PAPUA NEW GUINEA
NATIONAL AGRICULTURAL RESEARCH INSTITUTE

ANNUAL REPORT 2022

Promoting Excellence in Agricultural Research for Sustainable Development

The National Agricultural Research Institute (NARI) was established by an Act of the National Parliament of Papua New Guinea (PNG) in July 1996 as a public funded, statutory research organisation to conduct and foster applied and adaptive research into:

I. any branch of biological, physical and natural sciences related to agriculture;

II. cultural and socio-economic aspects of the agricultural sector, especially of the smallholder agriculture; and

III. matters relating to rural development and of relevance to Papua New Guinea.

In its Vision for PNG, NARI sees *Prosperous PNG Agricultural Communities* through its Mission of promoting innovative agricultural development in PNG through scientific research, knowledge creation and information exchange. This is to be accomplished through the Institute's Purpose (Strategic Objective) of enhanced productivity, efficiency, stability and sustainability of the smallholder agriculture sector in the country so as to contribute to the improved welfare of farming and rural communities who depend wholly or partly on agriculture for their livelihoods.

See *Annex 8: The Institute* for more information on the Institute.

2022

Annual Report

National Agricultural Research Institute
Lae, Papua New Guinea

Corporate Document 1 / 2023

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Foreword

Greetings to you all from the NARI Council and Management. It gives us great pleasure to share NARI's progress during 2022 with you. It was good to see a decline in Covid19 and its restrictions. It has been a challenging year with the operations of the National General Election and related financial constraints providing a challenge. The new Government brought a change in Ministry responsibilities with NARI now closer to the other partners in the sector, under the Ministry of Agriculture.

The ten year NARI Corporate Plan for 2022-2031 was finalised early in the year with the Council approval of the NARI Strategic Implementation Plan 2022-2026 and Annual Implementation Plan for 2022. Going forward, the groundwork in the Strategic Implementation Plan has allowed the research component of the Annual Implementation Plan for 2023 to also be prepared in a timely manner. The release of the 2023 budget will allow us to finalise the complete 2023 plan. The Annual Implementation Plan 2023 is available on the NARI web site along with the full Institute Corporate Plan. The launching of the NARI Corporate Plan for 2022-2031 by the Minister for Agriculture, Hon Aiye Tambua, was a highlight of the year.

We are concerned that while the importance of agriculture is well known, the Government support through funding for agricultural research, in relative terms, has been in decline over the past 20 years. The excellent returns on research investment have been well documented for countries similar to PNG. We call on the Government to closely review this situation and substantially increase research funding. The collaborative work by NARI, with the International Food Policy Research Institute in 2022, has highlighted the direction PNG must take in agricultural development. This direction shift requires urgent intensive research. The minimal funding and resource requirement to properly operationalise NARI is provided in the NARI Strategic Implementation Plan 2022-2026.

The key research outcomes revolved around the three priority areas covering policy, commercialisation, resilience to shocks, and nutrition. We appreciate the continued support from our development partners, particularly from the European Union and the Australian Government through the Centre for International Agricultural Research and funding for the collaborative work with the International Food Policy Research Institute. We are also appreciative of the assistance provided through Taiwan ICDF, the International Atomic Energy Association and Bioversity International. In 2022 we also contributed to the ongoing African Swine Fever and Fall Army Worm responses and were happy to also be able to assist the Food and Agriculture Organisation of the United Nations on a request to assist them in implementation of two projects.

The NARI Council and Management are pleased that there were reasonable achievements of targeted outputs planned for 2022 and express their appreciation to our partners and NARI staff for their contributions and commitment which underpins the organisation's expanding achievements. NARI will continue to build in 2023 on its modest progress made in 2022 to continue to strengthen our ongoing transformation as an improved results-oriented learning organisation. We look forward to your continued support in 2023.

Warea Orapa
a/Director General

Nimo Walter Kama
NARI Council Chairman

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Executive Summary

There has been good achievement of targeted outputs planned for 2022. There have been unavoidable delays due to movement restrictions with African Swine Fever, finance constraints to staffing, and the non-release of Public Investment Program (PIP) funding for development of critical research infrastructure and securing of state lands under the custody of NARI.

In 2022 NARI continued to effectively manage existing partnerships and developed new collaborations and arrangements. Most of the currently implemented projects are collaborative, involving international donors as well as government and non-government organisations. ACIAR as a donor and Australian institutions as partner organisations dominate the current project portfolio.

The IFPRI collaboration on agri-food systems research delivered strong results and policy contributions. It also strengthened NARI's cross-sectoral working relationships. The case for increased funding for research to develop the agri-food sector as a whole, improving productivity and increasing the importance of mid-stream and down-stream components was highlighted. Five publications are available from this work.

The Galip nut value chain work is on schedule with 11 publications and reports available. A Public Private Partnership arrangement has also been established to take the Galip marketing aspects forward, leaving NARI to concentrate on the supporting agronomic, crop protection and production system research programs.

The major EU-funded Project, "*Strengthening food production capacity and the resilience to drought of vulnerable communities*" was successfully completed with good reviews from stakeholders and acceptance of the final technical report by the EU Office. As with all short-term projects, the intended impact will be long term so NARI will be continuing to make inputs and impact assessments beyond the project life.

Research on Genetic Resources is a key area for NARI and PNG, but sadly relies on international donor funding. We are seeking additional funding to ensure that agro-biodiversity and collections of valuable genetic plant and animal resources are not lost.

Under the *"Development, Validation and Optimisation of New Cost Effective Analytical Techniques for Contaminants in Food and Associated Matrices Such as Water and Feed Based on Health Risk Assessment in PNG"* between IAEA and NARI, critical equipment, process and skills upgrade with two NARI chemists undertaking 3 months training in Pakistan.

NARI has good staff, but lacks the critical mass needed, and it has been especially challenging to fill the Principal and Senior Scientist positions with experienced staff able to mentor and guide less experienced teams. We lost most of the socio-economics team as they moved on to more financially rewarding life choices, leaving NARI with a severe capacity gap. The minimal Human Resource requirements are laid out in the NARI Strategic Implementation Plan 2022-2026 which can be accessed at this link: https://www.nari.gov.pg/publications/corporate-documents/

The highlight of 2022 was the launching of NARI's Corporate Plans: Strategy & Results Framework 2022-2031 and Strategic Implementation Plan 2022-2026. These documents were launched by the Minister for Agriculture Hon. Aiye Tambua MP in early December.

NARI's research funding has not seen any real increases over the past 20 years, with an actual decline in relative terms. Research is a critical need in fulfilling the Government development plans to revitalise and take agriculture forward. The IFPRI collaborative study has strongly reminded us of the need to adjust the components of the agri-food system with a move to proportionally more mid-stream and down-stream action. This requires urgent funding support to enable recruitment and support for research input into agriculture commercialisation of food and other crops and livestock.

Introduction

The *NARI Annual Report 2022* provides a review and assessment of the achievements of the Institute at different levels of operation against planned milestones, outputs and outcomes, as outlined in the *Annual Implementation Plan 2022* (AIP 2022). The AIP 2022 is the first annual plan to be based on the second *NARI Strategy and Results Framework 2022-2031* (SRF 2) and its subsidiary *NARI Strategic Implementation Plan 2022-2026* (SIP 2) which guides implementation for the first five year period of the SRF 2, from 2022 to 2026.

The Institute links well with the GoPNG priorities arising from the targeted development impacts of reduction of poverty, assurance of food and nutritional security and health and sustainable resources management as guided by the countries long-and medium-term development strategies. The three derived priorities of the Institute for the next 10 years for which the Institute will contribute to are:

Priority 1: Economic resilience and development by enhancing agricultural markets, value chains and trade.

Priority 2: Enhanced resilience of rural communities and systems in light of climate, economic and demographic changes and associated threats to livelihoods and the environment.

Priority 3: Enhanced consumption of healthy and sustainable diets by rural and urban households.

The Result Areas being targeted within the priority areas:

1. Foresighting and Advocacy
2. Value Chain Support
3. Household resilience
4. Agro-ecosystem resilience
5. Biosecurity
6 Genetic Resources
7. Safe and nutritious Food

For each of these areas there are key cross-cutting results to ensure appropriate delivery of research outputs and ensure a significant return on research investment:

- Scaling for impact
- Gender, Youth and Social Inclusion (GESI)
- Communication for Change

All staff are required to develop and follow a personal annual implementation plan aligned with the overall NARI Strategic Implementation Plan. Overall, staff have become familiar with the new SIP 2. All staff personal implementation plans are monitored at the Centre level. The AIP 2022 was monitored through quarterly reports, a mid year staff AIP review and end of year review of the overall AIP 2022. The mid year review was used to redirect where necessary and improve compliance both in personal AIPs and project level AIPs. Issues and remedial measures were identified and marked for implementation. The assessment exercise focused on the scientific and technical staff. It was noted that for most of the issues at centres, it is the responsibility of centre management and support staff to manage resources and create an enabling environment for research to flourish. This is being

addressed in the shorter term through recruitment and reporting adjustments, supported by the organisational restructure over the longer term. The assessment of the Institute needs for effective implementation is laid out in the *NARI Strategic Implementation Plan 2022-2026.*

Section 1 of this report covers the achievements for each of the priority areas with further explanations of implementation progress. The second section includes an assessment of the overall institutional progress and achievements.

The full table of achievements against the AIP 2022 for each Result Area and Institutional Management is provided in *Annex 1: NARI Annual Implementation Plan 2022 Achievement.*

1. Achievements in Priority Areas

1.1 Contribution to economic resilience and development by enhancing agricultural markets, value chains and trade

Agri-food system fore-sighting was advanced through collaboration with the Washington based International Food Policy Research Institute (IFPRI) through the project, *Informing agricultural investment strategy and food policy in PNG*, has been very useful in identifying agriculture development and research strategies and in contribution to policy.

The project has delivered on its primary objective to strengthen the capacity of Papua New Guinea policy research institutions through active collaboration in applied rural development policy research and collaborative research initiatives. This involved a number of studies and workshops. The studies identified the need to maximise efficiency throughout the entire agri-food value chain, as it is critical to fostering greater economic growth and poverty reduction within the country. In addition to efforts promoting agriculture

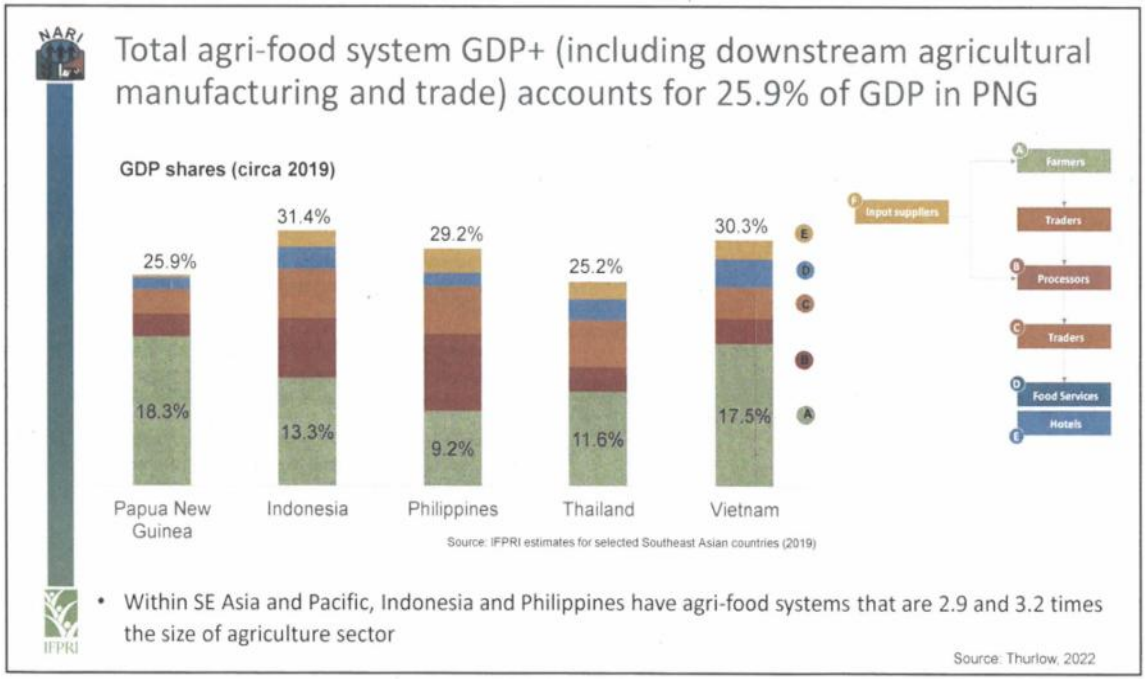

Figure 1: GDP shares in the agri-food system

productivity, growing a globally competitive agriculture sector also demands investments and capacity strengthening in mid-stream value chain operations such as product aggregation, transport logistics, packaging and processing, and handling. The key message for PNG to develop the downstream components of the agri-food system was highlighted in the research result workshop presentations (Fig 1).

The analysis of three key agricultural value chains (poultry, sweet potato, and fresh vegetables) indicates the need for PNG to significantly improve efficiency throughout the entire agri-food value chain in order to be domestically and globally competitive. Not only is support to increase agricultural productivity needed, but investments and capacity strengthening in mid-stream value chain operations such as product aggregation, transport logistics, packaging and processing, and handling, are critical to support a globally competitive agriculture sector in PNG.

Along with the in-country research, the NARI team took a key role in a macroeconomic modelling study in Washington DC to develop a Social Accounting Matrix (SAM) or Input-Output Table for the PNG wide economy. This came about following climate change and the Covid19 related world food supply shocks, and can be used to do forecasting of shocks and simulate their multiplier effects using the Computable Generalised Equilibrium model for the agriculture and other economic indicators.

Figure 2: Macroeconomic modelling workshop in Washington DC

Going forward from the outcomes of the training, an inter-agency coordination group has been informally set up, led by PMNEC and the Australian High Commission (AHC). A concept paper is in preparation by the inter-agency group for PMNEC to establish a proposed ''Economic Sector Coordination Group'' with the aim to effectively coordinate any initiative that requires government agency inputs such as data collection for the SAM macro modelling work.

A framework has been developed that can be used in future for macroeconomic studies, however data collection, and harmonising of the framework and standards, will need to involve effective inter-agency coordination. The outcomes of the research has been

presented to public and private sector parties at Research Results workshops held at Crossroads Hotel in Lae and at the Hilton Hotel in Port Moresby. Follow on training and development of cross sectoral initiatives from this work is planned for early 2023 through the leadership of the PMNEC.

Figure 3: Galip products under PPP

NARI has an on-going commitment to support the development of the **Galip Nut Value Chain**. The Galip nut (*Canarium indicum*) is an indigenous resource, unique to only a few countries in the Pacific with a proven potential to become an important crop for income generation at different scales. Work has continued under the collaborative *Enhancing private sector-led development of the Canarium industry in Papua New Guinea – phase 2* project to further explore and realise the potential to a commercially viable industry supplying domestic and export markets. Considerable progress has been made with a limited supply of high quality Galip products now available in the domestic market and focus has shifted to the assessment of the extent of the Galip resource, development and adaptation of production system technologies to protect and encourage expansion of the industry, and promotion and advocacy in increasing investment into the development of this industry.

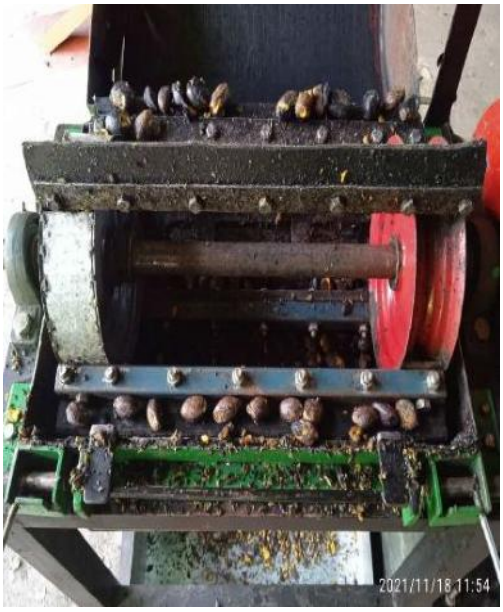

Figure 4: Galip de-pulper

Business case models on farmer selling of fresh and partially processed nuts has been conducted, looking at methodology, profitability and quality risks, and related training modules produced. Testing of the prototype de-pulper developed in collaboration with Andrew Puy from the University of Technology continued with success, and best practice harvesting and drying trials were conducted. The processing manual has been updated to include recommendations for primary depulping at the village level. A fruit development study was carried out to assist processors to better schedule and maintain quality. A new startup, "Frangipani Foods Limited", has participated in a "Public Private Partnership with NARI. 'They commenced buying in January 2022 and have done well, purchasing 44 tonnes of Nut

in Pulp (NIP) from farmers in the East New Britain Province, in their first season. They have used this harvest to develop processed product variations suited to new market opportunities.

Galip weevil (*Ectatorhinus magicus)* research continued with several activities, including a Galip weevil survey, where interestingly, the West New Britain survey did not find any weevil damage. This will be further researched to determine if there are factors which can be useful to decrease weevil damage in other producing areas. Further information on the Galip research activities is available in the project reports (See Annex 7: Publications).

Figure 5: Galip weevil

Figure 6: Milling cassava

Progress was made in the work *Managing pig gut health, weaning stress resilience by feeding fermented cassava and sweetpotato diets to sows and piglets* as part of the **Pork Value Chain** work.

The focus has been on feed trials for sows and weaned piglets on fermented cassava. A number of commercial and village pig breeding stock were obtained for the specific purpose of producing F1 and F2 progeny to supply farming households with improved crossbreeds (high pedigree) suitable for intensive farming and also breeding stock of locally adapted crossbreeds (low pedigree) suitable for small-scale farming. Experimental observations are in progress. No results are as yet available for reporting.

Figure 7: Preparing compost for sweetpotato

ACIAR funded research towards a **Soil Management package for sweetpotato production** systems progressed.

This ongoing trial aims at understanding effects of low input soil management practices, including legume rotations, fallow management and organic fertilisers using on-farm resources. Progressive results show the use of organic fertilisers in the form of chicken litter and coffee pulp give significantly high yields of sweetpotato. While the findings are still incomplete, there has been local uptake in the on-farm trial areas in Jiwaka Province on the positive results from the various organic fertilisers. The awareness and adoption was assisted through use of the Family Farm Team approach. Technology uptake of the use of mineral fertilisers in the Asaro Valley, has been gradual.

Another study considered that many highland soils may have inadequate plant-available phosphorus (PAP) which can result in low yield in sweetpotato. Crop rotations using specific crops were tested as an economical means of mobilising PAP for following sweetpotato crop. Seven different crop and fallow rotation systems using carrot, natural fallow, wild Mexican sunflower, pigeon pea, cassava, sweetpotato, and wheat were studied over 2 seasons. The results have not shown any strong benefit from the alternate rotation systems tested. The project period has been extended until May 2024.

1.2 Contribution to enhanced resilience of rural communities and systems in light of climate, economic and demographic changes and associated threats to livelihoods and the environment

This was our biggest area of work with inputs and studies across several projects.

The **EU funded Climate Change Resilience Project** "*Strengthening food production capacity and the resilience to drought of vulnerable communities*" has been the mainstay of this work over the past four years. The project generated much useful research, information materials, and contributed valuable lessons learned. The Action was completed in July and the final report submitted and accepted in September. The adaptive capacity of 18 Local Level Governments (Fig. 8) was strengthened to respond with appropriate agricultural technologies and strategies to abiotic stresses arising from seasonal weather patterns and climate change an impacting on agricultural productivity. The outcome achievement is demonstrated through sharing and the spread of planting materials and breeding stock, soil and water conservation techniques, training by lead farmers and site-based extension officers, and uptake and innovation of adaptive technologies.

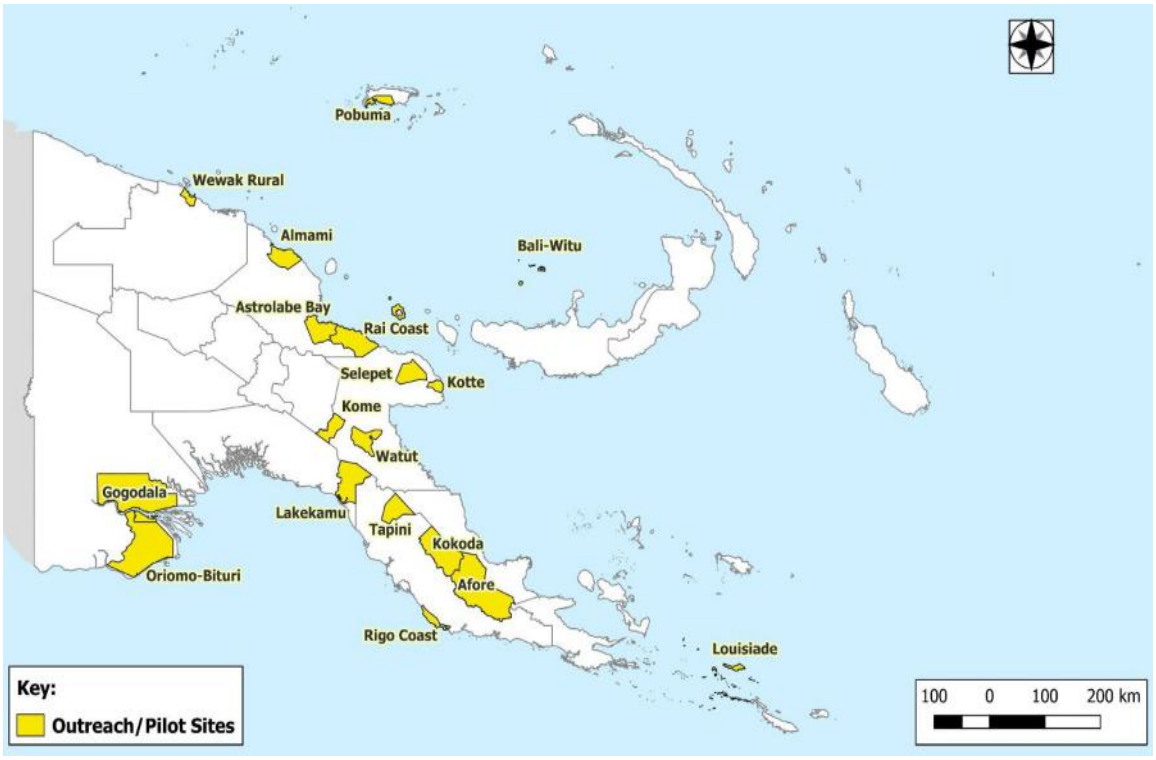

Figure 8: Climate change resilience action - project sites

The adoption of new technologies led to diversified sources of nutrition and income in the households. Improved health benefits in children from the new diversity in crop selection has been observed. The introduction of the new crop varieties has been embraced due to desirable characteristics including early maturity, high dry matter, wide adaptation, good culinary, disease tolerance, drought tolerance, frost tolerance, low cyanide, high nutritional value (vitamin & minerals), longer shelf life/storage ability, soil nitrogen-fixation, flour processing ability and market preference, and sustained through 54 seed multiplication gardens established by the various site community members.

The adoption of these technologies includes sweetpotato silage for pig feeding which provided security in feed supply and in so doing has reduced work burden for women in sourcing food during periods of stress; implementation of mobile pens for village chicken combined with supplementary feeding local sources has increased the availability of nutritious eggs, especially for children under five years old. The flour processed from root crops was widely adopted due to the observed benefits in food storage and income generation. The purchase of three hundred hand mills by farmers themselves supports the value of this intervention; improved awareness on climate change has helped them value and protect local environment. Envisioning the importance of the interventions, climate champion groups/associations are formed with the aim of conducting awareness and imparting knowledge and skills to wider members of communities and their region. The associated studies and publications are indicated in the Annexes.

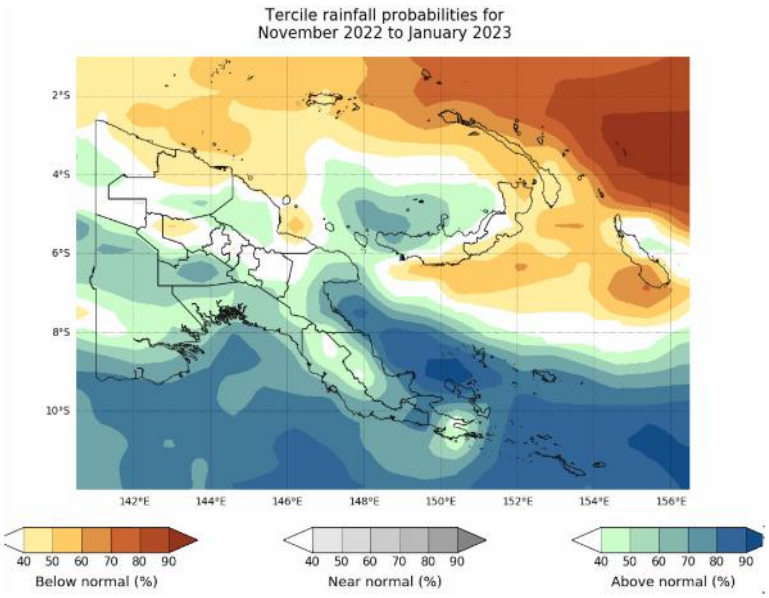

Figure 9: NWS climate forecasts

Being **Climate Smart** requires good information on climate forecasts and drought risk. We are collaborating with National Weather Service to publish the seasonal climate forecasts (Fig. 9) on the NARI website and Information system.

We are also working with the Australian National University and other PNG and Australian partners to interpret the seasonal climate forecasts to provide farmers with advice on management decisions arising from the forecasts. The work is supported by ACIAR with funding extended to 2024 due to the Covid19 impacts on travel.

Figure 10: Climate vulnerability TOT and support

NARI's contribution to the **FAO Climate Resilient Agriculture project** was focused at equipping both the Southern Highlands and Hela Provincial DPI's and participating NGO's with validated interventions for agricultural resilience. Key actions taken to progress expected outcomes was the provision of foundation clean planting materials and enhancing training capacity on climate resilient practices for sweetpotato and potato farming. Foundation seeds and training for intermediate crops (wheat, rice, cassava & pyrethrum) and natural resource management was conducted as interventions and progressing the development of climatic forecast and advisory services as an essential farming tool. Figure 10 indicates the types of foundation planting material and extensive training resources provided during the TOT workshops.

Figure 11: Rice at Kagua in SHP

Support to rice growers in Southern Highlands, Milne Bay, Madang, and Western Provinces in Training of Trainers for production, field mechanisation and milling was enabled through NARI assistance to the FAO project, ***"Emergency support to preventing the spread and mitigating the impacts of COVID-19 along the agricultural value chain and building resilience in food security, nutrition and livelihoods".*** The respective provinces were also assisted with quality foundation seed for rice and other crops. Figure 11 shows the good productivity and potential at Kagua in the Southern Highlands.

Figure 12: Setting up Provincial screen house

Four Training of Trainer workshops on climate resilience were conducted for provincial agriculture officers and NGOs under the **PIP Climate Change Resilience** project. Two additional training manuals for use by TOT recipients developed and used both in these workshops and the FAO project. With the relaxed Covid19 restrictions, the support to establish Provincial Didiman Centres was continued. Figure 12 shows the setting up of an insect proof screen house to grow virus free sweetpotato cuttings from Pathogen Tested sweetpotato roots provided by the Aiyura tissue culture laboratory.

NARI purchased six 20m screen houses to boost the capacity to provide disease free planting materials, especially for sweetpotato and potato. The associated post harvest facility, to better prepare planting materials for distribution, funded under the new PIP Infrastructure project, has been delayed as funds were not available. It is planned to progress this in 2023.

Figure 13: MRC / ICDF rice seed production

Figure 14: Rigo rice seedling nursery

This has also delayed the establishment of a seed laboratory for rice (fig. 13) and other seeds, to be established at MRC in collaboration with Taiwan ICDF. ICDF has procured the laboratory equipment during 2022 in preparation for this laboratory. Rice under irrigation continues to perform well at Bubia. High yields of up to 7 T/ha ensure good seed stock availability. We have also introduced vacuum bag storage to improve storage life of foundation rice seed. The NERICA (from New Rice for Africa) rice variety assessment continued under the EU funded action to strengthen climate change resilience. There are some promising varieties. A selection of these is also being tested under irrigation at the Rigo Rice farm (Fig. 14).

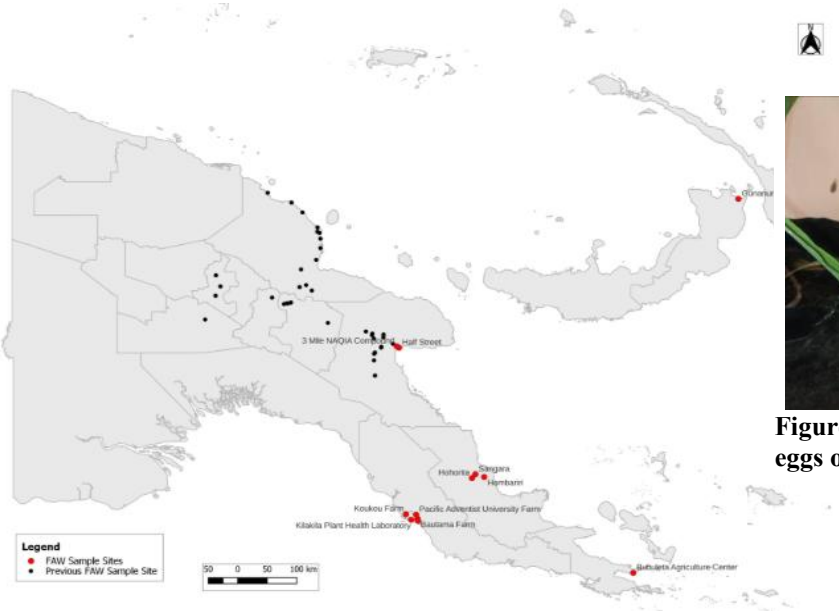

Figure 15: FAW distribution

Figure 16: Adult FAW laying eggs on corn

NARI has continued its collaborative monitoring with NAQIA of **Fall Army Worm** (FAW) in PNG. The latest distribution map (Fig. 15) shows FAW is now widely distributed throughout PNG. Corn (Fig. 16) remains the most severely affected food crop.

Figure 17: Sweetpotato polycross for controlled pollination

NARI is the custodian of the **Genetic Resources** (GR) for Food and Agriculture (FA) diversity which is an important heritage and basis for food security and the advancement of commercial crop and livestock production in the country. Work programs are implemented under the two sub Result- Areas of GR management and GR Use and Access.

In 2022, NARI continued to maintain a range of Plant GRFA collections *ex situ*. A summary of the collections held at the different NARI Centres is provided in *Annex 6: Plant Genetic Resources*.

As the National Focal Point to manage international commitment and agreements such as the membership in the FAO Commissions on Plant Genetic Resources For Agriculture (PGRFA) and as contracting party to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), NARI submitted the annual report to FAO on status of PGR collections and participated as part of the PNG Delegation the 9th Governing Body Meeting for the ITPGRFA.

Figure 18: Community Genetic Resources project

Diversification of food systems is an important strategy for greater resilience of communities towards the effects of seasonal and climatic variations in weather patterns exacerbated by Global Climate change. Farmers from drought vulnerable farming communities in four geographically distinct regions namely Usurufa (Eastern Highlands), Teptep (Madang), Menya (Morobe) and Rigwali (Central) have been engaging with NARI in building resilience capacity through introduction of new and improved varieties of sweetpotato while learning about the importance to conserve their own diversity of sweetpotato variety in situ as a community driven approach. In 2022, participating farmers evaluated sixteen (16) sweetpotato cultivars through participatory varietal selection (PVS) approach. The cultivars comprising of attributes like early maturing and range of flesh colours (mostly orange, purple, yellow and white flesh) were brought to the farmers.

Farmers worked together as family teams taking part in each family team screening three new cultivars along with their own preferred variety, and selections made at full maturity.

Capacity was built for family teams to sustainably conserve and utilise cultivars in their local communities.

Figure 19: Polycross at Kosena Primary School

Farmers were given best practice training to cultivate sweetpotato and breeding plots to collect botanical seeds from the vines. The new cultivars along with the practices were widely adopted although a good number of people still had reservation with orange and purple flesh sweetpotato. Another highlight in this collaborative work with local communities was the introduction of the use of polycross nurseries established at local primary and secondary schools to generate new diverse varieties. Combined with the skills learnt in the PVS, participating farmers now have the awareness and skills to actively generate and select new sweetpotato varieties that match their specific needs. The Benefit Sharing Fund of the International Treaty on Plant Genetic Resources for Food and Agriculture is greatly acknowledged for the funding support of this work.

Figure 20: Malabar spinach

Other work that concluded in 2022 involved the assessment of vegetable diversity kits. Each kit containing a 3-crop (triadic) combination from a total of six vegetable species viz., amaranth, jute mallow, mung bean, Malabar spinach and okra, sourced from the World Veg Centre in Taiwan. Over 1,000 seed kits were distributed to farmers throughout PNG, especially, East Sepik, Madang, Morobe, West New Britain, Manus, Oro, Western, Gulf, Central and Milne Bay Provinces. Farmers evaluated the crops species using triadic comparison of vegetable crops, a recently developed citizen-science approach where farmers screen three vegetables species at a time and adopt the ones preferred. Seed kits were distributed in collaboration with the District Rural Development Officers, model farmers and collaborating partners including Adventist Development and Relief Agency and World Vision. While COVID19 disrupted the systematic collection of data within the project period, visits in 2021 and 2022 to farming households throughout intervention sites reported that the vegetables have performed well across the various agro-ecosystems and many were adopted into their food system. Family diets have been diversified with the vegetable with added nutrients coming from the new species. The vegetables have also become a source of income, especially for womenfolk.

1.3 Contribution to the enhanced consumption of healthy and sustainable diets by rural and urban households

Several studies contribute to this area. The key project, **Sustainable poultry, aquaculture and goat farming for economic and nutritional well being of rural communities in Morobe and Madang Provinces**, which brings these together is targeted to deliver livestock and aquaculture systems in selected communities in MOMASE with known protein deficient diets. The overall aim is to increase availability and consumption of animal protein in the daily diet of households practising sustainable livestock and aqua culture farming systems, and leading to improved nutritional outcomes especially among women and children.

Figure 21: Baseline study in Madang

A baseline survey is providing the first steps towards systematic establishment of local village chicken and duck supply chains. The Madang Baseline survey was completed in late 2022 and provides a household level measurement for setting achievable goals with the planned 25 family farming teams – young couples either pregnant or with infants under the age of five. The Needs Assessment component provides the context social, economic and environment within which poultry farming and related food and feed crop technologies will be trialled with participating family teams.

The project approach intends to deliver sustainable results through Community hatcheries supplying poultry stock directly to the participating and interested families. A Commercial hatchery then supplies breeding stock to the project sites and continues business within the province, aiming to operate at" better than return on costs". Family farming teams will be trained in the skills and technologies for producing poultry for meat and eggs for household consumption and income, particularly for eggs towards infant and maternal nutrition. The 25 participating family teams will then be assisted through a defined period as layer-bird and meat bird farming enterprises, and the process assessed for scaling.

There have been delays in getting to this stage, but the lessons learned will guide the next steps and contribute to sustainable results.

1.4 Cross cutting areas: Scaling, GESI, Communication

Figure 22: Family involvement in project activity

NARI has progressed well in the area of gender and social inclusion, though it remains a challenge. While more women are involved in agriculture, they often have less opportunity to participate in and benefit from their inputs or to participate in higher value agriculture. From the work with IFPRI, analysis suggests that women's economic participation and engagement in commercial farming is associated with greater participation of women in household decision-making as well as improvements in household welfare on a variety of dimensions. There is a strong business case for alleviating the society norms that are keeping women out of certain activities and more generally expanding opportunities for women's participation in key value chains in the agriculture and livestock sectors in PNG. By promoting women's economic opportunities, especially in mid-stream activities in key value chains, the country can realise a better growth trajectory and greater human development indicators.

With the recognition that it is important to ensure that women play a part in household decision making, particularly related to the use of household income spending and reinvestment, we are championing the use of the Family Farm Teams tool to build family cohesiveness. This has helped in project implementation with such success that there could be a tendency to overuse the process!

The institute continues to support the sector at large with various information on agricultural research, innovative practices and technologies as well as documenting traditional and adaptive knowledge to stimulate discussion and further research and development.

Various formats are used to package information targeting the diverse stakeholders in the sector but focusing on smallholder farmers. A total of 126 articles were published in various mass media through the year. Nine Training of Trainer oriented manuals have been developed but still require additional video and poster resources to be a package with a full set of learning materials. More work is also required on strengthening the Training of Trainers approach. To further support the trainees, pictorial brochure layouts have been adopted for farmer level awareness materials – 8 brochures are available.

Aligned with this work, we have confirmed several partnership with MOUs signed with Provincial Governments, Ok Tedi Development Foundation, Reef and Rainforest Research Centre, Blue Carbon Credit interests, University of Natural Resources and Environment, and agreements with FAO.

The NARI Nius was produced quarterly as light informative reading for our multi stakeholders. In this reporting period, the newsletter underwent minor changes in formatting for ease of reading electronic formats. The articles in NARI Nius are also available separately through the web and Facebook.

There were less field day events and shows as the effects of Covid19 linger. The NARI Agricultural Innovation Show is now scheduled to re-start in 2023. However, NARI publications were still displayed and distributed whenever possible. Information was also made available to staff on project activities to display to farmers during their meetings.

While we continue to maintain an effective networking with the mainstream media to create increased awareness on NARI AR4D activities, we recognise the main mechanism for information sharing has moved online and we now recognise this as the primary means for NARI information, while maintaining traditional print platforms.

As seen from the publications list (*Annex 7: Publications*), the tendency of project scientists to first seek publication at conferences and in journals, and not documenting project results as NARI Technical Reports, is a concern contributing to delays in the availability of scientific results to farmers. In some cases there has been time issues, or simply reluctance to follow the set procedures, while for many it is inexperience in scientific reporting and documentation as required for peer review and utilisation by intended stakeholders. Active coaching in scientific documentation is necessary for most scientists. Centres implemented a literature review exercise in 2022 as a self help measure to build the capacity of scientific staff in this area. NARI has a wealth of information in this area which will be made available through an online self-learning platform A more formal capacity strengthening process is being sought to serve both the current team, and especially new young recruitment.

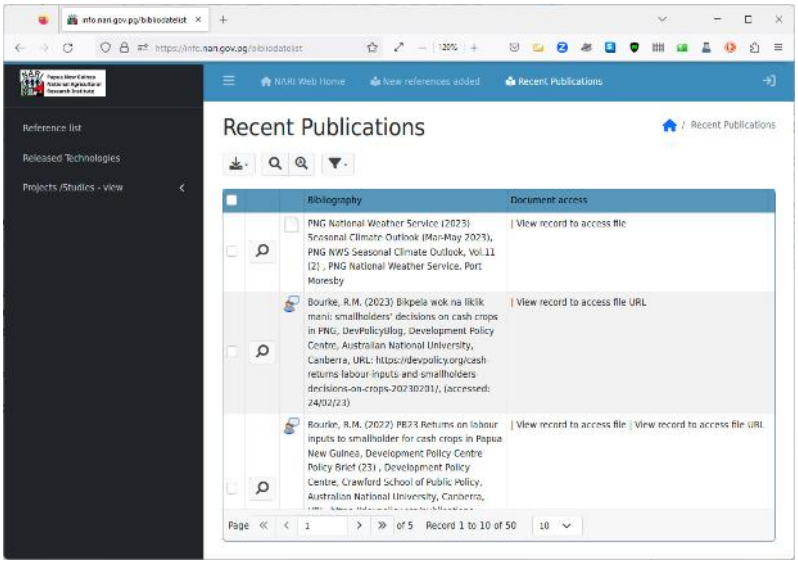

Figure 23: NARI Online Information System

We have launched our new NARI Information system at https://info.nari.gov.pg with the aim to make all our information available easily in open access electronic format.

The platform is easily scalable and we will be approaching our sectoral partners to join us in a collaborative information system for all things "Agriculture".

Proposals for funding have also been submitted to support the extension of the system.

2. Institution Management and Services

Figure 24: Launching NARI Corporate Plan

The key event for 2022 was the launching of the NARI Corporate Plan by the Minister for Agriculture, Hon Aiye Tambua on 7th December 2022. This confirmed a major milestone in the Institute's ambition to continue effectively contributing to improving PNG's welfare, especially of smallholder farmers and rural communities. The new SRF 2 signals confidence in the Agricultural Research for Development (AR4D) paradigm adopted by NARI in 2011, and continues the emphasis on NARI as a results-oriented learning organisation. The Institute links well with the GoPNG priorities arising from the targeted development impacts of reduction of poverty, assurance of food and nutritional security and health and sustainable resources management as guided by the countries long-and medium-term development strategies. While the SRF 2 aligns with the National Development Goals and provides the overall direction for the Institute, it was important to carefully map out the different steps it will need to take to achieve this and deliver tangible outputs and outcomes to impact on lives of rural communities in the country. This is provided through development of a Strategic Implementation Plan (SIP 2), a second tier corporate planning document which provides NARI managers, researchers, donors and partners a guide to AR4D implementation for the first five years of the SRF 2. Together, these two documents form the NARI Corporate Plan as a living document which can guide research and adapt as needed over the next ten years.

Figure 25: Launching the SRF 2

Finance management, sources and trends

Agricultural research spending is in decline. This was especially apparent over the period 2013-2017 when agricultural research spending as a share of Agricultural GDP fell from 0.43 to 0.30 percent. The trend continues to 2022 with inadequate funding to improve or even maintain facilities, equipment (scientific, tractors, implements) etc. There is insufficient funding to increase staff strength in relevant disciplines with necessary competencies in research to deliver along the impact pathway.

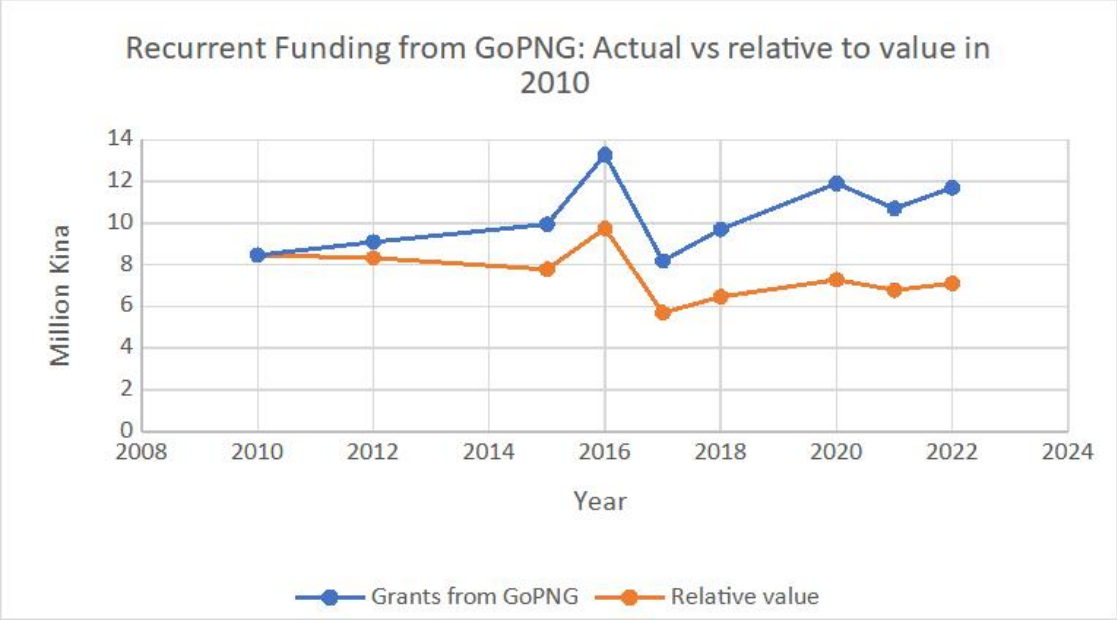

Figure 26: Funding in relative value decline

Related to this is the need for NARI to take valuable staff resources away from research to contribute to development oriented projects with very little research outcomes, simply to ensure funding for staff salaries. This needs to change to allow PNG to reap the benefits from research investment.

The GoPNG **Recurrent Budget** allocated to NARI for 2022 decreased in real terms despite a marginal increase from the K11.55m 2021 allocation to K11.66m. The 2022 allocation was still far short of the budget estimate of K29m requested.

There was also a shortfall of K4m (80%) of funds allocated under the 2022 **Public Investment Program (PIP)** budget. This has impacted

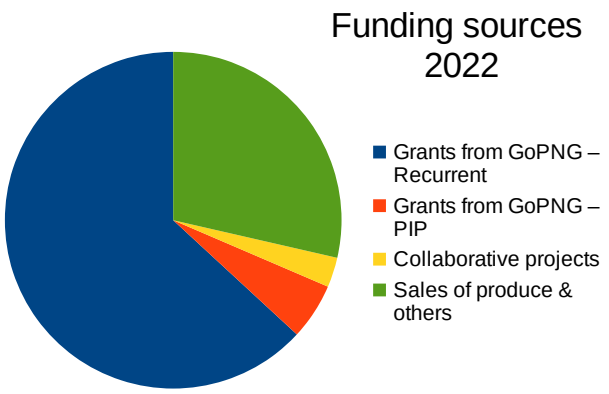

Figure 27: Funding sources 2022

implementation in two ongoing components under the Research and Development Program, "*Preparedness to cope with climate induced stress*" and "*Sustainable poultry, aquaculture and goat farming for economic and nutritional well being of rural communities in Morobe and Madang Provinces*". The newly approved NARI Infrastructure Development Program, under the PIP, was limited to planning, as the K3m budgeted allocation was not received.

The changes in funding allocations by source for 2020 to 2022 are illustrated below.

Table 1: Sources of Funds (millions):

Funding Source	2020	2021	2022
Grants from GoPNG – Recurrent	11.06	11.55	11.66
Grants from GoPNG – PIP	1	2	1
Collaborative projects	0.09	1.25	0.53
Sales of produce & others	1.46	3.55	5.28
Total Funds Available	13.61	18.34	18.47

The Institute's detailed funding and expenditure statement for the year ending December 2022 is given in Annex 4: Income and Expenditure 2022. While salaries and wages continue to take around sixty percent (60%) of the total GoPNG grant, this remains far short of the amount required to recruit the staff needed, and unfortunately limits delivery of impacts from research. A more realistic staffing scenario has been presented as part of our Strategic Implementation Plan for 2022 – 2026. With very tight recurrent cash flow during 2022, the Management has focused on regular and routine costs such as personnel emoluments and essential operational activities.

Table 2: Expenditure: 2020-2022 (Km)

Expenditure Category	2020	2021	2022
Salaries and wages	9.84	11.43	10.27
Operational Expenses	3.95	5.97	6.69
Capital Formation	2.50	0.87	1.04
Total Expenditure	**16.29**	**18.27**	**18.00**

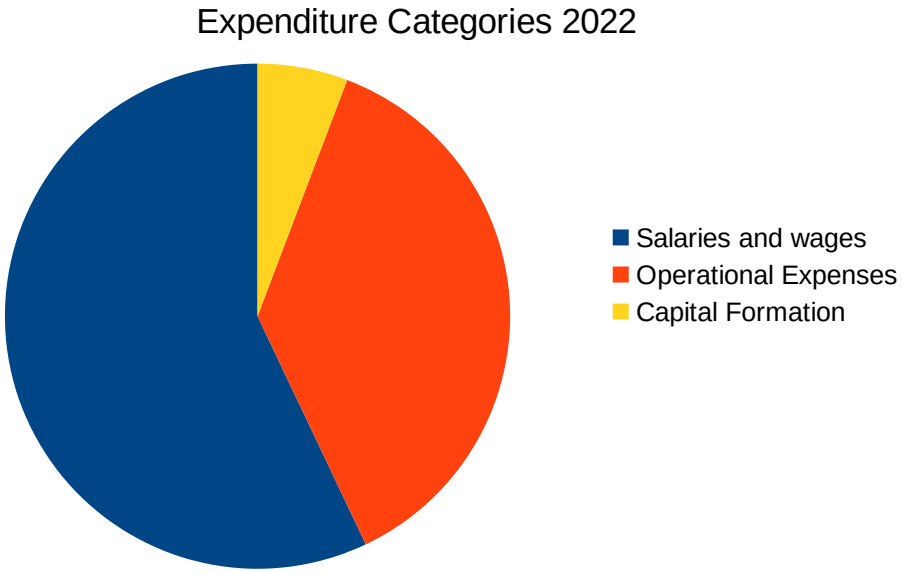

Figure 28: Expenditure categories 2022

The Institute continues to manage its expenditure under strict financial management procedures and protocols. All financial transactions in NARI are subject to annual audit by the Auditor General's Office. The Institute has a clean record of unqualified audit reports since its establishment in 1997. The financial report for the 2020 fiscal year has received an unqualified audit report. The 2021 audit is near complete.

Figure 29: Bubia generator replacement

The increasing blackouts have taken their toll on our ageing **infrastructure**, requiring expensive repairs or replacement of backup generators. Generators for both Laloki SRC and Bubia HQ were replaced to ensure basic functions could be maintained. Some losses of valuable tissue culture material was lost following the equipment failure.

These unexpected costs are reducing needed funds for other work, especially scheduled maintenance. Funding for the newly approved infrastructure development was not available in 2022.

Communications is key to both productivity and sharing of information. 2022 has been a

challenging year with the unstable power supply and a lengthy internet outage due to earthquake damage to submarine cables in the latter half of 2022. We are countering the power shortfalls to IT infrastructure with installation of solar backup power at all centres. The installation will continue into 2023 and support the internet backbone upgrade from unreliable and slower microwave to fibre optic connection at 4 centres. The lack of good internet infrastructure at Tambul in the Western Highlands and Laloki, close to Port Moresby, continues to be an issue. This will be further assessed in the first quarter of 2023.

NARI **Human Resource** management saw a reorganisation later in 2022 with the recruitment of a new Senior HR Officer who is now overseeing the HR functions under the guidance of the HR committee. Improvements are being made to records management, contract management, and performance reviews (PDR). It has been noted that further refinement is needed in the contract / PDR management area. Work has also begun on revision of the NARI Management Standards relating to HR. These are scheduled to be completed in 2023.

Sixty percent (60%) of current contract staff are engaged in science and research activities. Thirty seven percent (40%) provided management and technical support. Gender balance is also maintained within NARI, with sixty six percent (66%) Male staff and 44% Female staff making up the workforce. There is more detail in the tables provided in Annex 5.

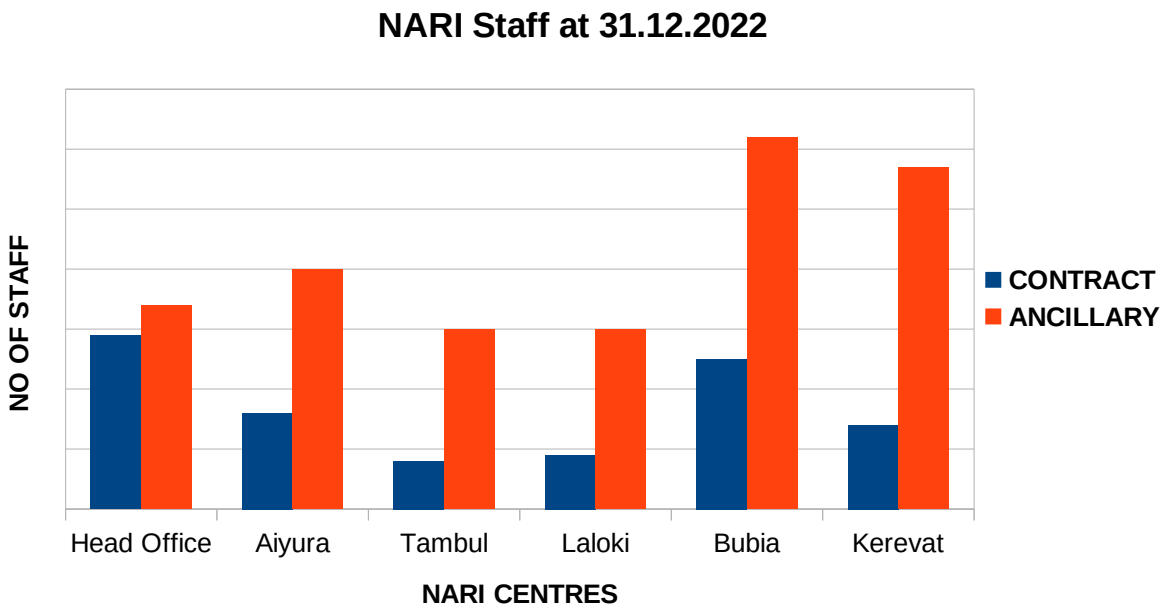

Figure 30: Staff categories at 31st December 2022

Thirteen staff have been recruited during 2022 with 10 staff leaving the institute. Emphasis on staff training and development continued in 2022 with a total of seven (7) staff members engaged in doing or have completed their Diploma or Post Graduate training programs. This represents 6.36% of current contract staff released for concentrated training. There are five (5) staff on Masters programs, One (1) staff completed Bachelor degree and one (1) staff completed Diploma course. Two staff from the Chemistry Laboratory in Kilakila undertook 3

months work place training in Pakistan. The planned retirement of long serving ancillary staff was put on hold in 2021 & 2022 due to lack of funding. The staff retirement listing is to be reviewed in 2023.

The ***Professor John Kola Chemistry Laboratory*** is accredited under the PNG Laboratory Accreditation Scheme. As an ISO/IEC 17025 registered laboratory it offers a wide range of chemical (trace and heavy metals), physio-chemical parameters (ions and anions) and bacteriological (anaerobic coliform) analyses.

While the laboratory has accreditation, scientific staff, and state of the art equipment to serve agricultural development through soil, plant, and product analysis, the demand for these services in 2022 has been disappointing. The laboratory has capacity to more widely serve the PNG agricultural industry.

Table 3: Summary of analysis of samples in 2022

Sample Types	Water	Soil	Plant	Nat Prod /Food	2022 Totals
No of Batches	**365**	**48**	**1**	**22**	**463**
No of Samples	**888**	**152**	**2**	**100**	**1,142**
No of Tests	**5,210**	**1,118**	**22**	**324**	**6,674**

The International Atomic Energy Agency (IAEA) TC RAS 5078 Project continues to provide support in development of food safety laboratory capability to perform tests on veterinary drug residues and related chemical contaminants. Under the IAEA support, 2 staff were provided work attachment training for 3 months at the Nuclear Institute of Biology & Agriculture in Pakistan.

NARI also continued to support internship industrial training at the Laboratory with six students from UPNG Waigani Campus and one from University of Technology during December 2022 to Jan 2023.

Figure 31: Aiyura TCL

NARI has two operating **Tissue Culture Laboratories** (TCL). The smaller laboratory at the Bubia Momase Regional Centre Biotechnology Laboratory has focused on research. The larger facility at Aiyura is a shared facility between NARI and Coffee Industry Corporation (CIC).

NARI has been the manager and main user of the Aiyura TCL over recent years, primarily to supply foundation material for the National seed potato program

and for producers of virus free sweetpotato planting cuttings from NARI Pathogen Tested (PT) planting material.

The Aiyura TCL maintains tissue culture of crop species for germplasm conservation, virus cleaning (PT) and mass micro-propagation for commercial purposes. The commercial use contributes to the cost of consumables and electricity, but is not yet commercially viable. 11,130 PT sweetpotato sprouted cuttings have been supplied along with 49,600 potato plantlets supplied to FPDA.

Alongside the actual tissue culture work, we are also looking at alternative methods of rapid multiplication which may be cheaper and more productive. The work in 2022 examined the protocols for this work. Figure 32 shows the advanced stage of this research. The main challenges for 2022 remain the frequent power disruptions. A replacement generator has been installed but adds significantly to operating cost.

Figure 32: Potato RMT development

The **MRC Biotechnology Laboratory** is conducting molecular research and invitro mutagenesis. The laboratory has identified the Banana Wilt Associated Phytoplasma (BWAP) causing decline in bananas in the Markham Valley, its insect vectors, and developed the tissue culture technique for providing clean planting material for the *Kalapua* and *Yawa* varieties affected. The work on mutation breeding is done with support of the International Atomic Energy Agency (IAEA) which involves preparing tissue culture material for mutation through radiation by the IAEA. Invitro mutagenesis of vegetatively propagated crops relies on reproducible tissue culture protocols. The laboratory is currently updating laboratory protocols

Figure 33: NAIC Display

The **National Agricultural Insect Collection** (NAIC) is the key service activity. The collection holds more than 200,000 insect specimens. Adding specimens to the NAIC database continues to be the main task. This is designed to be a photographic database and will have web access. Development of the NAIC database began in 2018 with recording of 24,035 specimens belonging to 2,183 species from four orders: *Lepidoptera, Hemiptera, Hymenoptera,* and *Orthoptera.* Work has been ongoing since then. This has now grown to 96,744 specimens over 16 Orders.

Figure 34: NAIC power damage

We should note though that the virtual database collection is primarily for ease of searching and cannot replace the need for a physical collection.

The maintenance requirements for the NAIC facility remain a key area of concern with the delay in the approved funding to upgrade the facility. Renovation is urgently needed to allow it to continue to serve the wider agricultural research and development community. Figure 34 shows damage to the NAIC switchboard which could have resulted in a catastrophic fire.

Appendix

Annex 1: NARI Annual Implementation Plan 2022 Achievement

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Result Area 1 – Foresighting and Advocacy		
Information on costs and benefits of key agri-food system and investment options that are inclusive, pro-poor and targeted to promote economic growth;	• Literature reviews on NARI's previous work on value chains; • New value chains of food crops with potential for commercialisation identified • Macro-economic models on future investment developed; • growth opportunities in the non-farm sector with a focus on female engagement and empowerment identified • indicators/ measures of participation by and benefits received for women, youth, and other vulnerable groups	Completed (IFPRI/NARI collaboration): One paper published: Benny et al. 2022 - Improving agricultural productivity in Papua New Guinea: Strategic and policy considerations; other paper on poultry value chain in progress Fang, P., Dickson, B., Ovah, R., Roberts, A., Schmidt, E. and Solomon, E. 2022. Expanding rural poultry production in PNG requires a network of input suppliers to ensure sustainability. Working Paper - DRAFT Dorosh, P. A., and Pradesha, A. 2022. Implications of public investments and external shocks on agriculture, economic growth and poverty in Papua New Guinea: An economy wide analysis Kosec, Katrina; Schmidt, Emily; Carrillo, Lucia; Fang, Peixun; Ivekolia, Mark; and Ovah, Raywin. 2022. Improving agricultural value chain coordination and gender inclusiveness in PNG. Papua New Guinea Food Policy Strengthening Working Paper 4. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136350 Schmidt, Emily; Fang, Peixun; and Mahrt, Kristi. 2022. Synopsis: Rural household welfare in Papua New Guinea: Food security and nutrition challenges. Papua New Guinea Project Note 9. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136320

Result Area/Targeted Output in SIP	**Outputs from projects/studies to be delivered in 2022**	**Achievements in 2022**
Increased capacity and networking in the design of agricultural transformation strategies;	• Study tour to IFPRI in Washington • Successful completion of implemented studies • Application of knowledge in other areas	• Study tour to IFPRI in Washington, DC and two NARI staff trained in macro modelling; • NARI staff liaised with staff from NRI, DNPM, Prime Minister Officer as part of the IFPRI led study and established contacts and networks; • No follow-on studies/projects as yet developed
Information on future research needs and partnerships in policy analysis and data-driven investment opportunities;	• inventory of relevant organisations/ministries/ agencies that are directly involved in agriculture and biosecurity policy formulation and regulation • Factors contributing to an environment that is conducive and effective in promoting investment growth in the agricultural sector.	Factors are captured in above publications
Communications tools used and stakeholder interactions facilitated to share information and advocate identified strategies;	• Presentations made to relevant stakeholders and policy makers on recommendations from the IFPRI funded study	• Under IFPRI leadership, a number of presentations were made to different groups of stakeholders; Presentation of preliminary results to stakeholders around Lae; stakeholder workshop in Port Moresby and a stakeholder seminar at the Prime Minister Department for policy level audience; followed by a further training on macro-economic modelling for senior GoPNG department staff;

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Result Area 2 – Value Chain Support – Value chain innovations for sweetpotato, potato and banana		
In-depth value chain mapping and research needs assessment for sweetpotato, potato and banana	• Soil fertility improvement in banana production systems in PNG (Literature review)	• The work has started but has not been accomplished by End of 2022
Soil management package for sweetpotato production systems	• Information on preliminary nutrient budgets for typical sweetpotato production system, and the nutrient response of the system to the addition of limiting macro nutrients • A range of nutrient management strategies to sustain and intensify semi-commercial sweetpotato cropping systems in the PNG Highlands developed; • Information on costs and benefits of crop management strategies such as crop rotations, hedgerow biomass incorporation, and introduced fertilisers including 'waste' materials • Capacity of smallholder families in Jiwaka to use a range of soil management techniques improved; • Field research capacity in for junior scientists and technicians at HRC increased and quality and operation efficiency at Chem lab improved;	• Trials have been completed; data analysis and soil and plant tissue analysis pending; • Options trialled include organic and mineral fertiliser options; crop rotations • Trials in farmer fields on-going; • Data analysis in progress; some trials still pending; (ACIAR funding support has been extended until May 2024) • in Jiwaka, women groups participated in Family Farm Team training assisting in adoption on new practices for soil management in sweetpotato systems; • Junior scientist on study leave for MSc training in Taiwan; one Scientist returned from MSc training; one graduate engaged as technical officer and receiving on-the-job training; mentoring from Australian scientist

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Potato and sweetpotato varieties meeting end-user requirements;	• Review of available information on potato and sweetpotato varieties • Plan to fill information gaps	Not accomplished
Gaps in availability of guidelines, protocols and systems for production of certified planting material of sweetpotato, potato and banana addressed;	• Status of virus infection in common potato varieties • Protocols for Potato Rapid propagation technique available to stakeholders • Capacity in virus diagnostic using DAS-ELISA and LAMP improved; • Protocols for tissue culture propagation for 1 diploid and 1 triploid banana types developed; • Banana and sweetpotato plantlets sent for irradiation;	• Status in common potato varieties has been established using DAS-ELISA method; 4 viruses were detected in samples of a range of varieties commonly grown in PNG in samples collected from field grown potatoes including Potato Virus (PV) X, PVY, Potato Leaf Roll Virus; the most commonly detected virus found in in-vitro samples was the PLRV; Validation using LAMP method is pending; • ELISA-DAS diagnostic was successfully applied but the time frame for building wider capacity too short; staff involved also left NARI; (Intervention completed) • in-vitro propagation protocols for several banana types from genomic groups AA, AB, AAA, ABB have been developed that target different in-vitro growth stages including (1) Surface sterilisation (2) initiation (3) Multiplication and (4) Rooting (5) Acclimatisation. • Not achieved, to be done in May-July 2023 in Malaysia (intervention continuing)

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Specific innovations in target value chains made available to actors in the value chains as part of scaling process	• PT varieties produced and supplied according to demand; • Quality Potato plantlets supplied as per agreement	• Total 11,130 PT sweetpotato sprouted cuttings supplied • 49,600 potato plantlets supplied to FPDA
Result Area 2 – Value Chain Support – Galip value chain		
Commercial viability of business models for galip nut processing improved;	• Financial analysis of operating cost at the factory and primary processing to factory gate; • Cost of production of nuts and various by-products Options for use of by-products assessed	• Analysis of business case models conducted: a) Kernel in Testa Suppliers; b) Nut-in-Pulp suppliers; Model a) returns 1/3 of national minimum wage and Model b) returns about 2/3 of minimum wage; for processors purchase of KIT is cheaper but bears more risks for quality and not possible outside the season; (Refer Project Annual Report 2021/2022 for more details on trials conducted) • Assessment of use of by-products yet to start;
Appropriate business models for micro-enterprises developed and capacity of operators increased; (Refer Project Annual Report 2021/2022 for more details on trials conducted)	• financial analysis for female smallholders selling galip or from micro-enterprises • Training modules and learning materials appropriate for micro-enterprises and female smallholders for galip production and processing • Key factors that enable micro enterprises and female entrepreneurs to effectively participate in Canarium value adding and processing	• A galip selling business models survey was developed and undertaken in ENB and New Ireland • Training modules have been developed for smallholders around supply of NIS and KIT to processors and is under review by the team to align with current best practice understandings • The social media platform-based materials have been designed, and can be translated and adapted to individual commercial needs. The inherent share-ability of this information creates a barrier to freely releasing these. • Relevant information will be informed from above mentioned surveys

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Improved production technologies developed (harvesting practices, on-farm processing;	• Information and protocol for effective and affordable off-station drying methods and protocols; • Harvesting system at different scales of operation; • Information on reproductive biology of trees and implications for tree improvement; development of a cropping calendar • Information on tree variability	• NIS drying trials were undertaken using best practice, canvas, raised mesh bed and concrete slab • A depulping trial was carried out using hot water to explore the most efficient, safe and easy method for decentralised depulping. • The processing manual has been updated to include recommendations for primary depulping at village level • Two trial test sessions on the Unitech Prototype de-pulper were conducted at NARI, IRC, Kerevat station (Refer Project Annual Report 2021/2022 for more details on trials conducted) • Trials carried out to determine how long NIP can be left on the ground before it needs to be harvested, how long a 'galip season' is or period of fruit drop, ground cover management; • A study to assess fruit development was carried out so that processors know how long it takes from fruit set to harvest., influence of altitude on fruit development on trees • A tree selection strategy has been drafted • 20 trees have been assessed for nut characteristics. This data will provide the basis for the preliminary report • A plot with marcotts from trees showing resistance/tolerance to weevil attack is in progress of establishment • An experiment is currently underway to determine if trees are self-compatible.

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Information on management options and strategies for the Galip weevil	• Information on Galip Weevil life cycle stages and protocols for in-vitro rearing of weevil; • Information on natural enemies of GW; • Information on population structure and vertical distribution maps of GW in infested trees; • information on origin and dispersal of GW; • information on alternative hosts of the GW;	• Rearing/life cycle research was undertaken at Keravat with successful oviposition. Eggs were successfully hatched and reared to the third larval stage – to continue • yet to be done (ACIAR funding support extended to June 2024) • Tree response variables were measured for 293 trees across 2020 (ENB), 2021 (NI) and 2022 (WNB) and in process of analysis; • New galip weevil surveys were conducted in 2021/2022 in ENB, as well as a major trip to West New Britain (WNB). No galip weevil was found in WNB. The WNB galip variety is hypothesised as resistant to weevil attack • Galip weevil samples were sent to partners in Australia for genomic analysis • Host plant preference research was undertaken. Adult galip weevil were found to feed on leaves and petioles of Cashew (Anacardium occidentale), wild and elite varieties of galip (Canarium indicum), Rambutan (Nephelium lappaceum) and Taun (Pometia pinnata) (2021 report). Weevil larvae were confirmed as specialist galip feeders
Suitable mechanisation options available for different scales of operation;	• Information on efficiency, suitability of depulping methods and equipment for on-station and off-station processing;	• A prototype de-pulper that can depulp nuts without need for soaking has been developed and tested; Report available

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Advocacy and Awareness on Galip production	• Media articles on areas of production, processing and marketing in print and social media	• Publication undertaken in The National March 31. Radio awareness on Radio ENB April 22
Result Area 2 – Value Chain Support – Pork Value Chain		
Effective research collaboration and networks between NARI and NAQIA on animal health & diseases.	• Participation and contribution to African Swine Fever Task force	• Meetings attended as and when requested by the ASF Task force or by NAQIA
Capacity of selected smallholder farmers on improved production practices and animal Health & welfare management and production increased.	• Information available on the impact of ASF in local household of Tambul District and disease areas • Maps documenting spatial distribution of ASF in the Mt. Giluwe LLG of Tambul based on epidemiological information	• Implementation of activities postponed to 2023
Value chain mapping and key determinants influencing output across the value chain documented;	• Improved understanding of status of the pork value chain and gaps in research (Literature review)	• Deferred to 2023
Demand & key requirements in production, processing and marketing to support niche markets for pork meat determined;	• Information on the most cost-efficient feeding regimes for weaner and for grower-finisher pigs using different commercial feeds and blended diets based on local feeds available	• Publication of results as part of a technical bulletin planned but pending;

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Result Area 3 – Household resilience – Climate Smart Solutions		
Vulnerability assessment information and maps	• Information on vulnerability status and needs to improve for 10 LLGs previously worst affected by El Nino impacts • Information on traditional knowledge and risk management in selected communities • Needs of 7x Highland provinces in relation to preparedness to cope with climate induced stresses established;	• Strengthening food production capacity and the resilience to drought of vulnerable communities, 30th January 2017 to 30th April 2022 – Final Narrative Report • Final Study Report – An assessment of indigenous knowledge and practices in managing climate variability induced risks and emergency situations: The case of Teptep, Rigo Coast and Pobuma communities of Papua New Guinea • Prioritisation done for all 7 highlands provinces and needs identified, Final report pending
Diversified climate resilient portfolios of crop varieties and species as well as livestock strategies and technologies adapted to climate risks available to stakeholders;	• Information on promising NERICA rice varieties; • Information on the use of Disaster response vegetable seed kits; • Information on use of BSFL as low cost protein source to supplement diets in village chicken	• Trials completed; Final report pending • Vegetable diversity kits containing 3-crop (triadic) combination of six vegetable species viz., amaranth, jute mallow, mung bean, Malabar spinach and okra, sourced from the WVC, distributed to over 1000 farmers, evaluated and adopted • Trials using BSFL in fish diets completed; presentation of results in Conference paper: Potential for application of Black Soldier Fly Larvae (BSFL; *Hermetia illucens*) as efficient converters of under-utilised organic farm wastes in Papua New Guinea. • Effects of water sources either fertilised or unfertilised on growth performances of mono-sex juvenile male GIFT tilapia fed a black soldier fly (BSF; *Hermetia illucens*) larval meal diet in

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
		Papua New Guinea (Research Note Unpublished)
Relevant farm practices and strategies from production to marketing (e.g. soil fertility and moisture management, storage, on-farm processing, use of seasonal farm advisory) to mitigate risks to household resilience developed and adapted;	• Effective sweetpotato storage system available for scaling and adoption by stakeholders; • Crop calendars documented for selected areas in the country • Crop intervention matrix for seasonal climate forecasts • Key crop advisories for NWS seasonal climate forecasts • Information on soil water dynamics in sweetpotato mounds established; • Information on economic benefit of the use of locally available fertilisers in vegetables, corn and sweetpotato available	• Validation of the storage sand sprouting (SSS) method for sweet potato tuber storage during drought/frost conditions in PNG for vine generation. T. Kui, J. Anton, G. Kawale, B. Komolong – Final Technical report; to be published as NARI Technical Bulletin • Documentation of crop calendars in progress, not completed • Draft matrix developed and workshop tested; work to progress in 2023 • Sample seasonal crop advisory developed for testing; work to progress in 2023 • Final report and publication pending • First season of trials implemented; continued in 2023
Scaling approaches applied for wider awareness and adoption on use of climate smart innovations in target areas;	• Capacity of extension agents in vulnerable districts in climate smart use of agriculture production technologies and practices built; • Evidence of adoption of technologies and practices for climate smart use in local agricultural food production systems in 18 LLGs in vulnerable areas; • Information on contributions and	• 4 Training of Trainer workshops on climate resilience conducted for provincial agriculture officers and NGOs. • 2 additional training manuals for use by TOT recipients developed and used. • Strengthening food production capacity and the resilience to drought of vulnerable communities, 30th January 2017 to 30th April 2022 – Final Narrative Report (EU funded Climate Change Resilience action) • see final Narrative Report for EU funded Climate Change

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
	economic benefits of drought tolerant sweet potato cultivars for strengthening household food resilience against droughts made available; • Rural hatcheries and nurseries set up in 7 locations	Resilience action, 2017-2022) • Additional sites in progress, some delay due funding delays and National General Election, 2022. • see final Narrative Report for EU funded Climate Change Resilience action, 2017-2022)
Result Area 3 – Household resilience – Disaster Response		
Sufficient quality planting material and breeding stock available as foundation material for rehabilitation after disaster events;	• Increased capacity in production of quality planting material and breeding stock at NARI Centres	• Six 20m insect proof screen houses procured for MRC and SRC. • Planned seed processing and storage at centres waiting on funds release. • Planned seed laboratory in partnership with Taiwan ICDF at MRC – delayed waiting on funds release. • Vacuum bag storage introduced to improve storage life of foundation rice seed. • High (7T/ha) rice yields ensured good stock availability • crop varieties for farm production and nutrition resilience maintained at NARI Centres.
Weather data available from all NARI Centres to stakeholders	• Weather data captured from the AWS at all Centres and captured in central database • Climate forecast information sharing platform for Hela and SHP;	• Automatic Weather Stations installed and operational in all centres. Web interface online. Online data collation delayed at three centres due to network issues. • NWS climate forecasts available on NARI website. • Forecast response guide and sample Seasonal Crop Advisory available. Ongoing collaboration with NWS in 2023.
Result Area 4 – Agro-ecosystem resilience		

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
No outputs planned for 2022		

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
Result Area 5 – Biosecurity – Management of Biosecurity Threats		
Fall Army Worm Management Package and associated information available and capacity built for use by different stakeholders;	• Information on FAW baseline sensitivity for pesticides used in control and efficacy under lab conditions; • Information on presence and identity of FAW natural enemies in selected areas in PNG	• Bio-assay protocol, methodology finalised, Materials and equipment procured. • Experiment to be conducted in 2023 • Survey completed in WHP, Simbu, Jiwaka, EHP (Highlands Region), Lae, Madang (Momase region); other regions to be completed in 2023 in collaboration with NAQIA. Distribution map available.
Additional environmentally safe options available to vegetable producers for effective management of Diamond-back moth;	• Information on Diamond Back moth baseline sensitivity for novel insecticides (BT and others) and information on efficacy of two best performing insecticides;	• Bio-assay experiment completed, data collected and in the analysis stage for scientific write up. Report pending • Field assessment with farmer engagement. (Aiyura & Kabiufa) completed; Report pending. • Farmer Survey in EHP completed, Final report pending
Improved understanding of the biology, population dynamics and management options of the Galip Weevil;	• Information on Galip Weevil life cycle stages and protocols for in-vitro rearing of weevil; • Information on origin and dispersal of GW; • Information on natural enemies of GW; • Information on alternative hosts of the	See above- update in RA2 Galip value chain

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
	GW;	
Effective management strategies of Banana-associated Phytoplasma in affected areas in Morobe and Madang;	• Information on spread of BWAP in the Markham Valley; • Information on vectors involved with transmission of BWAP in the Markham Valley • Tissue culture protocols for preferred banana varieties in the Markham Valley developed • Pathogen tested banana plantlets of preferred varieties available for distribution	• "*Confirmation of Phytoplasma as cause of Kalapua deaths and its spread and distribution in the Markham District of Morobe Province, Papua New Guinea*" authors; Rauka.G.B, Pilon.J.L, and Komolong,B. • (Abstract accepted for Full paper development in New Zealand Journal for Crop and Horticultural Science) • From lab studies four insects; colgar, Taparella, Lophopds and Dermids are primary suspect vectors; controlled field studies in progress; • groups AA, AB, AAA, ABB have been developed that target different *in-vitro* growth stages including (1) Surface sterilisation (2) initiation (3) Multiplication and (4) Rooting (5) Acclimatisation. • Close to 500 Kalapua plantlets and other cooking bananas (diploids) produced; operation was severely affected in Q3 and 4 by power issues at MRC Bubia
Standard operating manuals and procedures applied for production of quality, and pest- and disease-free planting material and breeding stock;	• Draft manual for planting material biosecurity procedures	• Not achieved – deferred to 2023
Relevant information on other pest and disease management issues	• Information on baseline sensitivity of *Phythophthora infestans* isolates to Chlorothalonil;	• Final report in progress

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
	• Information on causal agent(s) of Sago decline in AroB; • Management strategies for ascites in broiler chicken in the Highlands of PNG	• Conference paper (Huon Seminar) submitted: The Decline in Sago (*Metroxylon salomonense)* cause by a pit rotting fungi, with likely transmission by the *Rhynchophorus bilineatus* weevil, on the Island of Autonomous Region of Bougainville, Papua New Guinea: A survey Report and preliminary identification using bar-coding of the weevil and the fungi. • On-station trial has been completed; data analysis and Final report to be completed in 2023
Result Area 5 – Biosecurity – Biosecurity Preparedness		
Contribution to data bases developed for pest alert and incursion threats by NAQIA for stakeholder advise and planning.	• Specimen in the NAIC maintained and 500 specimen digitised in an electronic database;	300 specimens digitised – Poor power supply (PNG Power) has delayed digitisation and put the collection at risk due to lack of cooling and de-humidification. Electronic records are maintained with online database scheduled for 2023.
• Pest & Disease diagnostic capacity increased in supporting the sector;	• Use of LAMP diagnostic technology applied in Sweetpotato virus diagnostic; • Status of virus infection in common potato varieties • Capacity in virus diagnostic using DAS-ELISA and LAMP improved;	All experimental activities completed; Final Report to be completed in Q1 2023 • Status in common potato varieties has been established using DAS-ELISA method; 4 viruses were detected in samples of a range of varieties commonly grown in PNG in samples collected from field grown potatoes including Potato Virus (PV) X, PVY, Potato Leaf Roll Virus; the most commonly detected virus found in in-vitro samples was the PLRV; Validation using LAMP method is pending; • ELISA-DAS diagnostic was successfully applied but the time frame for building wider capacity too short; staff involved also left

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
		NARI;
Result Area 6 – Genetic Resources – Genetic Resources Management		
A pilot in-situ conservation approach to sweetpotato genetic resources is tested in four districts;	• *In-situ* conservation training manual developed; • *In-situ* conservation training conducted in 4 communities;	• Deferred to 2023 • training conducted in 1 community in Rigo
Sweetpotato cultivars characterised, phenotyped, evaluated, documented, pre-bred for traits of importance to adaptation and resilience;	• Sweetpotato cultivars in national collections characterised and phenotyped;	• Sweetpotato National Collection with 856 accessions has been regenerated and 40% of collection characterised using morphological descriptors; intervention to continue in 2023
Information on GRFA is available to stakeholders in PNG and international community;	• Sweetpotato PGR information captured in a local database and kept current capturing all PGR kept in ex-situ collections at NARI stations; • Information on sweetpotato accessions held in NARI ex-situ databases incl new breeding lines assigned DOIs from upload into Genesys/GLIS; • Information on genetic and phenotypic diversity of PNG Amaranth accessions; • Baseline data on goat breeding stock at NARI available	• Sweetpotato accessions all captured in databases including National collection at Aiyura and working collections at other centres; • Dataset for 70 accessions prepared and sent to ITPGRFA secretariat for vetting • Final report to be completed in 2023 • Baseline data established; information briefs on local sheep breeds produced
Germplasm of root and tuber	• All PGR collections are documented with	• Work in progress; most collections have information gaps;

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
crops, fruits and nuts, rice, wheat, maize, OP vegetable seed, spices maintained for further research and development purposes with minimum losses;	basic passport data and other pre-breeding information as available; • all PGR collections are numbered with respective accessions numbers in the field and field plans available;	little pre-breeding information available • accessions of PGRFA held at NARI Centres captured with assigned accession numbers in spreadsheets
Breeding stock of village chicken, cross-breeds, ducks, goats and pigs maintained at NARI centres;	• Data base of livestock GR set up; • Chicken and duck breeds characterised; • Breeders clearly marked with rings or ear marks and corresponding Stock number	• Activities deferred to 2023 • partially completed but not documented
• Compliance with contracting parties to ITPGRFA obligations	• ITPGRFA compliance report updated and submitted to the Secretariat	• Activity deferred to 2023
Result Area 6 – Genetic Resources – Genetic Resources Use and Access		
Locally adapted sweetpotato varieties (early maturing, drought tolerant, purple and orange fleshed) bred with farmers' participation;	• Selection of preferred varieties from 16 new sweetpotato varieties introduced into 4 communities in Central, Morobe, Madang and EHP Provinces from participatory variety selections; • Polycross nurseries established in selected primary schools in 4 communities and seed harvested; • Workshops conducted in 4 sites and shared learning on breeding of sweetpotato using polycross;	• Farmers in 4 communities in Central, Morobe, Madang and EHP provinces selected preferred new varieties; Technical Report pending • Polycross nurseries established in all 4 sites • activities deferred to 2023 • activities deferred to 2023

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
	• C1 evaluation at MRC and HRC completed;	
Seed systems enhanced to promote adapted sweetpotato varieties and other crops;	• New sweetpotato varieties introduced to target communities; • Increased knowledge on quality planting material of sweetpotato by target communities; • Effective sweetpotato root storage system available for scaling and adoption by stakeholders;	• 16 new accessions introduced into each of the sites • activities continue in 2023 • Validation of the storage sand sprouting (SSS) method for sweet potato tuber storage during drought/frost conditions in PNG for vine generation. T. Kui, J. Anton, G. Kawale, B. Komolong – Final Technical report; to be published as NARI Technical Bulletin
Improved rice and corn varieties released;	• 64 introduced rice varieties assessed and most promising accessions identified for on-farm trials;	• Phase I Observation trial completed (60 accessions) and Phase II Micro-plot trial with 40 genotypes completed and 15 accessions selected for macro-plot trials; Intervention to continue in 2023
New spice and essential oil varieties introduced and basic information generated;	• Priority list of spice PGR • Import permits and export approvals organised for supply from India for selected spice PGR	• Activities deferred to 2023 as per demand by stakeholders
Standard operating procedures operating in all NARI centres for production of foundation crop planting materials and breeding stock;	• Standard operating procedures for poultry breeding stock production	• Activities deferred to 2023
Facilities, equipment and infrastructure in place for	• Multipurpose shed incl seed processing set up at MRC	• Draft sketches done and agreement on size and location; Activities deferred to 2023 due to non-receipt of funds

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements in 2022
production and post harvest processing and safe storage of seed and planting material at NARI centres	• Seed laboratory developed at MRC/ICDF • Seed stores developed at HARC, HRC, MRC • Facility for PT SP production established at MRC; 2 TOs have capability to conduct grafting on *I setosa*, NCM test and maintain PT materials;	• Construction of laboratory delayed, waiting on release of funds. Electronic seed counter, incubator, oven, camera/microscope procured through Taiwan ICD. • Improving initial design and concept for seed storage in Tambul progressing; activities deferred to 2023 • Screen house procured, assembly delayed; deferred to 2023
Facilities, equipment and infrastructure in place for improved supply of poultry breeding stock at NARI Centres;	• 2 breeding sheds and hatchery set up at MRC	• Not started; funds not received for this PIP
Stakeholders access to and supply with quality breeding stock and planting material of priority crops and varieties improved;	• Foundation poultry breeding stock production and supply increased to baseline (2021) • Foundation planting material supply increased to baseline (2021) • Online portal for ordering planting material, breeding stock, and information resources;	• Baseline not established; planned for 2023 • Baseline not established; planned for 2023 • Information system framework online, ordering portal deferred to 2023

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievements for 2022
Result Area 7 – Nutritious Food and Health – Improved Diets		
Improved capacity of households to practice sustainable village poultry farming and other appropriate livestock systems in target communities and districts;	• Communities in eight districts have basic skills and knowledge and foundation poultry breeding stock for increased production of ducks and chicken;	• Activities deferred to 2023
Enhanced active involvement in households and community on equitable use and consumption of livestock and fish products from village poultry or other livestock/aquaculture systems;	• Information on needs and baseline on status of food and nutritional security generated; • Family Farm Team Training units delivered;	• Baseline survey for sites/communities in Madang completed • to be implemented to 2023
Result Area 7 – Nutritious Food and Health – Advocacy on safe and nutritious food		
Information materials produced and disseminated on nutritional properties of crop and livestock products	Information materials developed	• Not started

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievement in 2022
Cross-cutting Areas		
2.4.1 Scaling of outcomes and impacts of R4D innovations		
Inclusive and equitable partnership models and improved institutional arrangements for scaling of research outputs and providing sustainable support to target value chains, vulnerable communities and other target beneficiaries;	• MOUs developed and signed with provinces in 7x highland provinces on climate change adaptation support and provincial Didiman centres • MOUs developed and signed with Districts/Provinces in Madang and Morobe on small livestock breeding centres and support for livestock development • other partnerships established	• 6 MOUs signed with SHP, Hela, EHP, Jiwaka, Simbu, Enga; WHP not yet agreed to sign; • Madang/Morobe activity deferred to 2023 (MRC/U10015) • MOU signed with Reef and Rainforest Research Centre for South Fly Resilience project • MOU signed with University of Natural Resources and Environment
Research outcomes and impacts assessed and key drivers of success determined;	• Approach for Assessment developed	• Activities deferred until in capacity in M&E and socio-economics has been improved
Technical feasibility and commercial viability of research outputs determined;	• Commercial viability of business models for galip nut processing improved;	• Progress of work on Galip business models reported above under RA1 galip value chain
Systems and processes in place for up scaling of supply of planting material and breeding stock;	• District administration and relevant stakeholders are engaged to manage and promote sustainable farming of village poultry, fish and goats at households in selected communities; • Provincial administration and relevant	• Some informal discussions held with Madang and Morobe under PIP R&D Component 2 • PIP R&D component 1 - Hela and Enga tunnels for PT sweetpotato sprouting / multiplication in place. Sites selected by Provinces for 2023 establishment of tunnels in

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievement in 2022
	stakeholders are engaged to support resilient farming in seven highland provinces • Information and lesson's learned on set up of rural nursery and hatchery infrastructure concept including solar poultry egg incubators in selected districts in climate change vulnerable areas; • Facilities at NARI MRC and SRC upgraded	SHP, EHP, Jiwaka, and Simbu. Tunnel allocated for WHP established at Tambul in 2022. • Infrastructure established during 2022 – lessons learned to be gathered during 2023. • MRC facility upgrade commenced – will be completed along with SRC facility following funds released anticipated in 2023.
Innovative learning approaches and activities in knowledge transfer and information access to reach rural communities in ADDs developed and applied;	• Mobile app for information dissemination developed and launched; • TOT modules incl suit of learning materials fully developed for 5 modules	• Mobile app developed and available but content to be further built up • • 9 modules developed but not fully resourced as package with full set of learning materials;
Events organised enabling exchange and sharing of insights into lessons learnt from R4D interventions among stakeholders and policy makers;	• Stakeholder workshop EU CCR project • Stakeholder workshop on climate adaptation action	• Strengthening food production capacity and the resilience to drought of vulnerable communities, 30th January 2017 to 30th April 2022 – Final Narrative Report • Workshop on vulnerability assessment and application of NWS climate forecast data held with FAO/NWS/NARI. Ongoing collaboration with NWS in 2023.
Stakeholders supported with efficient and affordable diagnostic and analytical services;	• Increase of sample submission and analysis compared to baseline (2021) at Chemlab • Reduction in sample turnover time	• Baseline 2021: 9161 analysis (81.5% water analysis); total samples in 2022 were 6,674 (78% water); drop by 27% in sample analysis;

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievement in 2022
	compared to baseline (2021) at Chemlab • Tissue Culture delivery targets met	• Baseline not available • Total 11,130 PT sweetpotato cuttings supplied to customers, 49,600 potato plantlets supplied to FPDA; no current targets for SP PT; supply for potato is below target but in line with customer demand;
2.4.2 Gender, Youth and Social Inclusion		
Information access takes into account education and literacy (basic and technical literacy such as use of ICT) as well as a client friendly design of NARI's infrastructure.	• Examples of learning materials for farmer level learning are suitable for learning by groups with low literacy	• Pictorial brochure layout used for farmer level awareness materials. 8 brochures available. • Mobile App with synchronised narration to assist literacy introduced. Three resilience related topics prepared.
Assessments on the specific needs of gender, youth and other vulnerable groups are incorporated in the design of projects and programs to ensure that interventions enable equal participation and opportunity to access benefits across different social groups	• Gender analysis data captured from survey reports	• Incorporation of cross-cutting issues around GESI is considered to some extent and at a broad level mostly as per requirements by donors as part of planning of programs and projects. Translation of plans into targeted actions or design of targeted interventions to address any particular disadvantaged groups or to tailor interventions including communication products to respond to the needs of different groups captured under GESI is lacking at present primarily due to capacity at all level within the organisation.
R4D programs are tailored to capture the interest of young people in the rural areas using	• Youth of both gender feature in target population	• The principles are applied in planning workshops. The analysis for reporting will be part of the upcoming M&E

Result Area/Targeted Output in SIP	Outputs from projects/studies to be delivered in 2022	Achievement in 2022
approaches in capacity building and communication appropriate for the targeted age groups;		framework.
2.4.3 Communication for Change		
Communication Strategy	• Draft strategy developed	• Deferred to 2023
GIS databases and applications	• Project activity map	• Progressed – Framework for incorporation into https://info.nari.gov.pg using "Open Street Map completed.
Scientific, technical and general information accessible from on-line and other media platforms;	• Online platform • Funding proposal for digitisation and extended e-doc availability • Ongoing updating and increased access of stakeholders to records in the National Agricultural Information System;	• Online platform available at https://info.nari.gov.pg • Funding proposal for digitisation submitted for PIP funding • In progress. Additional funding sought to speed up the process.
Internal Information system with on-line databases on research management, Finance, HT and Assets management	• Research management database • Trip and activity report database	• Draft research management database online at https://info.nari.gov.pg • Trip and activity report database development in progress – rescheduled online Q2, 2023.

Result Area/Targeted Output in SIP	Milestones in addressing critical areas in Institutional Management and Development	Achievement in 2022
3.1 Results-based Management		
Annual Corporate Implementation Plan	• Annual Corporate Implementation Plan 2022 submitted for endorsement to 1st Council; • Annual Corporate Implementation Plan 2023 endorsed by Council in the last meeting;	• SIP 2022-2026 and SRF 2022-2031 approved and launched. • AIP2022 and AIP 2023 respectively endorsed by NARI Council
Institute M&E system – Stage I Basic capacity for M&E at project level	• Capacity building module for basic project M&E for NARI staff developed	• Delayed waiting on staff availability / recruitment
3.2 Resourcing the Institute		
3.2.1 Advocacy and Visibility		
Avenues for increased level of advocacy and dialogue at policy level created	• Advocacy, partners and policy related networking strategy; • Public Relation Officer established	• Public relations office delayed – dependent on organisation restructure • Partnership strategy to be included in communication strategy, 2023.
NARI achievements presented in diverse media and its profile raised	• Media articles (Radio, TV, Newspaper,); • Video clips; Social media posts; Press releases reporting on NARI key activities	• 37 newspaper articles, 8 Radio/television broadcasts, 71 web/Facebook posts
3.2.2 Diversifying Funding Sources		
Business plans for internal revenue activities completed and implemented	• Business plans for key income earning activities developed • Annual revenue targets met as per Business plan	I No yet implemented
Chemistry laboratory Business plan developed	• Business Plan developed that shows increasing level of cost coverage / decreasing operational subsidy by NARI recurrent funding	• Delayed

Result Area/Targeted Output in SIP	Milestones in addressing critical areas in Institutional Management and Development	Achievement in 2022
Legal and operational framework for establishment of a NARI Business arm developed	• Review of current NARI Act and options to incorporate a Business arm under current legislation;	• Delayed
NARI centre management structure and systems adjusted for improved delivery on assigned functions including revenue generation	• Restructuring plan submitted to Council	• Deferred as part of organisational restructure
Active engagement with GoPNG and donors result in annual award of diverse research for development grants and funding support	• 2 new PIP proposals developed • new proposals submitted to donors • engagement with ACIAR and DFAT for new project(s)	• 4 PIP proposals submitted covering information digitisation, smallholder mechanisation, genetic resources management, and commercialisation.
3.2.3 Investing in Human Talents		
Human Talent Management and Development Strategy (HTMDS) developed	• Review and revisions to position designations, career path progression completed and submitted to Council for endorsement; • Training plan established and implemented for NARI staff in all categories; • Concept note for NARI Cadetship Program completed • Position of Senior M&E officer scoped	• On hold for organisation restructure
Performance based Appraisal system operating	• Staff Annual Work plans submitted through rank and file; • PDR review time table implemented	• Staff work plan system implemented through centres. • Contract renewal PDR system improved, All staff Annual PDRs to be to be conducted over set period in 2023.

Result Area/Targeted Output in SIP	Milestones in addressing critical areas in Institutional Management and Development	Achievement in 2022
On-line HT Management system operating	• Leave management system operating	• 90% complete. To be tested in Q1 2023. HR records to be validated.
Annual targets in HTMDS achieved		• Critical targets achieved / system review progressed
3.2.4 Management of financial and material resources		
Integrated finance management system in NARI established with online access to reporting and project managt information	• System scoped	• Deferred to 2023
Medium-term assets and facility management and development plan developed and annual targets met	• Online fixed assets management register • NARI land use mapping and zoning plan developed • Field research area mapped, demarcated and land use history database developed in all Centres • Infrastructure Development Strategy and Implementation Plan for NARI Centres developed and implemented	• Draft online fixed asset system developed • GIS base for land use mapping prepared for next step planning of layout for land usage.
Housing estate management policy and strategy developed for NARI establishments	• Policy document developed and submission made for Council endorsement	• Delayed
Security risk mitigation strategy developed and implemented	• Analysis of security risks and mitigation strategies	• Delayed
NARI land resources secured with title and ownership ascertained	• 6 portions of land at HRC to get titles and secure	• In progress. Documentation with Regional Lands Office in Goroka.
3.3 Governance, Policies, Processes		
Revised Organisational Structure at corporate	• Restructuring plan submitted to Council	• Delayed. Assistance from DPM to be sought

Result Area/Targeted Output in SIP	**Milestones in addressing critical areas in Institutional Management and Development**	**Achievement in 2022**
level and regional centres in place		• The outline for organisational needs in SIP
HT Management policies updated or developed	• All current policies updated • Child Protection Policy- developed • OHS Policy developed	• Management Standard Terms & Conditions updated for presentation to Council.
Financial Management and procurement policies and processes updated	• Financial Management standard updated and submitted for endorsement by Council	• Delayed
ICT management policy developed	• Policy developed and submitted to Council for endorsement	• In progress, Delayed

Annex 2: Major Projects

Table 4: Major Projects

Name of Project/Study	Funding	Date	Status 31/12/2022
Strengthening food production capacity and the resilience to drought of vulnerable communities	EU	29/04/22	Completed – final report, publications available
Enhancing Disaster and Climate Resilient Agriculture in vulnerable communities in Papua New Guinea	FAO	31/05/22	Completed – final report, publications available
Informing investment for an inclusive agricultural transformation strategy in PNG	Australia DFAT / IFPRI	30/06/22	Completed – publications available
Emergency support to preventing the spread and mitigating the impacts of COVID-19 along the agricultural value chain and building resilience in food security, nutrition and livelihoods	FAO	31/12/22	Completed – final report pending, publications available
Sustaining soil fertility in support of intensification of sweetpotato cropping systems Phase II	ACIAR SLAM/2017/041	31/05/23	Continuing satisfactorily – publications available
In situ Conservation and Utilisation of Sweetpotato (Ipomoea batatas) for Climate Smart Agriculture Vulnerable Farmers in Papua New Guinea	ÌTPGRFA BSF	01/06/23	Continuing with technical delays.
Enhancing private sector- led development of the *Canarium* industry in PNG (Phase II)	ACIAR FST/2017/038	01/07/23	Continuing satisfactorily – publications available
Responding to emerging pest and disease threats to horticulture in the Pacific islands	ACIAR 2016/185	30/09/23	Continuing satisfactorily – publications available
Climate Smart Agriculture opportunities for enhanced food production in PNG	ACIAR ASEM /2017/026	31/12/23	Continuing satisfactorily – publications available
Regeneration, Conservation and Safety Duplication of Papua New Guinea Sweetpotato Germplasm Collection through Botanical Seeds at the Svalbard Global Seed Vault	BOLD/Crop Trust	31/01/24	Continuing with drought-prone delays

PNG Preparedness to Cope with Climate Change induced Stresses (Drought (frosts), Excess Moisture and Salinity)	PIP R&D	31/12/24	Continuing – publications available
Sustainable poultry, aquaculture and goat farming for economic and nutritional well being of rural communities in Morobe and Madang Provinces	PIP R&D	31/12/24	Continuing – Base line started

Annex 3: Research Studies

Table 5: Research Studies

Name of Study	Project / Funding	Ending date	Status 31/12/2022
Economic evaluation of introduced sweetpotato cultivars in strengthening climate change resilience of vulnerable households' food security in Misima and Selepet	EU-Climate Change Resilience	2022-04-29	Completed – report available
Evaluation of Promising NERICA rice Lines under Upland and irrigated Environmental Conditions in PNG (Laloki)	EU-Climate Change Resilience	2022-04-29	Completed – additional activities ongoing
Screening for potato (*Solanum tuberosum*) viruses in introduced varieties using DAS-ELISA and Loop-Mediated Isothermal Amplification (LAMP)	ARSF	2022-04-30	Completed – report pending
Assessment of variation in the relationship and genetic diversity between and within Amaranthus from Papua New Guinea by Dart fingerprinting	ARSF	2022-04-30	Completed – report pending
A reliable loop-mediated isothermal amplification (LAMP)technique for detection of Sweetpotato virus G (SPVG)	ARSF	2022-04-30	Completed – report pending
Investigation into Banana Wilt Associated Phytoplasma in the Markham valley	PIP R&D	2023-06-30	Delayed – external issues

Effects of Galip fruit depulping and nut-in-shell drying methods on kernel quality	PIP R&D	2022-12-31	Completed – report available
Analysis of business case models of galip smallholders and micro-enterprises, especially women-led households and micro-enterprises.	Galip Project (ACIAR)	2022-12-31	Completed – report available
Effects of fruit storage in traditional baskets or polypropylene bags prior to depulping and various water bath types to depulp *Canarium* fruit on kernel quality.	Galip Project (ACIAR)	2022-12-31	Completed – report available
Effects of ageing on antioxidant capacities of *Canarium* oil	Galip Project (ACIAR)	2022-12-31	Completed – report available
Galip weevil survey – WNB	Galip Project (ACIAR)	2022-12-31	Completed – report available
Wheat varieties	PIP R&D	2022-12-31	Completed – report pending
Determination of pro-vitamin (p-VAC) and carotene levels in 20 yellow/orange fleshed banana landraces	Crop Trust/Bioversity	2023-02-01	In progress
Managing pig gut health, weaning stress resilience by feeding fermented cassava and sweetpotato diets to sows and piglets	ARSF	2023-04-30	In progress
Rearing Black Soldier Fly Larvae (BSFL; *Hermetia illucens)* as an alternative source of high protein from regenerating organic farm wastes into feed for fish and chickens (Project U10008: Phase 2)	PIP R&D	2023-05-01	In progress
On-station evaluation and selection of suitable 64 new rice varieties in PNG	NARI Research fund	2023-08-31	In progress
Strategies to alleviate ascites in broiler chicken production in the high-altitude areas of Papua New Guinea (PNG).	NARI Research fund	2023-09-01	In progress

Evaluation on the performance of two Potato Rapid Multiplication Techniques on growth, potato tuber yield and quality of three commercial potato varieties at Aiyura and Tambul Stations	PIP R&D	2023-09-01	In progress
Assessing the effectiveness of Grow Hariap Foliar Fertiliser (GHFF) in managing crop productivity relative to conventional fertiliser practices.	NARI Research fund	2023-11-30	In progress
Banana (*Musa sp*) and Sweet potato in vitro mutagenesis in Papua New Guinea	IAEA/NARI Research Fund	2023-12-31	In progress
Investigating the epidemiology and economic impact of the African Swine Fever (ASF) in Tambul, WHP	NARI Research fund	2024-02-28	In progress
Optimum switch over time from starter to finisher for two broilers genotypes fed different commercial feeds	NARI Research fund	2024-08-31	In progress
Agro-morphological Characterisation of PNG Highlands Sweetpotato Germplasm for Establishment of Core Collection and their Conservation	**NARI Research fund**	**2024-12-31**	**In progress**

Annex 4: Income and Expenditure 2022

Table 6: Income and Expenditure 2022 (Interim)[1]

Descriptions	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total 2022
Income (Kina)					
GoPNG – Recurrent	2496941	3149437	3006380	3006242	11659000
GoPNG – PIP	-	500000	500000	-	1000000
Sales of Produce and Services	150238.52	303257.23	402236.38	733365.95	1589098.08
Assets Disposal	226676.2	645047.59	1350841.99	298362.36	2520928.14
Donor Project – HR and Admin Contributions	24214.33	59292.72	275954.53	168823.26	528284.84
Acquittal Reconciliations	53871.93	608604.82	344183.9	167385.58	1174046.23
Bank Interest	-	-	-	-	-
Total Funds Available	2951941.98	5265639.36	5879596.8	4374179.15	18471357.29
Expenditure (Kina)					
Salaries & Allowances	2335024.72	2432390.09	2290384.17	3207445.06	10265244.04
Travel Expenses	51497.33	113040.4	176945.57	97291	538774.3
Office Materials &Supplies	17629.45	26392.34	20605.65	23997.43	88624.87
Operational Materials/Supplies/Other Expense	898579	987264.32	1197764.48	837309.94	3920917.74
Transport & Fuel	37144.28	53213.06	86225.74	95013.12	271596.2
Council	54979.07	54979.07	54979.07	54979.07	219916.29
Legal	15601.78	15601.78	15601.78	15601.78	62407.1
Security	80099.93	80099.93	80099.93	80099.93	320399.73
Electricity and Water	101591.95	102362.24	87215.35	95352.59	386522.13
Information and Communications Technology	68252.74	59375.23	76020.65	79837.69	283486.31
Routine Maintenance	106692.08	135668.84	154991.45	193252.28	590604.65
R&M Substantive	3382.32	-	-	-	3382.32
Furniture & Office Equipment	54008.51	98613.53	141886.46	39450.79	333959.29
Purchase of Vehicles	-	-	-	221762.5	221762.5
Plant, Equipment & Machinery	9338.33	13514.01	101705.95	363129.92	487688.21
Total Expenditure	3933821.49	4172514.84	4484426.25	5404523.1	17995285.68
Net Surplus (Deficit)	-981879.51	1093124.52	1395170.55	-1030343.95	476071.61

[1]The audited 2022 financial report was not available at time of printing the Annual Report 2022.

Annex 5: Human Talent Status

Table 7: Staff roles at 31st December 2022

Distribution of Contract Staff as Per Various Categories													
Staff/ Category	Grades	Non-PNG Citizen	PNG Citizen	Sub Total	HQ	HRC Aiyura	HRC Tambul	SRC Laloki	SRC Kilakila	MRC Bubia	IRC Keravat	Total	%
Executive	Ex 4	0	1	1	1	0	0	0	0	0	0	1	1%
Director/ Manager	10 – 12	2	4	6	6	0	0	0	0	0	0	6	5%
Research Coordinator	5 – 10	0	6	6	0	1	1	1	1	1	1	6	5%
Research staff	4 – 9	0	60	60	1	13	5	6	6	19	10	60	55%
Management Support Staff	2 – 9	0	37	37	21	2	2	2	2	5	3	37	34%
Cadets	0	0	0	0	0	0	0	0	0	0	0	0	0%
Total Staff		**2**	**108**	**110**	**29**	**16**	**8**	**9**	**9**	**25**	**14**	**110**	**100%**
Male				66								66	60%
Female				**44**								**45**	**40%**

Table 8: Staff categories at 31st December 2022

LOCATION	CONTRACT	ANCILLARY	TOTAL	PERCENT (%)
Head Office	29	34	63	16.98%
Aiyura	16	40	56	15.09%
Tambul	8	30	38	10.24%
Laloki	9	30	39	10.51%
Bubia	25	62	87	23.45%
Kerevat	14	57	71	19.14%
Kilakila	9	8	17	4.59%
TOTAL	**110**	**261**	371	**100%**

Table 9: Staff movements

Staff Movement	Quarter: 1	Quarter: 2	Quarter: 3	Quarter: 4	Total
Staff Exiting	0	1	2	7	10
New Hires	0	3	8	2	13
Transfers	0	0	0	0	0

Table 10: Staff Training & Development in 2022

Name	Work Location	Training	Institute	Completion Status
Yapo Jeffery	Aiyura	Masters in Agriculture Science	National Pintung University, Taiwan	On going – complete in July 2023
Wilfred Wau	Kerevat	Masters in Agriculture Science	University of South Queensland. Australia	On going – complete in June 2023
Rodney Aku	Aiyura	Masters in Agriculture Science	University of New England, Australia	On going – complete in June 2024
Maima Sine	Tambul	Masters in Agriculture Science	University of Melbourne, Australia	On going – complete in December 2023
Tai Kui	Aiyura	Masters in Agriculture Science	Niigata University in Japan	On going – Complete in 31st March 2025
Beverlyn Pandau	Bubia	Diploma in Accounting	Pacific Institute of Leadership & Governance	Completed – October 2022
Cresencia Mathew	Head Office	Bachelor in Accounting	University of Technology	Completed - December 2022
Patrick Olou Hilda Sim	Chem Lab	Work attachment training	Pakistan Nuclear Institute of Biology & Agriculture	Completed

Annex 6: Plant Genetic Resources

Number of accessions of different crops held in ex-situ collections at NARI Centres

Crop/Centre	HRC	MRC	IRC	HARC	SRC
Sweetpotato	855	155	52	n/a	39
Aibika		13	12	n/a	54
Cassava	32	5	7	n/a	125
Yam sp	n/a	24	na/	n/a	112
Taro	n/a	216	12	n/a	67
Other Aroids	n/a	5	7	n/a	7
Banana	n/a	56	30	n/a	259
Winged Bean	n/a	n/a	n/a	n/a	15
Breadfruit	n/a	n/a	2	n/a	24
Amaranthus	n/a		n/a	n/a	25
Rice	n/a	63	n/a	n/a	
Bean and Vegetable collection	n/a	74	n/a	n/a	32
Wheat	n/a	n/a	n/a	53	n/a
Potato	n/a	n/a	n/a	8	n/a
Fruit and Nut collection	**n/a**	**n/a**	**94**	**n/a**	**n/a**

Annex 7: Publications

Journal Publications

Anton, J., Aku, R., Okrupa, M., Kud Sitango, Komolong, B., 2022. Evaluation of a Landrace Potato Kumdi Performance and Attributed Traits Across Three Different Agro-Ecological Zones in the Highlands of Papua New Guinea. International Journal of Agriculture and Biological Sciences 6, 17–28. https://doi.org/10.5281/ZENODO.6596735

Bai, S.H., Gallart, M., Singh, K., Hannet, G., Komolong, B., Yinil, D., Field, D.J., Muqaddas, B., Wallace, H.M., 2022. Leaf litter species affects decomposition rate and nutrient release in a cocoa plantation. Agriculture, Ecosystems & Environment 324, 107705. https://doi.org/10.1016/j.agee.2021.107705

Dom, M.T., Kirkwood, R.N., Ayalew, W.K., Kohun, P., Glatz, P.C., Hughes, P.E., 2022. Nutrient utilisation in Papua New Guinean mixed-genotype growing pigs fed boiled sweet potato or cassava roots blended with a wheat-based protein concentrate. Journal of South Pacific Agriculture 25.

Friedman, R.S., Mackenzie, E., Baiga, R., Inape, K., Crimp, S.J., Howden, M., 2022. Designing Climate Information Services to Enhance Resilient Farming Activities: Lessons From Papua New Guinea. Frontiers in Climate 4, 871987. https://doi.org/10.3389/fclim.2022.871987

Hainzer, K., O'Mullan, C., Brown, P.H., Ovah, R., 2022a. Consumer research in Papua New Guinea: Exploring preferences and purchasing behaviours for staple foods in an urban market. Journal of Agricultural Extension and Rural Development 14, 61–72. https://doi.org/10.5897/JAERD2022.1315

Hainzer, K., O'Mullan, C., Bugajim, C., Brown, P.H., 2022b. Exploring the design and adoption of a clean seed system for sweet potato in Papua New Guinea. Journal of Crop Improvement 36, 260–284. https://doi.org/10.1080/15427528.2021.1960456

Suruban, C., Kader, Md.A., Solaiman, Z.M., 2022. Influence of Various Composted Organic Amendments and their Rates of Application on Nitrogen Mineralisation and Soil Productivity Using Chinese Cabbage (*Brassica rapa L. var. Chinensis*) as an Indicator Crop. Agriculture 12. https://doi.org/10.3390/agriculture12020201

In-house Technical Publications

Benny, Dickson; Benson, Todd; Ivekolia, Mark; Kedir Jemal, Mekamu; and Ovah, Raywin. (2022). Improving agricultural productivity in Papua New Guinea: Strategic and policy considerations. Papua New Guinea Food Policy Strengthening, Working Paper 1. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.134987

Benny, Dickson; Benson, Todd; Ivekolia, Mark; Kedir Jemal, Mekamu; and Ovah, Raywin. (2022). Improving agricultural productivity in Papua New Guinea: Strategic and policy considerations: Synopsis. Papua New Guinea Project Note 8. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.135003

Kosec, Katrina; Schmidt, Emily; Carrillo, Lucia; Fang, Peixun; Ivekolia, Mark; and Ovah, Raywin. (2022). Improving agricultural value chain coordination and gender inclusiveness in PNG. Papua New Guinea Food Policy Strengthening Working Paper 4. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136350

Schmidt, Emily; Fang, Peixun; and Mahrt, Kristi. (2022). Synopsis: Rural household welfare in Papua New Guinea: Food security and nutrition challenges. Papua New Guinea Project Note 9. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136320

Kosec, Katrina; Schmidt, Emily; Carrillo, Lucia; Fang, Peixun; Ivekolia, Mark; and Ovah, Raywin. (2022). Synopsis: Improving agricultural value chain coordination and gender inclusiveness in Papua New Guinea. Papua New Guinea Project Note 11. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136351

Ovah, R. (2022) An Assessment of Smallholder Honey Production in the Unggai-Bena, Goroka and Lufa Districts of the Eastern Highlands in Papua New Guinea, NARI Technical Bulletin No. 26.

Anton, J., Aku, R., Okrupa, M., Kud Sitango, and Komolong, B. (2022) Evaluation of a Landrace Potato Kumdi Performance and Attributed Traits Across Three Different Agro-Ecological Zones in the Highlands of Papua New Guinea. Available at: https://zenodo.org/record/6596735 [Accessed November 10, 2022].

Maso, Winnie; Bobby, Jean; Dennien, Sandra; Hughes, Michael (2021) Aiyura klin kaukau (PT) manual: best practices for producing healthy kaukau, 171 pages, Qld Department of Agriculture and Fisheries with National Agricultural Research Institute.

Maso, Winnie; Dennien, Sandra; Hughes, Michael (2019) Klin kaukau farmer screen house management: best practices for the production of klin kaukau planting material in Papua New Guinea, 73 pages, Qld Department of Agriculture and Fisheries with National Agricultural Research Institute.

Dorosh, P. A., and Pradesha, A. (2022). Implications of public investments and external shocks on agriculture, economic growth and poverty in Papua New Guinea: An economy wide analysis

Unpublished

Fang, P., Dickson, B., Ovah, R., Roberts, A., Schmidt, E. and Solomon, E. (2022). Expanding rural poultry production in PNG requires a network of input suppliers to ensure sustainability. IFPRI/NARI Working Paper.

Katrina Kosec, Emily Schmidt, Lucia Carrillo, Peixun Fang, Mark Ivekolia, and Raywin Ovah (2022) Improving agricultural value chain coordination and gender inclusiveness in PNG; IFPRI, Working Paper No. 4

Roberts A., Lambert P., Solomon E., Dom M. (2022) Effects of water sources either fertilised or unfertilised on growth performances of mono-sex juvenile male GIFT tilapia fed a black soldier fly, *Hermetia illucens*, larval meal diet in Papua New Guinea, Research Note (Unpublished)

Conference papers

Roberts A., Dom M. (2022) Potential for application of Black Soldier Fly Larvae (BSFL; *Hermetia illucens*) as efficient converters of under-utilised organic farm wastes in Papua New Guinea, Huon Seminar 22, Lae, Papua New Guinea.

Wera, B. et al. (2022) Selection and evaluation of core samples for participatory variety selection in the lowlands and highlands of Papua New Guinea, Huon Seminar 22, Lae, 2022.

Dom, M. et al. (2022) Growth and feeding efficiency for pellet feed or improved blended meals offered to mixed genotype pigs: lowlands station trials, Huon Seminar 22, Lae, 2022.

Amben, S., et al. (2022) Effect of restricted feeding of blended sweet potato root silage or cereal-based pellet feeds on the growth performance of Papua New Guinean mixed genotype growing pigs, Huon Seminar 22, Lae, 2022.

Rauka, G., Shigaki, T, Komolong, B. (2022) The Decline in Sago (*Metroxylon salomonense*) cause by a pit rotting fungi, with likely transmission by the *Rhynchophorus bilineatus* weevil, on the Island of Autonomous Region of Bougainville, Papua New Guinea: A survey Report and preliminary identification using bar-coding of the weevil and the fungi, Huon Seminar 22, Lae, 2022.

Roberts, A., Dom, M. (2022) Potential for application of Black Soldier Fly Larvae (BSFL; *Hermetia illucens*) as efficient converters of under-utilised organic farm wastes in Papua New Guinea, Huon Seminar 22, Lae, 2022.

Sirabis W.,Kui T., Jeffery Y., Simo F., Kirchhof G., Menzies N., Weh B. (2022) Sweetpotato production and plant available phosphorus in crop rotations in the PNG Highlands, Poster presentation, TropAg, Conference, Brisbane, 2022.

Reports

NARI (2022) Narrative Report for EU funded Climate Change Resilience action, 2017-2022)

NARI (2022) Annual Report 2021, Corporate Document 4/2022, National Agricultural Research Institute, Lae, PNG.

NARI (2022) NARI Strategy and Results Framework 2022-2031, Corporate Plan 1/2022, National Agricultural Research Institute, Lae.

NARI (2022) NARI Strategic Implementation Plan 2022-2026, Corporate Plan 2/2022, National Agricultural Research Institute, Lae.

NARI (2022) NARI Annual Implementation Plan 2022, Corporate Plan 3/2022, National Agricultural Research Institute, Lae.

The following reports were produced under the collaborative Galip Project at Kerevat, *Enhancing Private Sector-led Development of the Canarium Industry in PNG – Phase 2*

Bai S.H., Hannet D., Grant E., Jones K., Wallace H. (2022) Effects of fruit depulping and nut-in-shell drying methods on kernel quality over 12 months. Galip Project Report.

Galip Project Team (2022) Effects of fruit storage in traditional baskets or polypropylene bags prior to depulping and various water bath types to depulp *Canarium* fruit on kernel quality. Galip Project Report.

Bai S.H., Hannet D., Tonissen K., Trapani D., Wallace, H. (2022) Effects of ageing on antioxidant capacities of *Canarium* oil. Galip Project Report.

Young D. (2022) Analysis of business case models of galip smallholders and micro-enterprises, especially women-led households and micro-enterprises. Galip Project Report.

Kill E., Pamphilon B., Hodges B. (2022) Galip sellers survey – New Ireland preliminary report. Galip Project Report.

Pamphilon B., Hodges B., Kill E. (2022) University of Canberra Milestone 4 Report for Enhancing Private Sector-led Development of the *Canarium* Industry in PNG – Phase 2. Galip Project Report.

Galip Project Team (2022) Report on experiments to develop appropriate galip harvesting systems. Galip Project Report.

Yombai J.,Martin D., Cassis G. (2022) Galip weevil survey – West New Britain 2021. Galip Project Report.

Yombai J. (2022) Galip Weevil Fact sheet, NARI Brochure, National Agricultural Research Institute, Kerevat.

Hannet G. (2022) Tree Breeding and Selection Strategy. Galip Project Report, National Agricultural Research Institute, Kerevat.

Puy, Andrew (2022) Field Testing and Evaluation (2021/2022) of Prototype Galip Nut Depulping Machine. Galip Project Report.

The following titles are accepted for publication in 2023 by the New Zealand Journal for Crop and Horticultural Science, in a special issue for the Pacific Islands.

- A novel galip nut ecotype mediated population dynamics and range expansion of a native and poorly known weevil to be a threat to the galip nut industry – Jacob Yombai, Gerry Cassis, Godfrey Hannet, Birte Komolong
- Biological contaminants during *in vitro* establishment of nursery derived sweetpotato at Aiyura, EHP – Winnie Maso and Birte Komolong
- Survey confirms Phytoplasma as cause of Kalapua deaths and reveals its spread and distribution in the Markham District of Morobe Province, Papua New Guinea – Gou Rauka, Joel Pilon, Birte Komolong
- Improved storage root yields under low input soil management practices and virus-free planting materials in intensified sweetpotato cropping systems of the Papua New Guinea Highlands – William Sirabis, Yapo Jeffery, Floyd Simo, Bernhard Wehr, Neal Menzies and Gunnar Kirchhof
- Cultivation System, Genotypes with Associated segments Influence level of Oxalate in Taro (*Colocasia esculenta* L.) - Joel Pilon, Miriam Simin, Jeffrey Waki, Birte Komolong;
- Effect of Nitrogen Application on Taro (*Colocasia esculenta)* Yield and Oxalate Level Under Wet Lowlands – Joel Pilon, Miriam Simin, Jeffrey Waki, Birte Komolong
- Rauka.G.B, Pilon.J.L, Komolong,B. (2022) Confirmation of Phytoplasma as cause of Kalapua deaths and its spread and distribution in the Markham District of Morobe Province, Papua New Guinea"

Annex 8: The Institute

The **National Agricultural Research Institute (NARI**) was established by an *Act of the National Parliament of Papua New Guinea (PNG)* in July 1996 as a public funded, statutory research organisation to conduct and foster applied and adaptive research into:

IV. any branch of biological, physical and natural sciences related to agriculture;

V. cultural and socio-economic aspects of the agricultural sector, especially of the smallholder agriculture; and

VI. matters relating to rural development and of relevance to Papua New Guinea.

Under the NARI ACT (1996), the Institute was given responsibility for the following functions:

- to generate and adapt agricultural technologies and resource management practices appropriate to the needs, circumstances and goals of smallholders.
- to promote and facilitate applied and adaptive research in food crops, livestock, alternative cash crops, and resource management.
- to promote the use of appropriate technologies and provide essential technical services to improve the productivity, income, nutritional status and food security, resource base and quality of life of rural households and communities.
- to develop and promote ways of improving the output, quality, harvesting, post-harvesting, handling and processing and marketing of food crops, livestock produce and alternative crops.
- to maintain and conserve the diversity of genetic resources for food and agriculture, act as custodian for these resources, and promote the effective utilisation of these resources in the country; and to update and maintain the national inventory on soil resources.
- to develop, promote and maintain sustainable practices in agriculture.
- to provide agricultural information services, extension service support and other such assistance packages to the agricultural sector.
- to provide liaison and access to international agencies that promote agricultural development
- to formulate national agricultural research policies, define sectoral research priorities and allocate funds and advise the Minister and the National Executive Council on these matters.

The Institute Council reports to the Ministry of Agriculture.

Governance

Figure 35: NARI Council 2022

Table 11: Composition of the Council, 2022-2025

Name	Constituency Represented
Mr Nimo Walter Kama Chairman	Smallholder Farmers
Mr Pius Piskaut Deputy Chairman	University of Papua New Guinea
Dr Patrick Michael	PNG University of Technology
Mrs Maria Linibi	Smallholder Women Farmers
Mr Humphrey Saese	Smallholder Farmers
Mr Ronnie Ilam	Growers' Association
Mr Francis Daink	Department of Agriculture – Secretary's Nominee
Mr Sioni Ioa	Department of Treasury - Secretary's Nominee
Mr Warea Orapa	NARI Management – a/Director General

The National Agricultural Research Institute Act, 1996, sets forward the roles and responsibilities of the NARI Council in providing governance for the organisation. This ensures the separation of governance from the management. It is the Council's role to approve strategic directions and structures for control and accountability. The Council safeguards and supports the implementation of the mission of the organisation, integrates

organisational interests and stakeholder interests, and serves as a link to NARI's constituencies. The Director General manages the affairs of the organisation to deliver the objectives and targets according to NARI's strategic directions as determined by the Council, and in compliance with the NARI Act and Council approved policies and procedures.

The Council is the final authority of NARI. The Institute was reporting to the Minister for Higher Education, Research, Science and Technology until recently through National Gazette No# G690 of 31st August 2022 on Determination of Titles and Responsibilities of Ministers, NARI is now reporting to the Minister for Agriculture. The membership is made up of nominated representatives from the agricultural sector, Higher Education, and Ex-Officio representatives of key Government Departments.

The non-Ex-Officio Council members were appointed in April 2022. The Council convened on three occasions in 2022.

NARI is guided by five core values:

Our Core Values

The five Core values provide the foundation for an organisational culture in NARI that is focused on leading in agricultural research for development and delivering innovative solutions to its stakeholders in agricultural and rural development.

Leadership is a key value for the future of the Institute. NARI needs leaders who are visionary, apply systemic thinking and serve as inspiring role models at different levels of the operation. Leaders should wish to serve, help others to see beyond the obvious and look forward to the new possibilities of shaping the future. This leadership aspiration extends to the aim for NARI to be a leading agricultural research organisation in PNG and the Pacific.

Innovativeness is a leading principle for the Institute as a leader in Agricultural Research for Development (AR4D). This encompasses catalysing, facilitating and incentivising creativity in all facets of organisational behaviour to ensure responsiveness to the changing external environment and encouragement of innovation as an on-going process in agricultural development.

Integrity at all levels of the organisation is the basic moral fabric that guides our behaviour and conduct. We uphold high transparency and accountability standards and believe in consistency between words and deeds, trust, unity and honesty within the organisation, with our valued partners and engagement with rural communities and other stakeholders.

Communication is a foundational value for NARI to reach all stakeholders. Communication needs to be clear, intentional, and effective and incorporate feedback as essential part in on-going organisational learning.

Organisational Excellence and Relevance is applied at all levels of the Institute. With a strong client focus, we plan and strive to be systematic and efficient and promote scientific rigour in research for development at high standards.

Our Strategy

In its Vision for PNG, NARI sees *Prosperous PNG Agricultural Communities* through its Mission of promoting innovative agricultural development in PNG through scientific research, knowledge creation and information exchange. This is to be accomplished through the Institute's Purpose (Strategic Objective) of *enhanced productivity, efficiency, stability and sustainability of the smallholder agriculture sector in the country so as to contribute to the improved welfare of farming and rural communities who depend wholly or partly on agriculture for their livelihoods*.

Our strategy aligns and contributes directly to the achievement of the GoPNG Development Goals, which also cascade from the UN Sustainable Development Goals (SDGs), the PNG Vision 2050, and PNG's DSP 2030, PNG Medium-Term Implementation Plan (MTDP3) 2018-2022, and the Agriculture Medium Term Development Plan (AMTDP), 2020-2022. The medium-term strategies and priorities are documented in the NARI Strategy and Results Framework 2022-2031 and NARI Strategic Implementation Plan (SIP) 2022-2026, and have guided the NARI research directions for 2022.

To deliver on its research mandate, NARI has its head office situated in Bubia, Lae, Morobe Province with regional centres established according to agro-ecological areas covering the dry lowlands, wet lowlands, highlands and high altitude highlands (Fig. 36). See Annex 8: The Institute for more details on the NARI regional centres.

NARI Regional Centres

NARI Head Office is located outside Lae, at Bubia in the Morobe Province. There are five regional centres and tree technical facilities. The regional centres are distributed throughout the country to enable adaptive research specific to the respective agro-ecological zone where they are located. While the centres primarily serve the region where they are located with research, information, and genetic resources, the location allows the centre to conduct research which can then be applied to similar agro-ecological zones anywhere in PNG. All centres have recently been equipped with automatic weather stations which are networked with the NARI website, and will supplement the national climate data collated by the National Weather Service.

Highlands Regional Centre

The Highlands Regional Centre (HRC) is in the Aiyura valley, close to the township of Kainantu, Eastern Highlands province. HRC Aiyura is situated at an altitude of 1664 metres above sea level (masl). The centre supplies the demand for foundation planting material for improved crop varieties and other planting materials for both commercial production and building of resilience to climate change and other natural disasters. HRC is the centre for several research studies in soil management and pest management, particularly in relation to the sweetpotato value chain.

High Altitude Regional Centre

Tambul in the Western Highlands province at 2200masl focuses on locations in the higher altitude range, from 1,800 to 2,850 masl.

The centre maintains planting material to supply foundation stock for adapted village chickens and high altitude adapted crop varieties for both commercial production and building of resilience to climate change and other natural disasters. Key focus crops have been potato, sweetpotato, wheat, and pyrethrum.

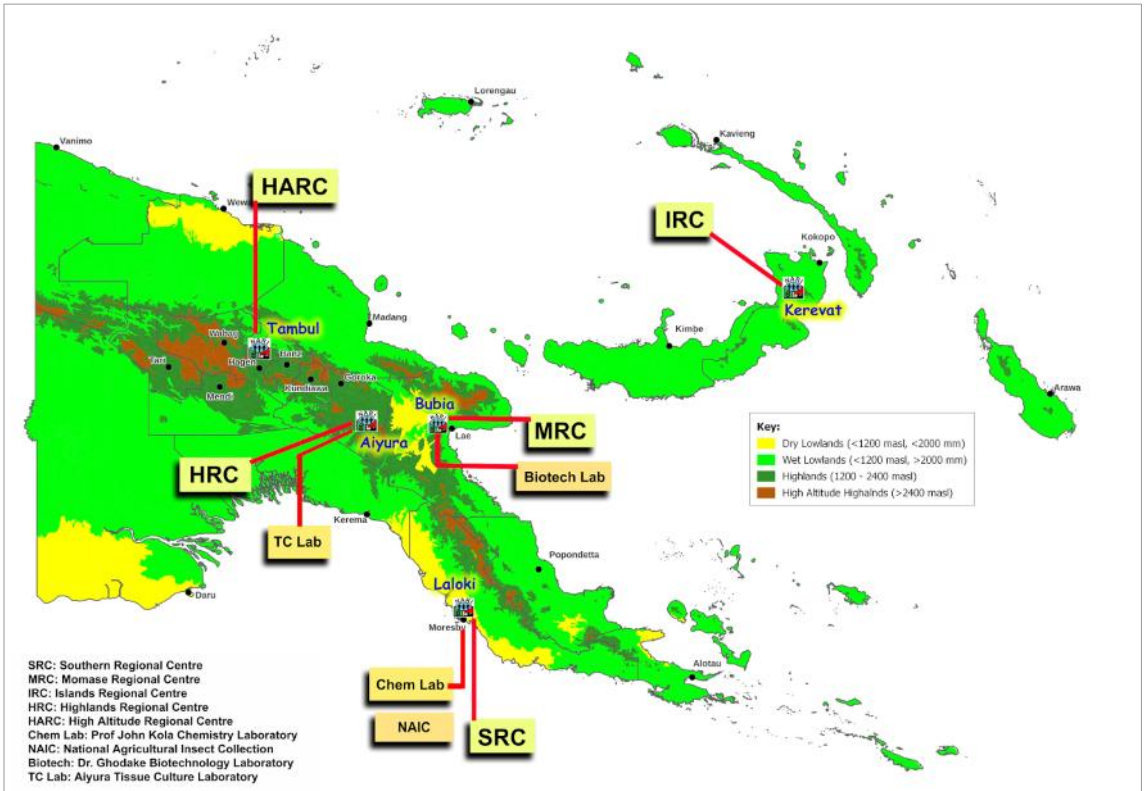

Figure 36: NARI Regional Centres

Islands Regional Centre

The agro ecological zone for the Islands Regional Centre (IRC) is the wet lowland and islands including atolls. Formerly known as Lowland Agriculture Experimental Station (LAES), the IRC is based at Keravat in the Gazelle Peninsula of the East New Britain Province. It services the agricultural research needs of the five island provinces of East New Britain, West New Britain, New Ireland, Manus and the Autonomous Region of Bougainville.

Galip research and development piloting value chains of quality Galip primary and secondary product (kernel, oil), has been a key focus for the Islands Regional Centre. Apart from Galip, maintenance of germplasm collections of food and cash crops of the region and implementation of the EUCCR and CSA projects have been key activities.

Momase Regional Centre

The Momase Regional Centre (MRC) research and development activities are coordinated from Bubia, Lae, Morobe province. Research and development initiatives at MRC is focused on both livestock and food crop improvement; germplasm maintenance; pest and disease

management; post harvest and food technology; lowlands food crop screening, evaluation and multiplication; integrated farming systems, and marketing systems.

The main focus of livestock research for development is on the delivery of appropriate technologies to make smallholder livestock production more effective and sustainable, especially on developing low cost feeding options through enhanced utilisation of local feed resources for priority small livestock such as pigs, chickens, ducks, goats, sheep and rabbits.

MRC also hosts a biotechnology research laboratory. The current focus has been on disease diagnosis using molecular tools, development of tissue culture protocols for the response to BWAP, and development of protocols for preparation of materials for invitro mutagenesis.

Southern Regional Centre

The Southern Regional Centre (SRC) is located at Laloki in the Central Province, about 30 km outside the capital, Port Moresby. Research and development activities of the Centre are focused on dry-lowland areas of the country. The Southern Region includes the Western Province through to Gulf and Central to Milne Bay and Oro Provinces.

Most of the current research and development activities are related to building climate change resilience under a European Union funded action, and multiplication of quality foundation seed with assistance from the Taiwan Technical Mission (Taiwan ICDF). The Centre also conducts conservation, characterisation, evaluation, maintenance and documentation of the national plant genetic resources (PGR) ex-situ collections of banana, yam, cassava and aibika.

National Agricultural Insect Collection

The National Agricultural Insect Collection (NAIC) located at Kilakila, Port Moresby. NAIC provides an insect identification service and holds more than 200,000 insect specimens.

Prof John Kola Chemistry Laboratory

The John Kola Chemistry Laboratory located at Kilakila, Port Moresby. It is an ISO/IEC 17025 registered laboratory and offers a wide range of services including chemical (trace and heavy metals), physio-chemical parameters (ions and anions) and bacteriological testing.

Aiyura Tissue Culture Laboratory

The tissue culture laboratory in HRC Aiyura is a shared facility with the Coffee Industry Corporation (CIC). NARI manages the facility and has been able to consistently provide pathogen free potato plantlets to the Fresh Produce Development Agency (FPDA) as foundation material for the national seed potato scheme. Supply of foundation planting material of potato late blight (PLB) resistant potato varieties continues as a key contribution to the commercial potato industry, reducing the need for chemical fungicides. The laboratory also provides pathogen free (PT) sweetpotato cuttings of commercial varieties.

Annex 9: Acronyms and Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AIP	Annual Implementation Plan
AR4D	Agricultural Research For Development
BCS	Bogia Coconut Syndrome
CCR	Climate Change Resilience
CSA	Climate Smart Agriculture
CIP	International Potato Centre
CPL	City Pharmacy Limited
DAL	Department of Agriculture and Livestock
ENB	East New Britain
EU	European Union
EUCCR	European Union funded action for climate change resilience
FAW	Fall Army Worm
FPDA	Fresh Produce Development Agency
GRFA	Genetic Resources For Agriculture
HARC	High Altitude Regional Centre
HRC	Highlands Regional Centre
IAEA	International Atomic Energy Agency
ICDF	Taiwan International Cooperation and Development Fund (TTM Taiwan)
IPM	Integrated Pest Management
IRC	Islands Regional Centre
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
KIT	Kernel in Testa (Galip)
LAES	Lowlands Agricultural Experiment Station
LLG	Local Level Government
MRC	Momase Regional Centre
NAIC	National Agricultural Insect Collection
NARI	National Agricultural Research Institute
NAQIA	National Agricultural Quarantine Inspection Authority
NGO	Non-Government Organisation
NIP	Nut in Pulp
NIS	Nut in Shell
PGR	Plant Genetic Resources
PIP	Public Investment Program
PMNEC	Department of Prime Minister and National Executive Council
PPP	Public Private Partnership
PT	Pathogen Tested
RA	Result Area
R4D	Research for Development
SIP	Strategic Implementation Plan
SP	Sweetpotato
SRC	Southern Regional Centre
SRF	Strategy and Results Framework
SSS	Storage, Seed, Sprouting
TADEP	Transformative Agriculture & Enterprise Development Program
TLC	Tissue Culture Laboratory
TOT	Training of Trainers

NARI Logo - *The letters NARI are the initials of the National Agricultural Research Institute. The PEOPLE symbolise those included in the mandate of NARI such as farmers, researchers, extension agents, partners, NGOs etc., backed with BLUE to encompass the sky and the macro environment. The LEAF symbolises crops, backed with GREEN to depict the crop environment. The PIG and CHICKEN heads symbolise livestock. The RED background portrays the toil and sweat of the people.*

Our international development partners play a key role in enabling the National Agricultural Research Institute to achieve its development objectives. The Institute gratefully acknowledges the generous support of our international partners.

Australian Government
Australian Centre for International Agricultural Research

ICDF

IAEA

PNGAus Partnership

Bioversity International

Food and Agriculture Organization of the United Nations

The International Treaty on Plant Genetic Resources for Food and Agriculture

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