The objective was to have smaller groups by teaming the laboratories with similar instrumentation and experience. Furthermore, it was envisioned to enable

better interactions between the trainer and trainees, as well as the sharing of laboratory experiences with other participants. In total, twenty-one chemists and scientists from the participating countries attended the training.

This interactive training improved the participants' understanding of the concept of GLP and general pesticide analytical laboratory processes, including sample shipping/receipt, storage, processing, extraction, clean-up, instrumental analysis, residue results, reporting and interpretation, record keeping and archives. It included a virtual demonstration of sample grinding and extraction procedures from the participating countries. Furthermore, it brought interaction for addressing specific issues that are being faced in the participating labs.

Development of functional capacities (soft skills) was also integrated in the technical training by introducing and reflecting on the principles of training of trainers, innovation and individual and collective reflection. Through interaction, the participants explored what are the main competencies and attitudes of effective trainers, and learned various tips and principles of adult learning. This is because it is envisioned that the trainees will become trainers themselves.

The use of personal logbooks was introduced to the participants at the beginning of the training, where they wrote their reflections and observations after each day of training. During the second part of the training, the participants had an opportunity to conduct a collective situation analysis and how they are going to use the new skills in their organizations, and influence decision makers. Specifically, they explored how they will go about communication with their supervisors and colleagues about promoting this training in their organizations; which activities need to be improved through this training and target group (organizational analysis); what are the task elements that the target group is expected to be carrying out (task analysis); and how to go about assessing the training needs by comparing them with the skills that the lab training builds. At the end of the training, a joint after-action review was conducted to provide constructive reflection on how to improve future technical training of the project.

After the training, APAARI has initiated the formation of an online hub for the participants for mentorship based on the feedback and requirement from the participants.

## Social Media engagement for APRMP

During the latest activities with the project participants, Social Media was considered as an important tool for communication that facilitates access to relevant information, creation and sharing of knowledge, and establishing a connection among users today. The project Facebook page and LinkedIn page were launched to facilitate such knowledge sharing, but also to provide a tool for mentorships to better address the common issues that the project participants are facing. To follow the project, the following links should be used: <https://www.facebook.com/STDF-Asia-Pacific-Pesticide-Mitigation-Project-102633895364911> and <https://www.linkedin.com/showcase/asia-pesticide-residue-mitigation-project/>.

## Advisory Committee Meeting

An Advisory Committee to guide the team on the technical aspects of the project was formed by APAARI. The meeting was conducted under the presence of the following Committee members: Dr. Wayne Jiang (University of Michigan); Dr. Adriana Castañeda, Inter-American Institute for Cooperation on Agriculture (IICA); Dr. Selvaraju Ramasamy (FAO); Dr. Ngan Chai Keong (MAARDI, Malaysia); Dr. Ketan Mehta (Ecosense Labs. Pvt. Ltd., India).

The progress and the challenges during the second half yearly period of the project were presented by Dr. Ravi Khetarpal, Executive Secretary, APAARI and Dr. Michael Braverman, Biopesticide manager, IR4. The Committee engaged in providing technical advice on exploring possibilities of external support to conduct in-person training, possibilities to treat the seeds with biopesticide and look more into the usage of pesticides by Asian farmers that are banned in the US and European Union.



## Charting the future of evidence-based agricultural policies - Research on Policy Pathway discussions

**In June 2021, APAARI conducted a survey on Research to Policy Pathways, involving 49 participants from 16 countries in Southeast Asia and the Pacific. The purpose of the survey was to map the agricultural research to policy pathways; understand the role and extent to which agricultural research institutions engage in the process of decision making; and the use of agricultural research**

**evidence and information in policy processes.**

Many issues currently challenge agricultural production, marketing and environmental systems. Agricultural research evidence and information can help decision makers to make well-informed decisions about policies, programmes and projects to address such issues, bring benefits to the sector and, importantly, to smallholder farmers. However, researchers often are unaware of the research-to-policy pathways, they lack skills to communicate evidence effectively; or they miss significant opportunities to do so.

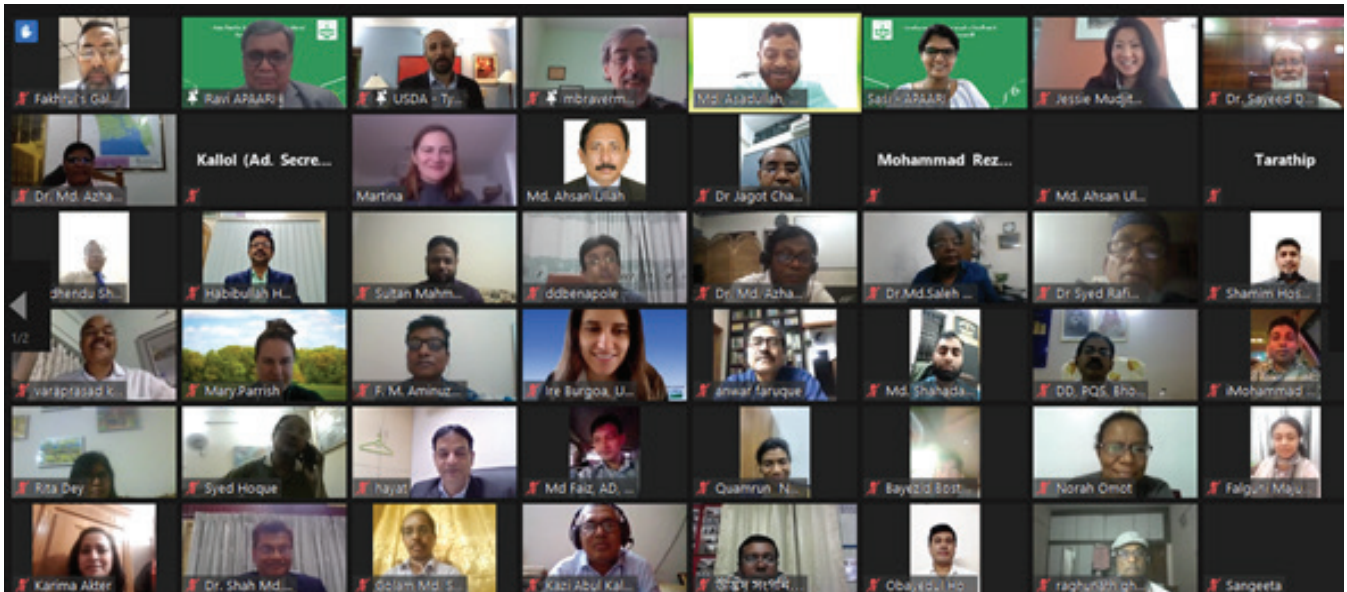
The survey found that the research to policy pathway is complex. It involves many players and platforms, and the effectiveness of countries in using research to inform policy is only average. A number of suggestions were provided in the survey on how to better integrate agricultural research into policy processes and be aware of factors that enable or impede uptake of research evidence and information in policy processes. The full report will be available in the last quarter of 2021.



## Inception Workshop launched the project on Improving Phytosanitary Trade Compliance in Bangladesh

**APAARI has just launched its new partnership with the Foreign Agriculture Service (FAS) of the United States Department of Agriculture (USDA), U.S. Agency for International Development (USAID), and Ministry of Agriculture, Bangladesh, to implement a new programme titled 'Improving Phytosanitary Trade Compliance in Bangladesh'. Other partners of the project include IR-4 (Rutgers University, USA), Plant Quarantine Wing, and Plant Protection Wing of the Department of Agriculture Extension, Bangladesh.**

The project aims to generate awareness on the importance of plant quarantine and plant protection, facilitate inter-departmental linkages, and strengthen the capacity of the National Plant Protection Organization (NPPO) to establish a framework of the National Plant Quarantine Authority. It also aims to enhance institutional capacity to boost regulatory harmonization of biopesticides, and increase awareness of the importance of harmonization of pesticides' Minimum Residue Levels (MRLs) with CODEX and the United States for trade, while promoting an integrated pest management approach.



Participants of the Inception Workshop

Several workshops, training of the trainers for the development of technical and functional capacities, knowledge management on SPS matters, and regulatory harmonization for biopesticides are being planned.

The project was officially launched on 24 February 2021, through a virtual inception workshop hosted by APAARI. Approximately 95 participants attended the event. The chief guests and keynote speakers of the inception workshop were: Honorable Mr. Kallol, Additional Secretary, MOA, Bangladesh; Mr. Mohammad Asadullah, Director General, Department of Agricultural Extension; Dr. Mohammad Abu Sayeed Miah, Director, Plant Protection Wing, and Dr. Mohammad Azhar Ali, Director, Plant Quarantine Wing, of the Department of Agricultural Extension; Dr. Ravi Khetarpal, Executive Secretary, APAARI; Mr. Tyler Babcock, Agricultural Attaché, USDA; Dr. Jessie Mudjitaba-Fernandez, International Program Specialist, USDA/FAS; and Dr. Michael Braverman, Manager Biopesticide, IR-4 (Rutgers University), USA.

The event was live-streamed on APAARI Thailand's YouTube channel and is accessible [here](#). The event has received significant recognition and support from the Government of Bangladesh. A number of press releases appeared in national newspapers and are available [here](#).



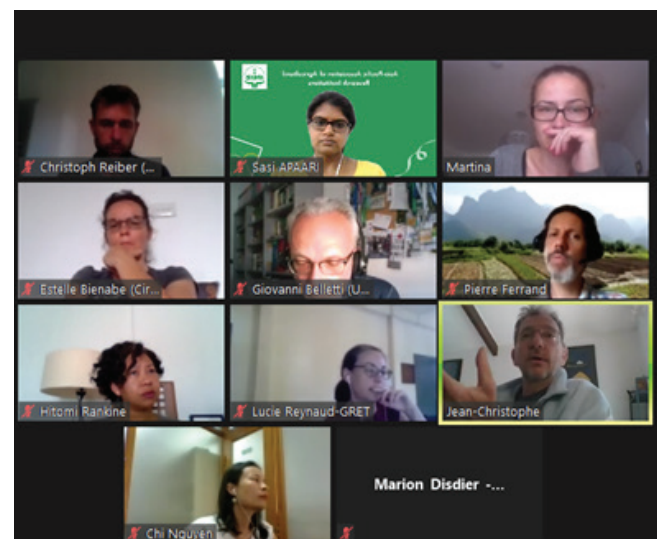
## APAARI started implementing the Agroecology and Safe Food System Transition (ASSET) project

Last year, APAARI signed a Consortium Agreement on Agroecology and Safe Food System

**Transitions (ASSET) in Southeast Asia. The five-year project is funded by the European Commission Directorate-General for International Cooperation and Development (DG DEVCO), and French Development Agency (AFD). This year has marked the beginning of the ASSET implementation, with APAARI's contributions as well.**

The ASSET Project is led by the Agricultural Research Centre for International Development (CIRAD), and implemented by 27 partners in Cambodia, Laos, Myanmar, and Vietnam, as well as APAARI as the regional partner. It explores the transition to systems that address critical issues, such as soil fertility and biodiversity depletion, water scarcity, or increasing biotic constraints to crop and livestock productions. The project's key components include:

- Impact-oriented stakeholder engagement into agroecology and safe food system transitions



First Com CoP meeting



- Scaling up agroecological and safe food system innovations from local to regional levels
- Project coordination and management

APAARI leads the project Sub-Component 1.3 on ASSET transitions through capacity development, communication, and visibility actions. It formed a Community of Practice (CoP) consisting of focal points from all 27 partners to ensure effective communication, knowledge sharing amongst the partners, and smooth coordination of the Sub-Component.

A stocktaking exercise with SWOT analysis was performed within the CoP to solicit the partners' inputs into the development of communication strategy. Consequently, APAARI developed the project's Communication and Visibility Strategy focused on external communication of the project, and provided a basis for the project's internal communication strategy.

This year, APAARI also developed the branding document for the project, containing the general instructions on using the ASSET and donor logos, and various templates in line with the donor requirements.

In the coming months, APAARI will be organizing CoP networking events, engage in policy advocacy at regional and global levels, implement the communication and visibility strategy through the development of project newsletter, and coordinate the content for the project website. APAARI is also developing synergies with its other ongoing activities, planning to establish a working group on agroecology where issues, good practices and opportunities for strengthening partnerships, capacity and enabling environment for innovation will be discussed in line with APAARI's work under the TAP.



## APAARI interviewed renowned Botanist and BBC's Follow the Food presenter James Wong on food production and climate change

**With the global population expected to rise to 10 billion in the next 30 years, the UN predicts that food production will need to double by 2050. How can this be done in an environmentally sustainable way, given the threat that climate change poses to our land and to food production? How can we avoid a catastrophic food disaster that could leave millions starving?**



The issue was brought into sharp focus in 2020 when travel restrictions and the dearth of labour, caused by COVID-19, led to the shortage of some food stuffs across the world. Suddenly, we were all forced to sit up and take notice of where our food comes from and how it is produced. It was a timely warning of the dangers of the food insecurity crisis we are all threatened with. In a new eight-part multi-platform series called [Follow the Food](#), sponsored by Corteva Agriscience [BBC World News](#) explore the stories behind feeding the world's ever-growing population. Presented by British Botanist and science writer James Wong, the series examine how farming, science, AI technology and the consumer can overcome this profound challenge, and asks whether we can do so in a way that doesn't harm the planet.

The series were launched in January 2020 with a fascinating look at the way food production causes an acceleration in climate change and how sustainable production methods can reverse it. The programme takes a deep dive into the exciting and innovative ways that the global farming industry is adapting to combat climate change and I think there are some stories your audience would be really interested in – from seaweed farms emitting fewer greenhouse gases to precision agriculture enabling farmers to reduce their use of water, pesticides and chemicals in particular the use of silica nanoparticles.

James Wong shares his insights with APAARI on the importance of innovation in agriculture, and what this means for our diets in the future.

**What are global agencies, such as FAO, doing to boost the much-needed innovations in agriculture?**

From supporting the conservation and wider adoption of under-utilised crop species, to empowering women and their role in agriculture, the FAO are doing a huge range of really important work to help support these much-needed innovations.

### **What are the innovative approaches for attaining and sustaining food and nutrition security globally?**

James: In [Follow the Food](#), we explore a huge range of innovative approaches for attaining and sustaining food and nutrition security around the world – from diversifying our diets to vertical farming, revitalising degraded land to encouraging a new generation of farmers into the industry. For example, in episode four, which airs on BBC World News on 20 and 21 February, we look at how drip-irrigating rice in India slashes water consumption and methane emissions in one go. India is now one of the most water-stressed countries in the world, with almost 50 per cent of the country facing drought-like situations. Worse still, 70 per cent of India's aquifers are dry. But finding a solution is an entirely female-led pioneering system called Bhungroo. They use a pump-like technology, which injects rainwater underground during monsoons. This helps keep land from waterlogging and recharges the ground aquifers. The stored water can then be used in farming or for other purposes during the dry season.

### **How can smallholder farmers of Asia and Africa cope up with modern technological innovations, such as Precision Farming and Artificial intelligence?**

James: I think the most important thing to bear in mind is that game-changing technological innovations don't always have to be of huge scale or out of reach of small-scale farmers. In fact, many are surprisingly democratic and ingeniously straightforward. As a small example, when I went to Harpers Adams University to investigate cutting-edge, AI driven farming machinery, I was expecting to see something straight out of a science fiction film. However, what I saw was a 30-year old, small-scale tractor that was hitched up to an iPad with really straightforward pieces of hardware. Essentially, not that much different to an old school sat nav, but could radically transform farmers' lives. Something that genuinely astounded me.

However, to even access some straightforward tech, there have to be social and political changes that allow equal access to them. This is a theme we also address in episode three of [Follow the Food](#), looking at the empowerment of women coffee farmers in Kenya and a generation of new farmers from

immigrant backgrounds in the United States, for example.

### **How can agriculture be made more lucrative and glamorous to avoid migration of farmers to urban areas in the developing countries?**

James: [Follow the Food](#) has a whole episode dedicated to how we are going to grow the next generation of farmers, interviewing the likes of food systems pioneer, Kimbal Musk (Elon Musk's brother), to robotics students, who are revolutionising agricultural tech.

I think a central theme that kept coming up when making [Follow the Food](#) was the misconception that working in agriculture is a low skill, low paid profession, which can exclude many of our best and brightest minds from considering a career in the industry. The crossover between different professions – robotics, tech, ecology, marine biology – seem to be the segue route to encouraging a new generation of incredible talent into agriculture.

### **How can we sustain the increase in agricultural production by ensuring environmental protection?**

James: These are often seen as conflicting pursuits, but the whole history of agriculture has also been the history of intensification; giving us higher yield with fewer inputs. This, counter to popular belief, means that our per capita contribution to planetary impact is actually lower than at any other time in our past, there are just so many more of us.

According to the UN, food production will need to double by 2050, to feed our growing population, so there is a real and urgent need to further intensify agriculture but with even lower inputs of land, water, fuel and agrochemicals.

What I found really inspirational about the stories in [Follow the Food](#) are the ingenious and, sometimes incredibly simple, ways in which we are already able to do this, including by slashing food waste, which is one of the most overlooked issues that faces humanity.

### **Learning a lesson from COVID-19 pandemic, what needs to be done to avoid disruptions in any global supply chain of agricultural goods?**

James: I think one of the clearest things is the need for international co-operation – the need to streamline food distribution chains and build in resilience. If you look at the success stories

behind food chains that proved resilient during the pandemic, one of the things that is really clear is how a mixture of approaches to mitigate risk is essential.

When it comes to food, we can often have quite a polarised, almost tribal approach to a perceived 'ideal'. Either local, small-scale and short chains, or global, mass scale and complex are pitted against each other as mutually-exclusive solutions. However, in reality what we saw is that a mixture of both these approaches was essential.

### **How can we avoid key agricultural biosecurity threats? Should we not be proactive and take prophylactic measures than lamenting and taken curative measures?**

James: Over millennia of agricultural practice, we've selectively bred a relatively small handful of robust nutritious plants to crop. More than half the calories that all of human civilisation is based upon come from the seeds of just three grass species – wheat, rice and corn. Whilst modern agriculture has given us the most affordable and the most plentiful food supply in the history of our species, relying on that small selection of crops we've been cultivating is a perilous foundation for all of humankind.

In episode two of [Follow the Food](#), we look at this specific issue and investigate how it affects the fourth most important crop in the world – bananas. Kenya grows around 1.5 million tonnes of bananas annually, and it's a key local food source. But the Cavendish variety, which makes up almost half of all the bananas grown on the planet, is susceptible to Panama disease and is at imminent risk of extinction. We visit a research centre in Kenya, as they've been studying alternative banana varieties, in the hope they can be as popular as the Cavendish, but much more resilient to disease.

### **What should be done in terms of knowledge management to ensure that one and all in the civil society understands the importance of sustainable agricultural development?**

James: Oh that's a really good question! For me, that's one of the key reasons I worked on [Follow the Food](#). In a time where public opinion on subjects as crucial as food and farming are increasingly polarised and coloured by a wealth of disinformation, it is even more vital for people to have access to an information source that explores these issues in an objective, clear and impartial way. That is exactly what we set out to do in [Follow the Food](#) – report on a diverse range of options from around the world,

explaining these to an international audience, and inviting them to make up their own mind on these issues.

APAARI appreciates the time of James Wong to address these important questions and invites all APAARI Community to watch [Follow the Food](#) series to learn more about these topics highlighted in this article.

[Follow the Food](#) is airing at 0130 and 1530 GMT on Saturdays and 0930 and 2030 GMT on Sundays on BBC World News for eight weeks from 28 January 2021. Audiences can also visit [www.bbc.com/followthefood](http://www.bbc.com/followthefood) for special features, and @BBCFuture for the latest from the series.



## **APAARI's "blending" model of technical and functional capacities gets international visibility**

**Building on the Asia Pesticide Residue Mitigation Project (APRMP) funded by STDF/WTO, APAARI participated in virtual activities organized by regional agencies in Latin America and Africa. APAARI shared the experiences and lessons learned from the Asia project, to ensure that these feed into the new similar projects to be implemented in these two regions.**

First, a virtual Steering Committee for the Latin American Residue Mitigation through the Promotion of Biopesticides for Enhancement of Trade Opportunities was organized in April 2021. This was organized in the context of the project preparation grant that was received from STDF/WTO by the Instituto Interamericano de Cooperación para la Agricultura (IICA) based in Costa Rica. APAARI actively shared the lessons learned from the implementation of the Asia project, particularly in relation to the blending of functional and technical capacities of the project participants.

Similarly, APAARI has started partnership with the International Centre for Genetic Engineering and Biotechnology in South Africa (ICGEB), which has recently received funding from STDF/WTO for a three-year project entitled '*Enhancing Trade Through Regulatory Harmonisation and Biopesticide Based Residue Mitigation in the SADC Region*'. The goal of the project is to promote the registration and use of biopesticides, and hence reduced chemical pesticide residues in major export crops. APAARI participated in a number of the project meetings sharing its



'blending' experience and getting feedback from the project partners. APAARI will support ICGEB in integrating this important functional area in this highly technical project through a training of trainers and KM strategy development.



## NEWS FROM NATIONAL AGRICULTURAL RESEARCH SYSTEMS (NARS)

### Indian Council of Agricultural Research (ICAR)

#### A protocol for increasing the production of immune-boosting organic jaggery

**A study conducted by the Indian Institute of Farming Systems Research in Modipuram, Meerut, India, showed that improving jaggery production can significantly increase the income of small-holder farmers in Meerut, Uttar Pradesh. It shows improved methods for production of immune boosting jaggery and reducing its dependence on chemicals to produce higher income.**



*Demonstration on value addition in organic jaggery at Muzaffarnagar, UP*

Jaggery is a nutrient-heavy rich sweetener with high therapeutic value, and is obtained by concentrating sugarcane juices. Traditionally, jaggery has been used for improving digestion, preventing bronchial or lung infections, blood purification, as well as regular functioning of liver and kidney. India produces the largest supply of jaggery in the world (70 per cent), and is also the largest consumer of jaggery. Jaggery production mainly begins in November and continues until May, depending upon the availability of sugarcane, demand in the market and location.

In India, the majority of jaggery manufacturing is done on a small scale by a group of farmers or local contractors using daily paid unskilled labourers. In most cases, it is manufactured in very unhygienic open spaces conditions. At present, the demand for jaggery is only limited to health-conscious consumers though it is considered to be more healthy than refined sugar. Organic jaggery has high demand in both national and international markets. Hence, jaggery produced in India has substantial potential for export. However, most of the commercially-produced jaggery available in the market is not safe for consumption because of excessive use of harmful chemicals (e.g. sodium bicarbonate, sulphur dioxide, citric acid, and alum) that is used for clarifying sugarcane juices to get an attractive light or bright yellow colour. These conditions of production restrict India's chances of export, constraining profits and benefits for farmers.

In the face of the current pandemic, health practitioners all over the world advocate for a regular consumption of different herbs and spices to improve people's immune system, which may also help in faster recovery of COVID-19. As such, research work was planned to identify and develop a suitable protocol for production of immune-boosting organic jaggery during January to April 2021. In this research programme, organically-grown sugar cane (CoS 8272) was harvested from the ICAR-IIFSR farm in Modipuram, Meerut. Different herbs and spices rich in phytochemical and antioxidant were also considered for this study, including black pepper (B), dried ginger (G), cinnamon (C), mulethi (M), safed musli (S) and tulsi oil (T), which were bought by local suppliers.

In each experiment, 1.5-2 liters of filtered sugarcane juices and clarifying agent suklaï @ 1% were used. Different treatments and their combinations were considered for evaluation of quality of organic value added jaggery with different spices and medicinal herbs. These were: T1 (B, 0.1% + G, 0.2% + C, 1.0%), T2 (M, 1% + S, 0.1% + T, 0.1%), T3 (T1 + M, 1%), T4 (T1 + S, 0.1%), T5 (T1 + T, 1%), T6 (T2 + B, 0.1%), T7 (T2 + G, 0.2%) and T8 (T2 + C, 1.0%). Each treatment was replicated thrice and got organic immune boosting jaggery blocks. These products were evaluated for organoleptic score using nine points hedonic scale with different stakeholders, including farmers, jaggery entrepreneurs and some staff of ICAR-IIFSR, Modipuram, Meerut.

Among different treatments, the maximum overall organoleptic score (7.9) was recorded for sugarcane

juice treated with T8 (T2+C,1.0%) followed by T4 (T1+S, 0.1%). However, the minimum overall organoleptic score (6.2) was recorded for sugarcane juice treated with T1 (B, 0.1% + G, 0.2% + C,1.0%). The process protocol for production of optimized produce was also shown in the organic sugarcane farmers' field and Jaggery units in the villages of Muzaffarnagar districts of Uttar Pradesh during April 2021. Farmers reported that with such value addition in jaggery, they could sell their produce at INR 100.00/kg (USD 1.32) and more instead of regular selling price of Rs.35-Rs.40.00/kg (USD 0.46-0.53) in the local markets.

Most jaggery manufacturers are small and marginal sugarcane growers, who mainly depend on rapid returns from their jaggery business. Hence, it is essential to protect the sugarcane farmers to earn more from their jaggery manufacturing unit by quality improvement through value addition. Production of immune-boosting jaggery using spices and herbs could be an alternative to enhance their income and entrepreneurship.



**A. Nath\*, D. Kumar, L.R. Meena, R.P. Mishra and A.S. Panwar, ICAR-Indian Institute of Farming Systems Research; [amitnath2005@gmail.com](mailto:amitnath2005@gmail.com)**

## **Vietnam Academy of Agricultural Sciences (VAAS), Ministry of Agriculture and Rural Development (MARD)**

### **Evaluating the results of the BreedCafs project and discussing the plan to develop production of Coffee arabica in the Northwest of Vietnam**

**BREEDCAFS is a project funded by the European Union (EU) and supported by CIRAD and implemented with the Northern Mountainous Agriculture and Forestry Science Institute (NOMAFSI). It aims at developing local conditions and resilience for cultivating imported coffee beans to support coffee production in Northwest Vietnam. The project that began in July 2017 and will end in October 2021 presented promising outcomes of its recent evaluation to its stakeholders.**

NOMAFSI and CIRAD co-organized a workshop on 20 April 2021 on 'Evaluating the results of the BREEDCAFS project: Evaluation and selection of coffee varieties for combined agroforestry systems for developing *coffea arabica* production in the Northwest of Vietnam'. The goal was to evaluate the

results of adaptation of imported *coffea arabica* hybrid varieties to the local ecological conditions, and to propose a plan for developing coffee production in the region.



*Participants of the workshop*

The workshop's participants were from institutions involved in implementing the BREEDCAFS project, including Vietnam Academy of Agricultural Sciences (VAAS), NOMAFSI, Agricultural Genetics Institute (AGI), EC, and local partners, such as the Department of Science and Technology of Son La province, Department of Agriculture and Rural Development of Son La and Dien Bien provinces, the People's Committees of the project's districts, local coffee processing companies (Cat Que, Minh Tien, Phuc Sinh, Detech), Son La Coffee Association, as well as some coffee cooperatives and households participating in the project's experiments.

The participation of twelve households in two provinces (seven in Son La and five in Dien Bien) helped the project conduct trials of varieties of coffee, such as Sarchimor Marsellesa, F1 hybrid Starmaya, F1 hybrid Centroamericano (H1) and Catimor variety (local variety - control) at different altitudes ranging from 600 m - 1100 m, and in a random agroforestry system, in a total area of 3 hectares.

### **Outcomes of the field trials**

The test trials started in July 2018 and produced the first harvest by 2020. Data on growth, pests and diseases were collected regularly during two years (2019 and 2020), along with yield data of the first harvest in 2020. Initial evaluation showed that Marsellesa and F1 hybrids have better growth, higher yield, and higher physical and mechanical quality and taste parameters than the controlled Catimor variety. Specifically, Marsellesa and F1 hybrids have higher plant height, larger stem diameter, 20-30 per



cent higher yields than the controlled; higher ratio of bean/fresh fruit, larger bean size, lower ration of poor-quality beans (50 per cent lower compared with the controlled). Their total tests score and the score of ingredient indicators projected higher than the controlled variety, and all belonged to the group of special quality.

### Next steps for the development of new coffee varieties

The workshop discussed the orientation for the development of these potential new coffee varieties in the Northwest region of Vietnam. Leaders of the two provinces have demonstrated their commitment to develop this specialized high-quality coffee. Specifically, Son La plans to plant 8,000 hectares of land, of which 500 hectares are for the new coffee varieties. Dien Bien plans to replant 300 ha of the new coffee varieties. The EU committed to support the maintenance of test trials and breeding for the replication of new hybrid coffee breeding models, and processing certificate of the national new variety to expand production.

The workshop ended with the commitment of local authorities, businesses and cooperatives involved in the coffee supply chain to develop Marsellesa coffee varieties and test F1 hybrids in the Northwest sector of Vietnam.



Source: Tuyet Nguyen Thi, VAAS, [tuyetvasi@gmail.com](mailto:tuyetvasi@gmail.com)

## Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD)



French Ambassador in Vietnam and partners of BreedCap project visited the field of *C. arabica* F1 hybrids tested in Dien Bien

## Supporting initiatives through science and technology in the Agri-Aqua sector in the Philippines to build endurance during the pandemic

The Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development of the Department of Science and Technology (DOST-PCAARRD) supports Science & Tech (S&T) initiatives in agriculture, aquatic, and natural resources (AANR) sector to help communities meet challenges and recognize opportunities during COVID-19.

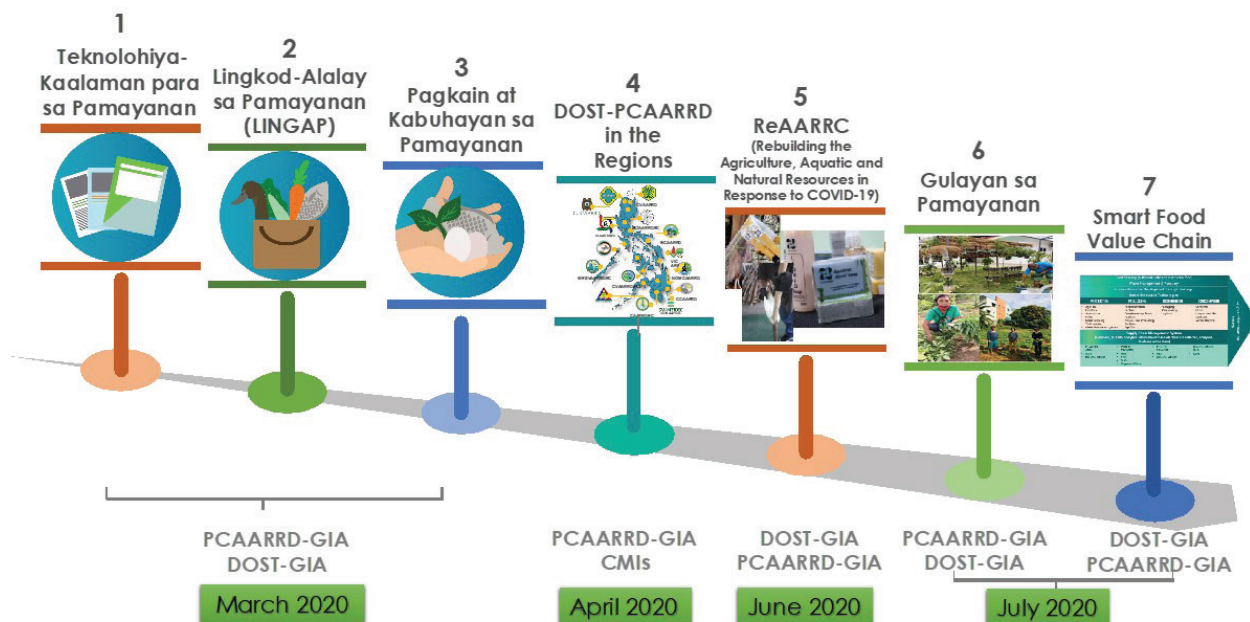
DOST-PCAARRD endures to provide support to S&T-based research and development in the AANR sector despite the COVID-19 pandemic. It focuses on formulating policies, plans, and programmes for S&T based applications in agriculture. Since March 2020, the initial three component projects of the Good Agri-Aqua Livelihood Initiatives towards National Goals (GALING)-PCAARRD Kontra COVID-19 programme were implemented.

The GALING-PCAARRD Kontra COVID-19 programme is under the umbrella of Bayanihan to Heal as One Act. DOST-PCAARRD through this programme opened up facilities, devised new strategies, and ramped-up its traditional and social media initiatives and efforts.

The Council and its partners have carried out 64 projects and 12 activities and initiatives with a total investment of ₱174 million (USD 3.5 million) in collaboration with over 48 partner institutions. Two of the 64 projects being implemented under GALING-PCAARRD Kontra COVID-19 program are on vegetable and tilapia farming, which are expected to help communities in Ilocos and Isabela in Luzon and the province of Leyte in Visayas. The two projects are being implemented under Component 2: "Pagkain at







The components of the Good Agri-Aqua Livelihood Initiatives towards National Goals (GALING)-PCAARRD Kontra COVID-19 Program (Source: GALING-PCAARRD Secretariat)

Kabuhayan sa Pamayanan” or Food and Livelihood for the Community.

The vegetable production projects, “Intensifying Vegetable Production to Mitigate Crisis Brought about by COVID-19” and “S&T-based Home Gardening Towards a Sustainable Source of Food for Families” are being implemented by the Visayas State University (VSU) and Isabela State University (ISU), respectively.

According to Dr. Edna A. Anit, Director of the Crops Research Division of DOST-PCAARRD, these short-duration livelihood projects were funded by the Council to address the immediate challenges on food security and livelihood brought about by the COVID-19 pandemic.

Among the target outputs of the project in Isabela, 60 community gardens and at least 500 people on vegetable production, gardening, and food processing received training. Meanwhile, the project in Leyte targets to curb the adverse impact of the pandemic on food supply by planting assorted vegetables and other short-term crops. This will also address the requirement for fresh and healthy vegetables of communities and selected institutions in Leyte.

Ilocos communities will benefit from the project, “Tilapia para sa pamayanan sa Amianan” or Tilapia for Communities in the Northern part of Luzon. This project is an offshoot of the “Tilapia para sa pamayanan” or Tilapia for Communities implemented in the provinces of Laguna and Batangas. The

project aims at providing more family-beneficiaries with immediate fish supply and additional income, especially during this time of pandemic.

While conducting the above projects, non-degree trainings in the National Agriculture, Aquatic and Natural Resources Research and Development Network (NAARRDN) continued despite the pandemic. This is being done through the DOST-PCAARRD’s Learning Management System (LMS), an online platform that merges the Council’s rich collection of training materials, which participants can learn from at their own pace.

The online training platform, available at <http://lms.pcaarrd.dost.gov.ph/training/moodle/>, offers trainings grouped into Agricultural Resources Management, Crops, Environmental Services, Forestry and Environment, Inland Aquatic Resources, Livestock, Marine Resources, Socio Economics, Technology Transfer, and other Cross cutting training areas. DOST-PCAARRD has also been using its Facebook page to communicate the results of its R&D initiatives online through webinars, live events, and social media posts.

Aside from these, the Council transformed its traditional library to a digital library, which can be accessed at <https://elibrary.pcaarrd.dost.gov.ph/slims/>. The online library was developed to efficiently and promptly disseminate and share AANR and other science and technology (S&T) information 24/7 to various networks, including the grassroots community of the society.

The DOST-PCAARRD e-Library is recognized as one of the KM tools to capture, share, and apply generated knowledge products and resources. With information on the AANR sector vital to the agenda of poverty alleviation, DOST-PCAARRD, through the help of the Science and Technology Information Institute of DOST, has developed a library management system designed to facilitate efficient and prompt dissemination, sharing, exchange, preservation, access, and retrieval of its resources.

The DOST-PCAARRD knowledge network of e-Libraries has been established through customization and deployment of the Science Library Integrated Management System (SLIMS) to the Council's R&D consortia for effective management and content development of the e-Library.



Source: Ms. Rose Anne M. Aya, DOST-PCAARRD S&T Media Services, [r.aya@pcaarrd.dost.gov.ph](mailto:r.aya@pcaarrd.dost.gov.ph)

## NEWS FROM THE HIGHER EDUCATION

### Anand Agricultural University

#### The University launches new dairy products based on its moringa research

On 9 March 2021, the SMC College of Dairy Science, AAU Anand launched two new dairy products - Moringa Buttermilk and Greek Yogurt in presence of honourable Dr. K.B. Kathiria, Vice Chancellor, AAU and other distinguished university officers.



Dignitaries launching the new products

The dairy products emerged from the research findings by the faculties of dairy science, Anand. The Buttermilk (*Chhash*) includes moringa leaf powder, which is highly nutritious. Moringa leaf powder contains appreciably higher vitamin A (25 x higher than in carrot), calcium (15 x higher than in milk), potassium (15 x higher than in banana), as well as

iron. One serving size of the moringa *Chhash* will furnish about 10, 10, 18 and 11 per cent of the recommended daily intake of vitamin A, vitamin C, calcium and iron respectively.

The Greek Yogurt contains beneficial lactic acid bacteria, flavoured with unique pickle flavor and contains about 8.0 per cent fat, 6.0 per cent protein, 21.5 per cent total solids and 171 mg calcium/100 g of product. The shelf life of such a product is claimed to be 15 days under refrigerated condition. The Director of Research and Hon. Vice Chancellor appreciated and congratulated the entire team of scientist led by Dr. S. V. Pinto for developing such nutritive and tasty dairy products.

Source: Dr. H. B. Patel, Director, Extension Education, Anand Agricultural University, [dee@aaau.in](mailto:dee@aaau.in)



### Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

#### WhatsApp support group for dairy farmers during COVID-19 pandemic

The significance of any-time-messaging and its merit in extending scientific knowledge to the rural communities in India through WhatsApp played a key role during the pandemic. It kept small-scale dairy farmers in Jammu informed on techniques and new approaches to increase yield during the outbreak of COVID-19.

A WhatsApp group created during the second wave of COVID-19 ensured need-based access to scientific information for dairy farmers in Jammu district of Jammu and Kashmir (J&K). Traditional extension methods, especially with lack of face-to-face communication during the pandemic have many limitations. This includes lack of interaction, access to timely information, and unavailability of need-based information, which were felt by the farmers. The lack of knowledge regarding scientific practices was a major constraint to improving the productivity of farm animals during the pandemic.

The National Sample Survey Organization (2005) survey reported that 60 per cent of the farmers do not have access to any source of information regarding scientific agricultural technologies. As a result, there was a wide gap in the farming community in achieving higher yields in production through optimum resource utilization.

The WhatsApp group established by Sher-e-Kashmir University helped overcome these constraints during the COVID outbreak, limiting movement and increasing access to livestock-related information for farmers and rural advisors. WhatsApp is an easy and convenient way of communicating with the farmers. The current forms of extension education methods (e.g. face-to-face) require a substantial amount of time and complexity of efforts to communicate with farmers. Mass media methods demand high infrastructure requirements, content preparation, refinement and delivery to produce the desired effect. Similarly, modern ICT-based advisory services require greater infrastructural availability by providers and users.

As such, WhatsApp seems to be a relatively easier and simpler ICT tool for farmers, which does not require many skills. It offers a communication approach that can be quite flexible and interactive. The introduced WhatsApp tool is also more participatory and demand-driven extension tool, offering opportunities for farmers to ask and respond to questions and comments. Farmers are encouraged to provide feedback and interact with other farmers through peer learning. Many times, fellow farmers answer the queries of other farmers, which shows potential to build networking and trust among each other.

The new WhatsApp group brought together researchers, extension agents, veterinarians, progressive farmers, sellers and buyers in a virtual space. It enabled local farmers to benefit from information on important milch breeds of dairy cattle and buffaloes adaptable in local conditions; standards of organic dairy farming; importance and need of organic farming for sustainable development; pioneers of organic movement in India and worldwide; as well as housing, feeding, health management and breeding aspects of dairy animals. Information was provided as text, videos, and graphics in both Hindi and English. Farmers' queries were resolved through expert suggestions and other farmers, clarifying their doubts on livestock diseases and symptoms.

**Source:** *Dr Pranav Kumar, SKUAST-Jammu, [vet\\_pranav1604@yahoo.co.in](mailto:vet_pranav1604@yahoo.co.in); [vet\\_pranav@rediffmail.com](mailto:vet_pranav@rediffmail.com),*



## Tamil Nadu Agricultural University

### Nanotechnology Center in TNAU

**The Tamil Nadu Agricultural University, India, is one of the early birds in introducing nanotechnology in agriculture as early as 2010. With the initial investment from ICAR, TNAU bought state-of-the-art infrastructure, sophisticated equipments and attracted trained human resources from advanced laboratories in USA, Canada and Europe with further investment. The Center is proud to share its achievements to date.**

Since its establishment in 2009, the Nanotechnology Center has generated research grants worth more than INR 30 Crores (USD 300 million), developed seven technologies for commercialization, filled two patents, introduced and facilitated over 60 Masters and Ph. D programmes in nano S&T, and published over 100 related articles in respectable journals.

Furthermore, the Center has now become a referral lab for nanotechnology at the country level, undertaking scientific validation of nano-fertilizers developed by the Indian Farmers Fertiliser Cooperative Limited (IFFCO) – the world's leading fertiliser manufacturing and marketing cooperative.

The Center is also assisting Fertilizer Control Order (promulgated under Section 3 of Essential Commodities Act, 1955 to ensure adequate availability of right quality fertilizers at right time and price to Indian farmers), in testing nano-products for biosafety. Furthermore, it is developing "Regulatory Guidelines for Evaluation of Nano-Agri Inputs and Food Products in India". In October 2020, TNAU shared its Center's achievements in the Prime Minister's global platform for resident and overseas Indian researchers and scientists called 'Vaishwik Bharatiya Vaigyanik (VAIBHAV) Summit'.

The Center has developed nano-agri inputs, such as nano-seed science, nano-fertilizers, nano-herbicides, hydrogels for moisture conservation, encapsulation of bio-inoculants, nano-food preservatives (e.g. nano-emulsion for fruit preservation, smart-packaging viz., electro spun-fibre matrix and cyclodextrin inclusion complex for extending shelf-life of fruits, nano-packaging from nano-fibrillated cellulose and encapsulation of functional foods), as well as nano-sanitizer.

**Source:** *Dr. K.S. Subramanian, Director of Research, TNAU, Coimbatore, [kss@tnau.ac.in](mailto:kss@tnau.ac.in)*





## NEWS FROM INTERNATIONAL AGRICULTURAL RESEARCH CENTRES

### International Maize and Wheat Improvement Center (CIMMYT)

#### 'AAA' drought-tolerant maize now available in Myanmar

**An "Affordable, Accessible, Asian" drought-tolerant hybrid maize variety developed by the International Maize and Wheat Improvement Center (CIMMYT) and its partner Syngenta—and first released in India—will become the first hybrid available to smallholders in Myanmar's Central Dry Zones.**

This time, smallholder farmers in Myanmar's Central Dry Zones will have access to drought-tolerant hybrid maize for the first time. The variety, known as TA5085, was jointly developed by CIMMYT and Syngenta, and has been commercially registered as ASC 108 by Ayeryarwady Seed in Myanmar. An initial, two-acre seed production pilot by Ayeyarwady Seed resulted in a yield of 1.2 tons/acre.

TA5085 was developed as an International Public Good as part of the decade-long Affordable, Accessible, Asian ("AAA") Drought-Tolerant Maize project, a public-private partnership between CIMMYT and Syngenta, and funded by the Syngenta Foundation. The project aims to make tropical maize hybrids accessible to Asian smallholders, especially those producing under rain-fed conditions in drought-prone areas.

"AAA maize is not just a product," said B.S. Vivek, Regional Maize Breeding Coordinator and Principal Scientist at CIMMYT. "The development of affordable and accessible drought-tolerant maize hybrids helps drive the maize seed market in underserved maize markets in Asia," he pointed out.

TA5084 was first commercialized in central India, where climate change is driving rising temperatures and increasingly erratic rainfall. From 2018 to 2020, TA5084 adoption in the region grew from 900 to 8,000 farmers. In 2020, 120 metric tons of AAA-maize were planted on 6,000 hectares in central India. Farmers, who switched to TA5084 earned an average of USD100/ha more than those using conventional maize.

"Despite the unprecedented challenges we all faced in 2020, "AAA" hybrid maize sales more than doubled

from the previous year, to 120 tons," said Herve Thieblemont, Head of Seeds2B Asia and Mekong Director at the Syngenta Foundation. "I'm delighted to report that the second country to introduce "AAA" maize is Myanmar. Our local seed partner Ayeyarwady Seed recently completed the registration and will proceed with the first sales this coming season."

The AAA initiative is one of the few examples of a public-private partnership delivering international public goods benefitting smallholders in central India and now Myanmar. The chosen regions are rain-fed and drought prone. Seed marketing in these regions is risky and unpredictable, dis-incentivizing multinationals and large seed companies from entering the market.

**B.S. Vivek and B.M. Prasanna, CIMMYT, [b.vivek@cgiar.org](mailto:b.vivek@cgiar.org); [b.m.prasanna@cgiar.org](mailto:b.m.prasanna@cgiar.org)**



### International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

#### What genomics powered crop improvement looks like when seen through the breeder's equation

**The current rate of genetic gain – incremental improvement in a trait targeted by a breeding programme in every generation – in many crops is insufficiently high to meet the food and nutrition demands of a growing population. Urgent interventions are needed to increase the rate of genetic gains in crop breeding programmes and speed up the delivery of climate-resilient and high-nutrition cultivars to ensure sustainable agriculture and food security. An international partnership addressed this issue through joint research.**

Scientists from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Rice Research Institute (IRRI), ICAR's Indian Institute of Pulses Research, Leibniz Institute of Plant Genetics and Crops Plant Research, and Murdoch University, have proposed integration of genomics and breeding innovations. This is best shown through the classic breeder's equation (a foundational application of quantitative genetics for crop improvement, Fig. 1), in a recently published paper in *Theoretical and Applied Genetics*.

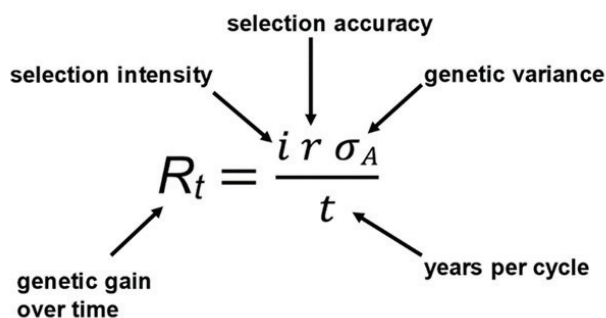


Fig. 1: Breeders equation for estimating genetic gain in crop improvement programme

The team led by Prof. Rajeev K. Varshney of ICRIASAT has suggested using modern genomics and associated breeding approaches to influence the core components of the equation, i.e., genetic variance, selection intensity, heritability and the breeding cycle time for accelerating genetic gains in crop-improvement programmes.

### Genetic variance

Genetic variance is the first component of the equation. It can be enhanced by identifying, creating and utilizing favourable alleles/haplotypes for traits of the interest (Fig. 2). In this direction, large scale germplasm characterization can be undertaken at genome level by sequencing or genotyping, and through modern high-throughput phenotyping in fields at multiple locations.

The data generated can be used for genome-wide association study (GWAS) for identification of genetic loci and haplotypes for target traits. Furthermore, a range of genetic populations, including multi-parent advanced generation intercross (MAGIC) and nested association mapping (NAM) populations, can be used with next-generation sequencing (NGS)-based trait mapping approaches for identification of candidate genes.

Going ahead, systems biology approaches can also be used for identification of 'causal' candidate genes for target traits. If genetic variation is not available in germplasm collections and breeding population, this can be created by using genome editing and by targeting induced local lesions in genomes (TILLING).

Finally, genomic breeding approaches including marker-assisted backcrossing (MABC), marker-assisted recurrent selection (MARS), haplotype-based breeding (HBB), forward breeding (FB) and genomic selection (GS) can be deployed for introgression of superior haplotypes (useful genetic variation) in crop-improvement programmes.

### Selection intensity

The second variable in the equation, selection intensity, depends on various parameters, including population size, selection ratio, selection targets, selection criteria, method of selection and traits prioritization into must-haves and value-added. Selection intensity can be improved by testing a

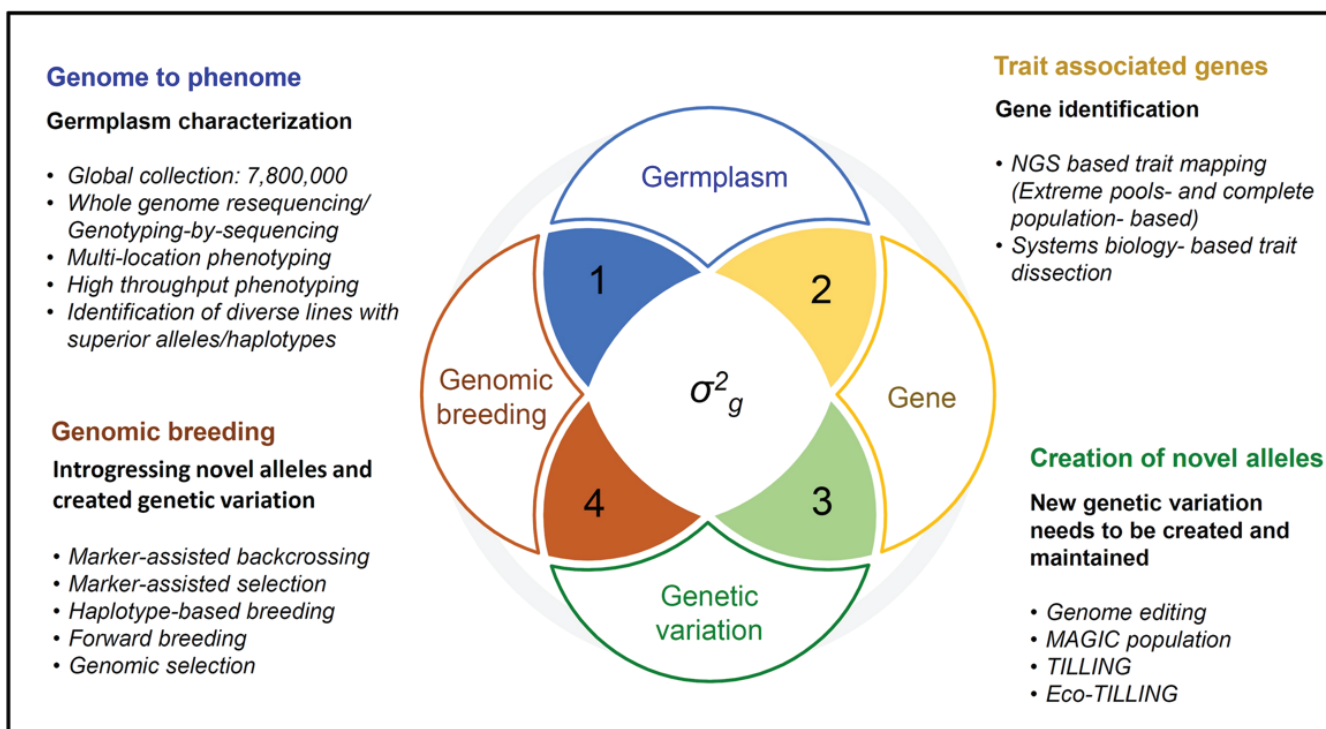


Fig. 2: Enhancing genetic variation through identifying/ creating and utilizing favorable alleles/haplotypes

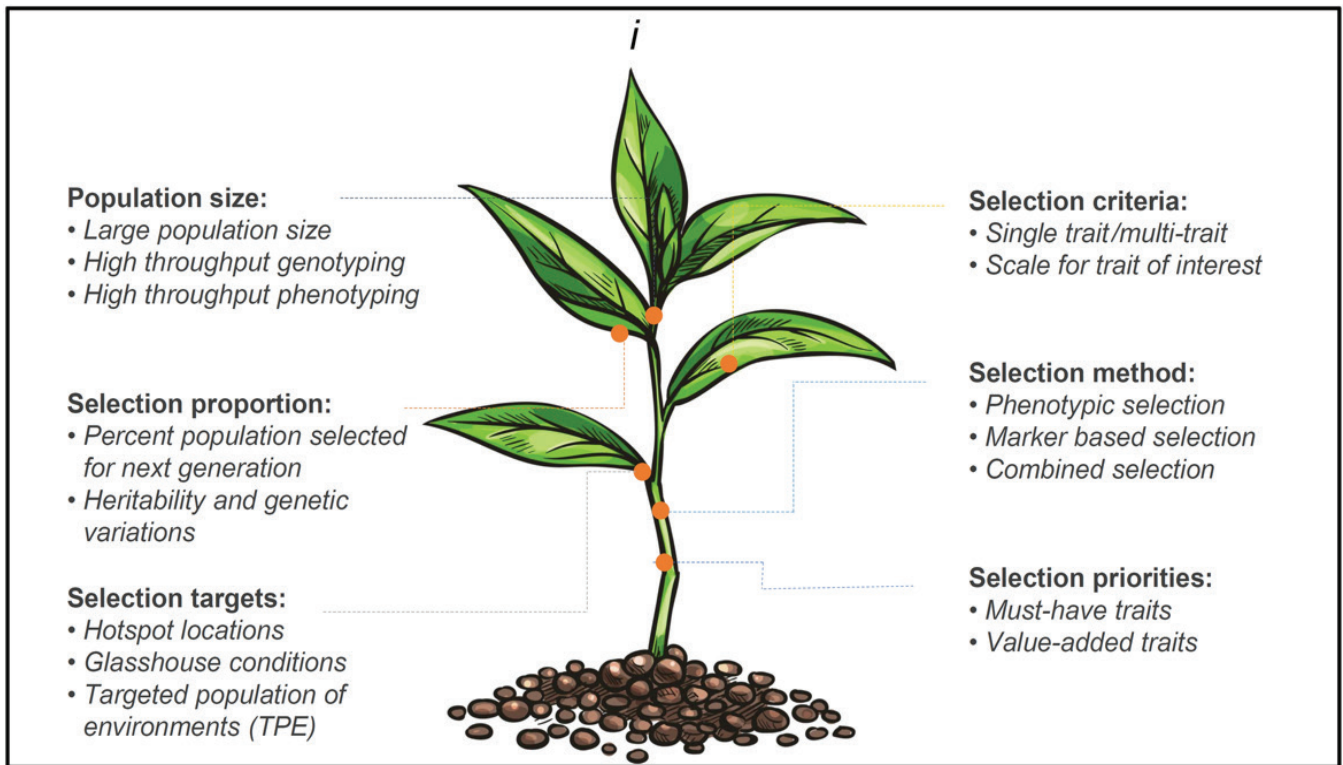


Fig. 3: Enhancing selection intensity (*i*) through tweaking various parameters

large population enabled by statistical designs with minimal replications and high-throughput phenotyping (Fig. 3). Selection priorities and criteria for selecting an appropriate portion of a population assumes an important role.

### Heritability

Heritability is the most important component of the breeder's equation. Heritability estimates depend on several factors, including the size and type of population and the statistical methods deployed. Precision phenotyping and minimizing experimental errors through efficient statistical design of trials and

thorough statistical analysis of the datasets is key to enhancing trait heritability (Fig. 4).

### Breeding cycle time

Lastly, the breeding cycle time as denominator in the breeder's equation can be reduced by harvesting more generations per year against the usual one or two generations per year, and making selection on a single plant basis, using visual selection or molecular markers. Speed breeding/rapid generation advancement (RGA) approaches can help advance generations in fields or under controlled conditions (Fig 5).

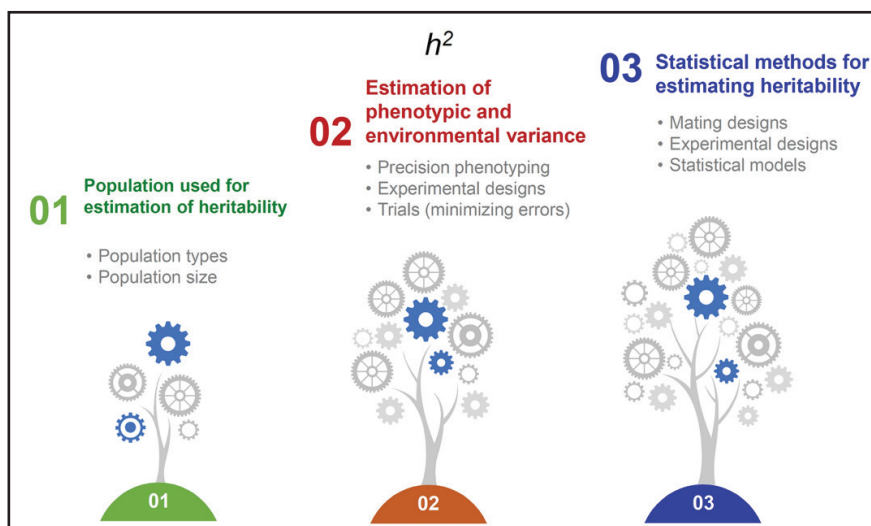


Fig. 4: Enhancing trait heritability



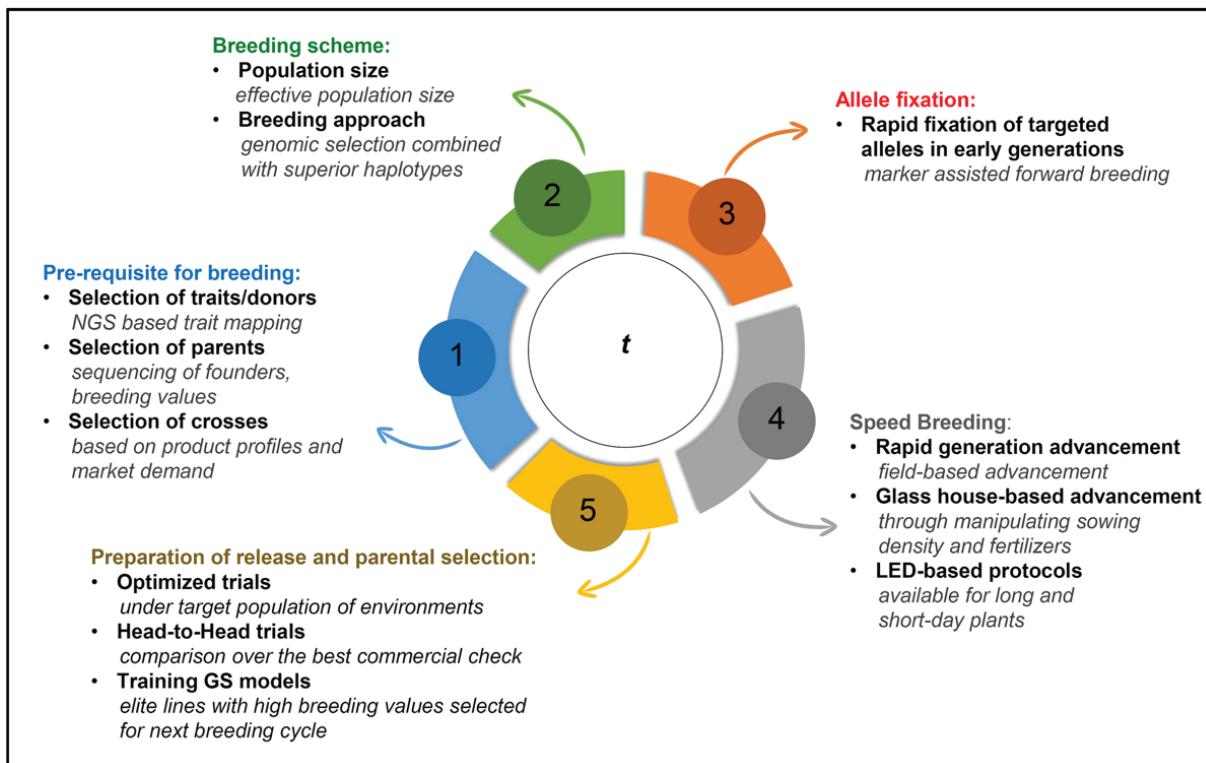


Fig. 5: Accelerating the breeding cycle time (t)

In summary, to enhance the genetic gain and speed up the development of climate-resilient and high-nutrition crops, there is a need to integrate breeding innovations with latest genomics tools and approaches at each stage of the breeding cycle to realize higher genetic gains in smallholder farmers' fields across the developing world.

**Source: Prof Rajeev K Varshney, Research Program Director- Genetic Gains, ICRISAT [r.k.varshney@cgiar.org](mailto:r.k.varshney@cgiar.org)**



## NEW MEMBER – PROFILE



**CIRAD – the French Agricultural Research and Cooperation Organization is working for sustainable development and is present in Asia and the Pacific. In the region, it has two regional offices and around 40 expatriate researchers. It works with its partners to build knowledge and solutions as part of resilient farming systems, for a more sustainable, inclusive world.**

CIRAD mobilizes science, innovation and training

to contribute to the SDGs. Its expertise supports the entire range of stakeholders, from producers to policymakers, to foster biodiversity protection, agroecological transitions, sustainable food systems, health (of plants, animals and ecosystems – One Health), as well as sustainable development of rural territories and their resilience to climate change.

In Asia-Pacific, demographic pressure in an area with sustained economic growth, the issues relating to food security and food quality, natural resource management (especially water and soils), and the environmental impact of climate change are a key challenge. In this context, CIRAD addresses research questions rooted in societal issues, such as urban food and urbanization; biodiversity conservation; traceability and sustainability within tropical commodity chains; monitoring of cross-border trade; and others.

In the region, CIRAD is working with its partners, i.e. research organizations, universities and departments of agriculture, to better understand the main issues around climate change mitigation, biodiversity protection and improved health, to better support the drafting of national and regional public policy.

### Southeast Asia

CIRAD's Regional Office for continental Southeast Asia covers the Greater Mekong subregion, with 30

researchers. In Southeast Asia, CIRAD operations are structured around two regional offices. Its research centres on natural resource management, biodiversity and the sustainability of tree crop-based systems, paying particular attention to the region's agro-ecosystems, which are sensitive to climate change. CIRAD has four partnership platforms in this sub-region, namely: Agroecology for Southeast Asia–ASEA; Emerging diseases in Southeast Asia–GREASE (see below); Rubber production in Southeast Asia–HRPP; and Sustainable food systems for cities in Asia–MALICA.

### The Pacific

In the Pacific, CIRAD has four staff members accredited to supervise research. Three are in New Caledonia and one in Vanuatu. CIRAD also maintains scientific partnership relations with other countries in the Pacific region, regularly committing resources through remote support or local missions.

The following are CIRAD's key initiatives in the region:

#### ***The TRAILS project: Limiting tropical deforestation caused by tree crop planting in Southeast Asia***

The TRAILS research project launched recently in Malaysia aims to provide innovative solutions to limit tropical deforestation caused by tree crop planting in Southeast Asia. The TRAILS project is built on a complementary partnership involving academics, NGOs, and private and public players, enabling an approach that encompasses a range of scientific fields, from agronomy and forestry to veterinary science. It also includes detailed socio-economic studies of local people's livelihoods (smallholders, forest rangers and plantation workers). The aim is to characterize various types of agroforestry with different densities and variable plantation: forest ratios in Malaysia.

#### ***The "GREASE" platform in partnership for research and training***

Southeast Asia is a hotspot in terms of disease emergence, because of several converging factors: climate change, deforestation, urban growth, and changing production conditions and market chains. The GREASE network promotes a "One Health" approach, considering the interdependence of social and epidemiological dynamics, biodiversity and health, as well as veterinary and human public health in order to prevent and control these diseases.

#### ***Membership of the Consortium for Research, Higher Education and Innovation in New Caledonia (CRESICA)***

In New Caledonia, CIRAD is a member of CRESICA – the Consortium for Research, Higher Education and Innovation ([www.cresica.nc](http://www.cresica.nc)). The consortium's prime aim is to boost collaboration between higher education and research institutions in New Caledonia to promote interdisciplinary research, and to mobilize all available skills and expertise to generate knowledge.



### NEW APPOINTMENTS

#### **Dr. K. B. Kathiria presides as the Fourth Regular Vice-Chancellor of AAU, Anand, India**



In March 2021, Dr. K. B. Kathiria was appointed as the fourth regular Vice-Chancellor of Anand Agricultural University (AAU) by the Government of Gujarat. Dr. Kathiria earned his Bachelor's degree of B. Sc. (Agri.) from the Gujarat Agricultural University; Masters from the University of Udaipur, and PhD. from the Rajasthan Agricultural University, with specialization in Plant Breeding and Genetics. Dr. Kathiria held various positions in education and research with over 37 years of experience in higher education. He has developed over 35 agro-technological applications for the farming and scientific community; developed or contributed to 39 varieties/hybrids of crops, including popular Gujarat Wheat 496 (GW 496) and Gujarat Anand Okra-5 varieties. In research, he has received nine different awards/rewards, including the prestigious "Sardar Patel Research Award" of the Government of Gujarat for his contribution to the development of important varieties of vegetable crops. He has guided 14 Ph.D. and 18 Master degree students in the subject of Plant breeding and Genetics.

Under his tenure, AAU has signed over 50 national and international level MoUs, which have strengthened the academic pursuit of the university. Dr. Kathiria's efforts also include distant hybridization in field and fruit crops using the wild plant

genetic resources for disease and pest resistance; involvement in multi-institutional networking project on tissue culture; establishment of laboratories/units and implementation of various research projects; strengthening postgraduate education and research through various reforms; as well as publishing over 120 research papers in reputable international and national journals, 36 books/book chapters and over 100 popular articles.

**Dato' Dr. Mohamad Zabawi Bin Abdul Ghani, Director General, Malaysian Agricultural Research and Development Institute (MARDI), Malaysia**



Recently, Dato' Dr Mohamad Zabawi was appointed as MARDI's Director General. Previously, he worked as Director, Agrobiodiversity and Environment Research Center, and has been associated with MARDI since 1988. His expertise includes soil science (soil conservation), agroecological zonation, climate change, green technology and water stress physiology. Dato' Dr Mohamad Zabawi got his PhD in Water Stress Physiology and MSc in Tropical Agriculture from the Reading University, UK, and his BSc in Agriculture Science (Soil Physic and Conservation) from Universiti Putra Malaysia.

Dato' Dr Mohamad Zabawi is the chairperson of the vulnerability and adaptation of agriculture to climate change for the Third National Communication. He is also a member of Academy of Sciences Malaysia Water and Climate Change Task Force; Research and Innovation in Green Technology and Climate Change; and Adaptation in Green Technology and Climate Change. Furthermore, he is a technical committee member of Economics of Climate Change Study for Malaysia, and panel of the National Competensi Standard in Green Technology. Dato' Dr Mohamad Zabawi has presented many technical papers on climate change (vulnerability and adaptation), green technology and biomass energy in local and international seminars, conferences and forums. His publications focusing on environmental issues

and crop performance were published in local and international journals.

**Mr. Koyama Osamu, President, Japan International Research Center for Agricultural Sciences (JIRCAS)**



In April 2021, Mr. KOYAMA Osamu (the former Vice President) was appointed as JIRCAS' new President. Mr. KOYAMA started his career at the Ministry of Agriculture Forestry and Fisheries of Japan in 1979. Consequently, he served FAO from 1986 to 1993, and engaged in econometric analyses of global food situation. He joined JIRCAS in 1993 when it was established with the reorganization of its predecessor, the Tropical Agriculture Research Center (TARC), to broaden its research mandates that included new target areas and academic fields. Mr. KOYAMA developed the research strategies of JIRCAS from 2002 amid the increasing trend of the globalization with the rapid evolution of the food and environmental challenges, until he assumed his position as Vice President in 2015. With over 27-year experience at JIRCAS, Mr. KOYAMA is geared to leading the institution's efforts to implement R&D to contribute to the advancement of sustainable agriculture, forestry and fisheries along with the JIRCAS' slogan "For the future of the earth and food".

**Dr. Jean Balié, Director General, International Rice Research Institute (IRRI)**



Dr. Balié, a French national, is currently the Director



General of the International Rice Research Institute (IRRI) since February 2021. Previously, he served as Research Director – External Engagement, and Deputy Director General for Research. He started working in IRRI in May 2018, as Head of the Agri-Food Policy Platform. He has over two decades of experience in leadership and policy development for agriculture, food, and rural development. As Director General of IRRI, Dr. Balié sets the global strategic direction of the institute and manages its affairs under the policies and decisions of the IRRI Board of Trustees.

Prior to IRRI, Dr. Balié worked in FAO, beginning as an Agricultural Economist - Policy Officer in 2001, then as Economist - Program Coordinator in 2006, and finally as Senior Economist, Program Manager from 2010 to 2018. He earned his PhD. in Agricultural Economics at the University of Göttingen in Germany, and has Master's degrees from Montpellier SupAgro, École Nationale Supérieure Agronomique de Toulouse (ENSAT), and the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM).

## NEW APAARI STAFF APPOINTMENTS

### Dr. Sasireka Rajendran, Project Manager



Dr. Sasireka Rajendran, who previously held a part-time position with APAARI while completing her PhD, started a full-time position as a Project Manager of the ASSET project from 1 July 2021. She holds a PhD in Processing and Food Engineering from TNAU, India. In addition to managing the ASSET project, Dr. Rajendran provides management support to other projects and activities, such as pesticide residue mitigation and phytosanitary development, focusing on facilitation of learning and integrating functional capacity development in technical activities.

### Dr. Lloyd Garcia - Consultant in APAARI-coordinated project funded by USDA on Pest Risk Assessment

Dr. Lloyd Garcia has broad experience implementing USDA's capacity building projects and transferring SPS knowledge and skills to developing countries, including Pest Risk Assessment (PRA) training to public and private representatives in Bangladesh. He has served as USDA's SPS advisor in East Africa (2004–2009), Afghanistan (2012), and Pakistan (2018–2019). In East Africa, he recognized the need for an International Plant Pest Convention compliant plant pest database and an SPS network, which led to the creation of the East Africa Phytosanitary Information Committee (EAPIC). This database was strengthened by building supporting activities with five core countries, namely: Burundi, Kenya, Rwanda, Tanzania and Uganda, to conduct plant pest network of surveillance, identification, assessment and communication. In partnership with NPPO officials from Kenya, Tanzania and Uganda, he guided the preparation and submission of a regional PRA for passion fruit, as well as country specific PRAs for peas, snow peas, baby carrots, baby corn and green beans from Kenya. Dr. Garcia is currently retired from USDA and is now working as a scientific and agricultural advisor to USDA's Office for Capacity Building and Development on food safety and regulatory projects. As such, he has been working with APAARI on the implementation of the project on Improving Phytosanitary Trade Compliance in Bangladesh.

### Dr. Mike Hennessey - Consultant on Pest Risk Assessment



Dr. Mike Hennessey started his career with the USDA's Agricultural Research Service in Miami, Florida, as a quarantine entomologist. In this capacity, he developed systems approaches and treatments for controlling fruit flies of importance to trade. He then worked in the US Environmental Protection Agency, where he was an entomologist involved in analyzing benefits and risks of pesticides under review for registration. For the rest of his federal career, Dr. Hennessey worked in Plant Protection and Quarantine (PPQ) of the Animal and Plant Health Inspection Service of USDA. He

specialized in commodity import and export PRA, and later directed pest risk management research. Finally, Dr. Hennessey worked in the PPQ policy area of environmental compliance. Shortly after his retirement in December 2020, he became a Senior Consultant for APAARI, collaborating with Dr. Lloyd Garcia in training NPPO and university scientists in Bangladesh in the principles and application of SPS PRA.

### Dr. Md. Ahsan Ullah, SPS Coordinator in Bangladesh



Dr. Md. Ahsan Ullah retired from his position as Additional Director, Department of Agricultural Extension under the Ministry of Agriculture, Bangladesh in February 2021. He started his career as a civil servant of the Government of Bangladesh as an Agricultural Extension Officer in April 1987, working in the area of horticulture for over 16 years. Between 2007-2014, he worked for Plant Quarantine, and later as a consultant for conducting PRA, especially for supervising the outsourced PRA under the 'Strengthening Phytosanitary Capacity in Bangladesh Project'. In January 2021, Dr. Ahsan Ullah joined APAARI a local SPS Coordinator in Bangladesh.

### NEW PUBLICATIONS OF APAARI

#### Regional Workshop on Underutilized Fish and Marine Genetic Resources and their Amelioration – Country Status Reports (ISBN: 978-616-7961-40-8)

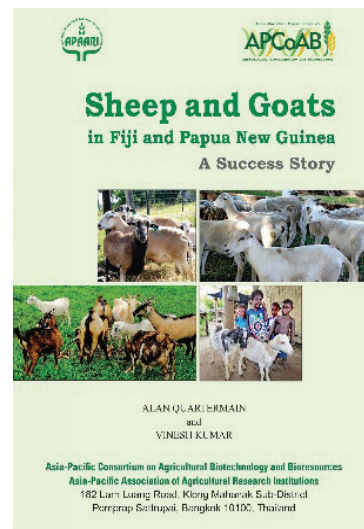
The document specifically focuses on country status reports belonging to twelve countries (Bhutan, Fiji, India, Iran, Lao PDR, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Taiwan) of the Asia-Pacific region. The data compiled and analyses will be helpful to policymakers to develop enabling policies to conserve and use underutilized fish and marine genetic resources. The publication is



available here: [http://www.apaari.org/web/wp-content/uploads/downloads/2020/CountryStatus\\_Reports-on\\_FMGR\(Final\)\\_7-8-2020\\_High\\_Resolution.pdf](http://www.apaari.org/web/wp-content/uploads/downloads/2020/CountryStatus_Reports-on_FMGR(Final)_7-8-2020_High_Resolution.pdf)

*Rishi K. Tyagi, D.H.N. Munasinghe, K.H.M. Ashoka Deepananda, Frank Niranjana and Ravi K. Khetarpal (2020) Regional Workshop on Underutilized Fish and Marine Genetic Resources and their Amelioration – Country Status Reports. Asia-Pacific Association for Agricultural Research Institutions (APAARI), Bangkok, Thailand, xiv+129 p.*

#### Sheep and Goats in Fiji and Papua New Guinea – A Success Story

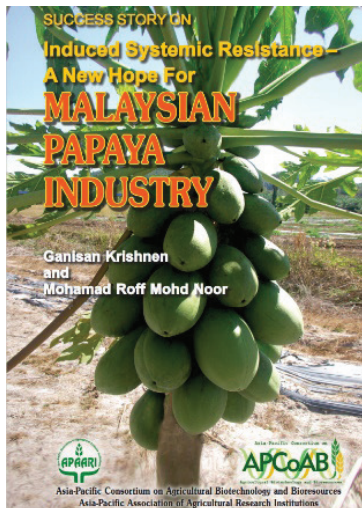


Sheep and goats have become established as domestic livestock in the Fiji Islands and Papua New Guinea (PNG) over the past 140 years. They complement the long-standing traditional livestock, pigs and chickens. In PNG, both species are part of village household ownership. However, in Fiji there is substantial commercial orientation, with substantial influence from the Indo-Fijian community both as producers and consumers. This success story covers the introduction and historical account, livelihood keeping, semi-commercial and commercial farming, development issues, consumption and marketing systems and regulatory policies for promoting sheep and goats for food security in PNG and Fiji. The

publication is available here: [http://www.apaari.org/web/wp-content/uploads/downloads/2021/SuccessStory\\_Sheep\\_Goats\\_in-Fiji-PNG\\_Final.pdf](http://www.apaari.org/web/wp-content/uploads/downloads/2021/SuccessStory_Sheep_Goats_in-Fiji-PNG_Final.pdf)

Alan Quartermain and Vinesh Kumar (2021) *Sheep and Goats in Fiji and Papua New Guinea – A Success Story*. Asia-Pacific Association for Agricultural Research Institutions (APAARI), Bangkok, Thailand, xiv + 62 p.

## Success Story on Induced Systemic Resistance: A New Hope for Malaysian Papaya Industry



Realizing the existing chemical, bio-control and farm practices that failed to control the bacterial dieback (BD) infection on papaya, a new strategy to induce the plant's resistance to manage this disease is proposed. Induced Systemic Resistance (ISR) technology was developed by MARDI by bioprospecting of the systemic resistance inducing Plant Growth Promoting Rhizobacteria from papaya-cultivated soil and by testing it in the hotspot and up-scaling in commercial farms for disease management. This publication includes the major protocols, field evaluation, technology transfer and adoption, and potential benefits to the farmers by adopting this technology. ISR technology is promising to rejuvenate back the ailing Malaysian papaya industry with a great boost. It also has great potential to revitalize the papaya industry in other countries of Asia-Pacific and beyond where papaya bacterial dieback disease affected its production. This publication is available here:

<http://www.apaari.org/web/wp-content/uploads/downloads/2021/Papaya%20Success%20Story%20Final%20High%20Res-28-6-21.pdf>

Ganisan Krishnen and Mohamad Roff Mohd. Noor (2021) *Success Story on Induced Systemic Resistance: A New Hope for Malaysian Papaya Industry*. Asia-Pacific

Association for Agricultural Research Institutions (APAARI), Bangkok, Thailand, xiv+63p.

## e-Training Manual (video) for Demonstration for AqGR Management



The demonstration video capsules were developed for virtually-organized Regional Capacity Building Programme on Biotechnological Tools in Aquatic Genetic Resource Management and *Ex Situ* Conservation for participants during 7-18 December 2020. An e-training manual was also prepared for the benefits of the participants and available in open access (<https://e-nbfgf.nbfgf.res.in>) to be used by researchers of Asia-Pacific countries and beyond.

APAARI Newsletter, Vol. 29(2), December 2020 (<https://www.apaari.org/web/apaaari-newsletter-vol-292-december-2020/>)

APAARI Capability Statement 2021 (<https://www.apaari.org/web/31625-2/>)

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# APAARI acknowledges the partnership and support of all the members and stakeholders

# THANKS



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