

2020 Annual Report



Promoting Excellence in Agricultural Research for Sustainable Development

The **National Agriculture 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.

NARI is responsible for providing technical, analytical, diagnostic and advisory services and up-to-date information to the agriculture sector in PNG.

The Institute's purpose (strategic objective) is to accomplish enhanced productivity, efficiency, stability and sustainability of the smallholder agriculture sector in the country so as to contribute to the improved welfare of rural families and communities who depend wholly or partly on agriculture for their livelihoods. This is intended to be accomplished through NARI's mission of promoting innovative agricultural development in Papua New Guinea through scientific research, knowledge creation and information exchange.

In its vision for PNG, NARI sees ***"Prosperous PNG Agricultural Communities"***.

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.

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2020 Annual Report

National Agricultural Research Institute
Lae, Papua New Guinea

June 2021

Distribution of this annual report is available through our website
(<https://www.nari.org.pg>) or by contacting:

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Acronyms and Abbreviations

ACIAR	Australian Centre for International Agricultural Research
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
HAHRC	Highlands High Altitude Regional Centre
HRC	Highlands Regional Centre
IAEA	International Atomic Energy Agency
ICDF	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
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
NISIT	National Institute of Standards and Industrial Technology
PGR	Plant Genetic Resources
PIP	Public Investment Program
PNGIF	Papua New Guinea Incentive Fund
PPP	Public Private Partnership
PPAP	Productive Partnership in Agriculture Project
PT	Pathogen Tested
R4D	Research for Development
SP	Sweetpotato
SRC	Southern Regional Centre
SRF	Strategy and Results Framework
TADEP	Transformative Agriculture & Enterprise Development Program
TOT	Training of Trainers
TTM	Taiwan Technical Mission to PNG (ICDF Taiwan)

Foreword

Greetings to you all from the NARI Council! While our Council has only recently been appointed to NARI, it gives us great pleasure to share with you NARI's progress during 2020.

2020 was a very challenging year which truly tested most organisations and NARI was no exception. The Covid19 pandemic brought both challenges and opportunities. The uncertainty with the severity of the pandemic and its effect on global trade caused PNG and many other countries to consider their food security and the importance of agricultural research.

While an early lock down curtailed some events, it is pleasing to note that even with the challenges, NARI staff showed their commitment to project objectives and enabled the Institute to not only survive, but make significant progress.

The recruitment of an experienced Commercialisation Manager in September 2020 proved a key move in showing new opportunities available for NARI to grasp. While NARI's primary role is in research, the demonstration of scaling of research outcomes to commercial success is essential to our country's future. With the research centres having under-utilised land valued at near K274m, it is important that NARI includes a commercial scaling approach to show a significant return on this government investment.

Work continued on development of the new ten year *NARI Corporate Plan for 2021-2030*. The lead *Strategy and Results Framework* component was developed to an advanced state, laying the ground work for development of the strategic implementation plans and organisational structure needed to ensure an effective Agricultural Research for Development environment.

The key research outcomes revolved around climate change adaptation and resilience with our development partners from the European Union and the Australian Centre for International Agricultural Research. NARI is also contributing to the African Swine Fever and Fall Army Worm responses as they have developed into major biosecurity concerns.

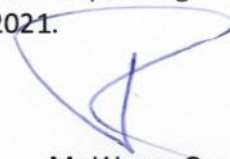
The year saw many of the long serving NARI support staff retire, and in December, four long serving contract staff at the Momase Regional Centre also retired. We thank them all for their contribution to NARI and Papua New Guinea agricultural development.

NARI received an *Unqualified Audit Report*, certified by the Auditor General's Office, for the 2019 financial year. Our thanks and congratulations to the Financial Controller and team.

The Council wishes to express its appreciation to all NARI staff and to our partners for their commitment and contributions which underpins the organisation's expanding achievements. We look forward to your continued support in 2021.



Prof. Topul Rali
Chairman, NARI Council



Mr Warea Orapa
Acting Director General

About NARI

General Overview

NARI has been promoting ***excellence in agricultural research for development*** since its establishment in 1996. The Institute was under the Ministry for Agriculture and Livestock but was brought under the Ministry of Higher Education, Research, Science and Technology in 2002. Our research and development efforts are focused on a range of food crops, emerging food and cash crops, smallholder livestock and resource management issues. We also provide technical, analytical and diagnostic services and up-to-date information to the agriculture sector.

NARI endeavours to meet and deliver on its institutional objectives under its four strategic programs.

They are:

- 1 Agriculture Systems
- 2 Enabling Environment
- 3 Information and Knowledge,
- 4 Institutional Management and Development



The NARI Headquarters is situated in Bubia, Lae, Morobe Province with regional centres established according to agro-ecological areas such as the Momase Regional Centre in Bubia and Labu, Highlands Regional Centres in Aiyura, Eastern Highlands and Tambul in the Western Highlands, Islands Regional Centre at Kerevat, East New Britain and Southern Regional Centre in Laloki, Central province.

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.



Council

The *National Agricultural Research Institute Act, 1996*, sets forward the roles and responsibilities of the Council in providing governance for the organisation. This ensures the separation of governance from the management. In general, it is the Council's role to set strategic directions and determine structures for control and accountability.

In this regard, the Council is the final authority of NARI and it reports to the Minister for *Higher Education, Research, Science and Technology*.

During 2020, the Institute Council met three times. These meetings deliberated on a number of policy and strategic issues fundamental to the running and development of the Institute. The key outcomes have been the unqualified Audit Report for 2019, Annual Report for 2019, External environment review to inform the Strategy and Results Framework development, and an Income & Expenditure Plan for 2020. The Council advertised for the position of Director General (Expired December 2019) but insufficient suitable candidates were available to continue the process. The recruitment has been deferred to 2021.

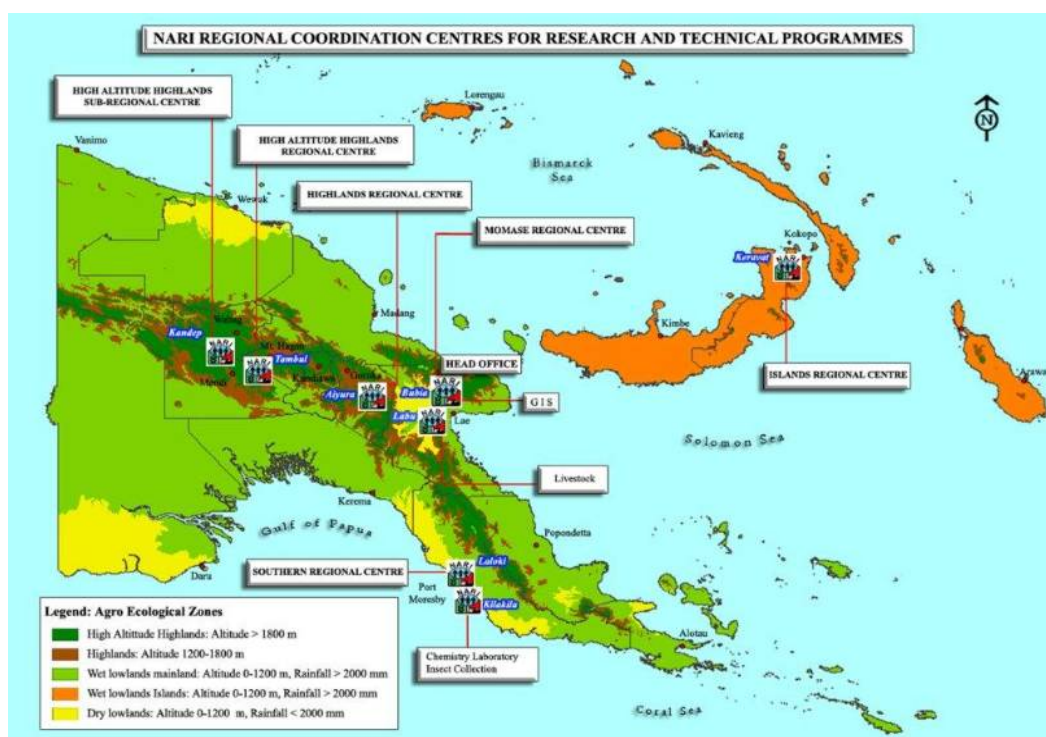
Membership of the 2020 Council is listed below. All *non-Ex-Officio* Council members will expire early in 2021 (February 1). A new Council to lead the Institute will be formed early in 2021.

Table 1: Composition of the Council, 2020

Name	Constituency Represented	Status
Professor Chalapan Kaluwin, <i>Chairman</i>	University of Papua New Guinea UPNG Nominee	Expires Feb. 1, 2021
Vacant	Smallholder Farmers – Highlands Region	Expired July 2019
Mr Paul Yepei, <i>Member</i>	Smallholder Farmers – Southern Region	Expires Feb 1, 2021
Dr Ora Renagi, <i>Member</i>	PNG University of Technology – Vice Chancellor	Expires Feb. 1, 2021
Vacant	Growers' Association	Expired July 2019
Vacant	Women Smallholder Farmers	Expired July 2019
Mr Francis Daink, <i>Member</i>	Department of Agriculture and Livestock – Secretary's Nominee	Ex-Officio
Mr Timothy Mais, <i>Member</i>	Department of Treasury – Secretary's Nominee	Ex-Officio
Dr Sergie Bang, <i>Member</i>	NARI Management – Director General	Ex-Officio
Mr Clifton Gwabu, <i>Observer</i>	NARI Staff Nominee	Expired mid 2020

NARI Regional Centres

NARI has five regional centres located around the country according to agro-ecological zones. They are the Momase Regional Centre at Bubia, Morobe province, the Islands Regional Centre at Kerevat, East New Britain province, Southern Regional Centre, Laloki, Central province, Highlands Regional Centre in Aiyura, Eastern Highlands and Tambul in Western Highlands.



The regional centres are designed to carry out adaptive research specifically for their respective agro-ecological areas based on identified constraints and opportunities of farming communities.

Highlands Regional Centres – Aiyura and Tambul

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

These two centres have been able to supply to the farming communities demand for improved crop varieties and other planting materials for both commercial production and building of resilience to climate change and other natural disasters. The tissue culture laboratory in HRC Aiyura has been able to consistently provide pathogen free Irish Potato plantlets to the Fresh Produce Development Agency (FPDA) as foundation material for the National seed potato scheme. The laboratory also provides pathogen free sweetpotato

cuttings of locally accepted commercial varieties. Supply of foundation planting material of potato late blight (PLB) resistant Irish Potato varieties continues as a key contribution to the commercial potato industry, reducing the need for chemical fungicides.

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, 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.

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. Attached to the Centre are the National Agricultural Insect Collection and the John Kola Chemistry Laboratory located at Kilakila, Port Moresby. The John Kola Chemistry Laboratory 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 (anaerobic coliform) testing.

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) collections of banana, yam, cassava and aibika in field conditions.

Agricultural Research for Development



Major Projects

Project portfolios are guided by the medium-term strategies and priorities as documented in the NARI Strategy and Results Framework 2011-2020, Strategic Program Implementation Plan (SPIP) 2012-2020, and Medium-Term Implementation Plan 2017-2020. The following table lists the current research projects funded through our international development partners and the PNG Public Investment Program (PIP). Most NARI research studies are funded through these major projects.

Table 2: Projects funded through Development partners and PNG PIP

Supporting commercial sweetpotato production and marketing in the PNG highlands (TADEP) <i>An ACIAR funded project led by CQU in partnership with NARI, FPDA, ANU and QDAFF. Project to sustainably increase the contribution of the sweetpotato crop to cash income and food security, via transformative improvements in selected sweetpotato value chains</i>	HORT/2014/097 Completion: February 2021
Developing improved crop protection options in support of intensification of sweetpotato production in Papua New Guinea <i>An ACIAR funded project led by Charles Sturt University in partnership between NARI, FPDA, UOT in PNG and USQ in Australia. Project developing, testing and promoting the adoption of sustainable solutions to protect sweetpotato crop production</i>	HORT/2014/083 Completion: August 2021
Strengthening food production capacity and resilience to drought of vulnerable communities (EUCCR) <i>A European Union funded action to contribute to achieving a greater resilience of smallholder farming and rural communities in Papua New Guinea to abiotic stresses arising from seasonal weather patterns, climate change or natural disasters and impacting on their livelihood.</i>	FED/2016/382-604 Completion: July 2021
On-farm diversity Root, Tuber, and Banana crops	Bioversity Int./Crop trust Completion: October 2021
Efficiency and Profitability in Local Honey Production by Smallholder Farmers in Eastern Highlands Province (Honey)	ACIAR FST/2014/063

<p>Sustaining soil fertility in support of intensification of sweetpotato cropping systems</p> <p><i>An ACIAR funded project led by UQ in partnership in partnership with NARI. Project providing farmers with a range of nutrient supply options to underpin the sustainable intensification of the PNG Highland sweetpotato cropping system.</i></p>	<p>SMCN/2012/105</p> <p>Completion: April 2023</p>
<p>Responding to emerging pest and disease threats to horticulture in the Pacific islands</p> <p><i>An ACIAR funded project led by UQ with partners from NARI, Fiji, Samoa, Tonga, Solomon Islands, and SPC. Project aims to develop integrated pest and disease management strategies for the sustainable intensification of fruit and vegetable crop production, addressing the threats posed by the inappropriate use of pesticides, emerging pests and diseases and climate change.</i></p>	<p>HORT/2016/185</p> <p>Completion: September 2023</p>
<p>In situ Conservation and Utilisation of Sweetpotato (Ipomoea batatas) for Climate Smart Agriculture Vulnerable Farmers in Papua New Guinea</p>	<p>ITPGRFA BSF</p> <p>Completion: June 2023</p>
<p>Climate Smart Agriculture opportunities for enhanced food production in PNG (CSA)</p> <p><i>An ACIAR funded project led by ANU with partners in PNG (NARI, CCDA, DAL, FPDA, NWS, UOG) and in Australia (ANU, Phloem 3 Pty Ltd, Sustineo Pty Ltd). Project facilitating the use of seasonal climate information in farming communities to inform food production decisions and by doing so improve food security outcomes for rural communities.</i></p>	<p>ASEM/2017/026</p> <p>Completion: December 2023</p>
<p>PNG Preparedness to Cope with Climate Change induced Stresses: Drought, frosts, Excess Moisture and Salinity (PIP El Nino Drought)</p> <p><i>Farming and rural communities are better prepared with abiotic stresses due to seasonal weather patterns, climate change or natural disasters – empowering rural and farming communities in climate change vulnerable districts with agriculture based contingency measures to better cope with droughts, frosts and other related stresses.</i></p>	<p>PNG Government PIP - El Nino Drought (03056)</p> <p>Completion: December 2023</p>
<p>Enhancing private sector-led development of the Canarium industry in Papua New Guinea – phase 2</p> <p><i>Project targets barriers to private sector investment in the Canarium industry by improving supply, further enhancing efficiencies in the production and processing systems and further developing both domestic and export markets for processed galip nuts</i></p>	<p>FST/2017/038</p> <p>NARI, Griffith University and the University of Adelaide</p> <p>Completion: December 2022</p>

Research Studies

The 2020 Agricultural Research for Development portfolio comprised a total of twenty eight key research studies with twenty four studies continuing and four studies completed as summarised in the following Table.

Table 3: 2020 research studies

Research Study	Fund source	Status
<i>Influence of inflow water and fertiliser levels on growth and yield qualities of Irish potato at Aiyura.</i>	ACIAR CSA Project	Active
<i>Effect of inflow water and fertiliser levels on bulb onion growth and yield component along different growth stages at Aiyura.</i>	ACIAR CSA Project	Active
<i>Comparing sweetpotato growth and yield under split fertiliser application, rainfed and irrigation condition at Bubia, Lae</i>	ACIAR CSA Project	Active
<i>Sensory Evaluation of Sweetpotato grown under split NPK application under Wet Low Lands at Bubia, Lae</i>	ACIAR CSA Project	Active
<i>Comparing taro growth and yield under split fertiliser application, rainfed and irrigation conditions at Bubia, Lae</i>	ACIAR CSA Project	Active
<i>Comparing sweet potato growth and yield under split fertiliser application, rainfed and irrigation condition at Kerevat ENBP.</i>	ACIAR CSA Project	Active
<i>Efficiency and Profitability in Local Honey Production by Smallholder Farmers in Eastern Highlands Province</i>	ACIAR Honey	Complete
<i>Identification and distribution of sweetpotato viruses and their vectors in the PNG Highlands</i>	ACIAR TADEP	Active
<i>Efficient technique to remove viruses in commercial sweet potato using meristem culture</i>	ACIAR TADEP	Active
<i>Sweetpotato viruses – second season trial – single and dual infection with viruses.</i>	ACIAR TADEP	Report pending
<i>Evaluation of drought tolerance in wild bananas from Papua New Guinea</i>	Crop Trust, Bioveristy, KULeuven	Complete

<i>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</i>	<i>EUCCR project</i>	<i>Active</i>
<i>Economic evaluation of introduced sweet potato cultivars in strengthening climate change resilience of vulnerable households' food security in Misima and Selepet</i>	<i>EUCCR project</i>	<i>Active</i>
<i>Evaluation of Promising NERICA rice Lines under Upland and irrigated Environmental Conditions in PNG (Laloki)</i>	<i>EUCCR project</i>	<i>Active</i>
<i>Validation of the SSS method for sweetpotato tuber storage during drought conditions in PNG</i>	<i>EUCCR project</i>	<i>Complete</i>
<i>Documentation of Indigenous knowledge in managing prolonged dry weather situations: The case of Teptep, Rigo and Pobuma communities of Papua New Guinea</i>	<i>EUCCR project</i>	<i>Active</i>
<i>Duckweed as a biological agent to manage organic farm waste and an alternate source of protein in duck feed under MRC-Labu conditions.</i>	<i>EUCCR project, NARI Research Fund</i>	<i>Active</i>
<i>Banana (Musa sp) and Sweet potato in vitro mutagenesis in Papua New Guinea</i>	<i>IAEA, NARI Research Fund</i>	<i>Active</i>
<i>Knowledge on effectiveness and feasibility of techniques enhancing rootability of Galip shoots for vegetative mass-propagation improved</i>	<i>NARI Research Fund</i>	<i>Active</i>
<i>Effect of plant spacing on galip nut production and timber yield in East New Britain</i>	<i>NARI Research Fund</i>	<i>Active</i>
<i>A study on the Ecology and life cycle of the Canarium weevil in East New Britain and PNG</i>	<i>NARI Research Fund</i>	<i>Active</i>
<i>In Vitro Evaluation of Fungicides against Phytophthora infestans of potato (Solanum tuberosum)</i>	<i>NARI Research fund</i>	<i>Active</i>
<i>Evaluating the productive performance of crossbred chickens reared under local on-farm conditions</i>	<i>NARI Research Fund</i>	<i>Active</i>
<i>Evaluating economical feeding regimes for weaner and grower pigs when fed grain-based diets or blended diets of sweet potato or cassava with universal protein concentrate</i>	<i>PIP El Nino Drought</i>	<i>Active</i>
<i>Investigating Soil Water Dynamics under different sweetpotato cultivation techniques</i>	<i>PIP El Nino Drought</i>	<i>Active</i>
<i>Preliminary evaluation of wheat varieties in the High Altitude Highlands of Papua New Guinea</i>	<i>PIP El Nino Drought</i>	<i>Active</i>
<i>Investigation into Banana Wilt Associated Phytoplasma in the Markham valley</i>	<i>PIP El Nino Drought</i>	<i>Active</i>

Research Studies completed

Agronomic Assessment of Kumdi potato variety

Kumdi is a potato variety of unknown origin and likely introduced as part of earlier variety evaluation trials under the Department of Agriculture. It is named after the village where it was maintained and used. After the incursion of the potato late blight fungus, Kumdi reportedly showed resistance to the disease. The study evaluated the variety to establish the level of resistance in relation to known resistant varieties NP01, NP02 and NP03 and Sequioa as the susceptible check variety. The study confirmed high level of resistance of Kumdi to potato late blight as well as resistance of the other NARI released potato varieties. All varieties produced acceptable yields without the use of fungicides while untreated Sequioa perished under the disease pressure.

Output: Technical Bulletin in preparation

Validation of the SSS method for sweetpotato tuber storage during drought conditions in PNG

The study tested the suitability of the Sand-Storage-Sprout method that was adapted by CIP in African Countries as a practice to help regenerate quality sweetpotato planting material after long dry periods under PNG conditions and local varieties. The study found that generally sand as a storage medium can be used across agroecological zones to store sweetpotato roots for more than 4 months and generate planting material from sprouted roots. Sweetpotato varieties with higher moisture content showed higher sprouting rates compared with those with higher Dry matter content. The plan is to validate the results using the best performing media. This practice can be useful as a mitigation measure during extended dry periods.

Output: Technical Bulletin; Technology release

Bogia coconut syndrome and related Phytoplasma syndromes in Papua New Guinea: developing biological knowledge and a risk management strategy

NARI was a partner organisation in this ACIAR funded project with CCI originally as lead agency in PNG and later superseded by KIK. NARI provided support with the laboratory analysis of plant samples for testing for the causal agent causing the Bogia coconut disease. The causal agent was confirmed to be a Phytoplasma later proposed to be classified as a novel taxon "Candidatus Phytoplasma noviguineense". The project identified several insect species as vectors of the disease with insect species of the Order Hemiptera, viz. *Zophiuma pupillata* and *Lophops saccharicidam* at this point the most competent vectors to transmit the disease. A number of other plant species tested positive for the Phytoplasma but at this point only coconut, banana and betelnut can be confirmed as hosts for this particular Phytoplasma with other plant species requiring additional tests. At this point there is no specific management package available as there are still many knowledge gaps yet to be addressed.

Output: Final Project Report

ASTI (Agricultural Science and Technology Indicators) Study

PNG's agricultural research expenditure declined steadily during 2013–2017 as the combined result of reductions in both donor and government funding. In 2017, PNG invested just 0.31 percent of its AgGDP in agricultural research. In contrast to spending, agricultural researcher numbers rose progressively during 2013–2017 to reach 146 FTEs in total. The country's research agencies lack the critical mass of highly qualified researchers and accompanying infrastructure needed to address the multi-disciplinary challenges facing the agricultural sector. Many critical research areas remain overlooked.

Output: PNG Country Brief

Efficiency and Profitability in Local Honey Production by Smallholder Farmers in Eastern Highlands Province

Activities completed in December – analysis and report in preparation.

Output: Report and Bee Keepers manual in English and Tok Pisin in preparation



Figure 2: Bees foraging *Leucaena leucocephala* shade trees



Figure 1: Checking bee hives

Climate Change and Food Security

Empowering rural and farming communities in drought, access moisture, salinity and front vulnerable areas/districts with (agriculture based) adaptation and contingency measures to cope with intermittent or prolonged occurrences of Climate Change induced stresses

NARI continued its work on food security through building resilience and preparedness to cope with weather and climate change induced stresses. The NARI agricultural research for development (AR4D) framework has been key to developing and sharing knowledge to build resilience through improved techniques in crop and variety selection, food preservation and crop, soil and water management. The “climate smart” techniques not only improve resilience, but as good farming practices also contribute to greenhouse gas mitigation efforts. The work has been supported with funding from both the PNG Public Investment Program (PIP) and our development partners from European Union and Australia.

- PIP El Nino Drought - “PNG Preparedness to Cope with Climate Change induced Stresses (Drought, Frost, Excess Moisture and Salinity)” to better cope with droughts, frosts and other related stresses.
- The EU funded “Strengthening food production capacity and resilience to drought on vulnerable communities” (EUCCR) has been a key ongoing project leading the work on climate resilience.
- ACIAR funded “Climate Smart Agriculture opportunities for enhanced food production in PNG”. This new project boosts resilience and adaptation through development of Seasonal Climate Forecasts (SCF) to inform farming decisions.

Our work in the climate change related area in 2020 has covered:

1. Training of trainers for more rapid uptake of technologies
2. Testing and improvement of training and learning materials
3. Development of climate change resilience messages
4. Research studies for climate change resilience
5. Partner engagement for development of resource centres and pilot sites
6. Multiplication of foundation planting materials and livestock for distribution
7. Enabling partners for multiplication of planting materials and livestock
8. Surveys for household baseline for CSA
9. Climate related early warning mechanism with NWS alerts published on NARI website

Climate smart interventions promoted under EU CCR project

1. Watershed management
2. Improved crop varieties
3. Sustainable gardens
4. Rapid Crop propagation techniques
5. Post harvest and processing
6. Family poultry
7. Sweetpotato silage for pigs
8. Integrating fish and poultry
9. Gender equality
10. Financial literacy

Despite the COVID19 lock down during the early part of the year, the EUUCR, PIP El Nino Drought, and ACIAR Climate Smart Agriculture projects all made significant progress in key planned activities during 2020. The key was with management changes which enabled the previously delayed recruitment of technical staff, and release of project funds.

EUCCR project

With the full-time support of the NARI Facilities Team, infrastructure development of the nursery and poultry shed were undertaken at Selepet, Kome, Watut and Teptep. Due the logistic challenges the progress has been moderate and is expected to be completed by March 2021. Once these sites are

completed, work is planned to start at other Pilot sites in the Southern and Islands Regions. This includes prototypes developed at the project implementing centres; Bubia – MRC, Laloki - SRC and Keravat - IRC.

A series of field visits were made to pilot sites (Kome, Watut, Selepet, Teptep, Bali-Witu, Rigo Coast and Misima) as well as outreach sites (Astrolabe Bay and Almami). These provided technical support and conducted farmer training on the various interventions introduced to the sites. Specialised training was conducted on new crops, including wheat, cowpea and World Vegetable centre seed kits (amaranth, mung bean, jute mallow, okra, spinach malabar, kankong), and on post-harvest and food processing, water purification for domestic use, natural resource management, and livestock. Planting materials, particularly cassava, early maturing sweetpotato, beans, vegetable seed kits, livestock breeding stock and information materials were also distributed across all sites.

With Covid restrictions limiting travel, an in-house Capacity Building workshop (IHCB) was held at the Momase Regional Centre, Lae, from 13 – 17 July 2020 for 28 participants. The week-long workshop covered a wide range of areas in crops, livestock, natural resource management, and post harvest technologies, with particular focus on the various interventions that are being rolled out to communities at the various sites. The workshop



Figure 3: Prototype nursery and poultry houses



Figure 4: Teptep participants in the EUCCR Action



Figure 5: Example brochures developed for EUCCR Action

multi-skilled technical support staff, equipping them with new skills, knowledge, tools, equipment, and other resources required for them to fully support the project implementation. A Training of Trainers workshop planned for November was deferred due to temporary closure of the project account. The workshop is rescheduled for March 2021. A gender TOT manual draft was developed through the engagement of an external gender consultant. The manual is undergoing fine tuning and will become one of the nine manuals already developed through the project.

Three research studies were conducted during 2020:

- *Evaluation of improved sweetpotato varieties released to farmers of drought affected communities was carried out in between September and October of 2020. The evaluation study was designed to assess the economic impact of sweetpotato distributed to farmers in terms of additional food or income generated, money saved, or labour saved. The study was also designed to assess the spread and sustainability of the sweetpotato genetic materials into the garden systems of the communities.*
- *Indigenous knowledge documentation study was conducted between October and November at three sites: Teptep (Rai Coast), Pobuma (Manus) and Rigo Coast (Rigo).*
- *Evaluation of NERICA rice varieties was undertaken at the Southern Regional Centre – Laloki and is currently in progress.*

PIP El Nino Drought

While Covid19 restrictions delayed the further development of the Provincial partnership plan initiated in 2019, the release of project funds allowed the highland centres to build up the stocks of planting material and livestock breeding stock. A Training of Trainers workshop was conducted for the ADRA and Care International NGOs to support their climate change intervention programs in Eastern and Southern Highlands Provinces.

Procurement of information extension and demonstration and multiplication garden equipment for the provinces was progressed. Computers, multimedia projectors and printers were procured for each of the seven highland provinces. These will be formatted with up to date information resources and supplied to provinces in 2021. Power cultivators, spraying equipment, growing tunnels and small tools for provincial demonstration gardens are under procurement, for delivery in early 2021.



Figure 6: Bio-sand filter training



Figure 7: Provincial partnership MOU signing

ACIAR Climate Smart Agriculture (CSA)

The recruitment of a full time scientist and allocation of centre staff allowed the NARI participation in this project to progress. Trials to test field management interventions were conducted at Bubia, Aiyura and Kerevat centres. These trials will run for three years and will inform the agriculture advisories for predicted weather scenarios. As part of the development of the trials and advisories, and determination of the most efficient and effective communication channels for their dissemination, an innovation platform process is being used. The final “*Social Network Analysis*” for the cooperating sites was conducted in East new Britain, prior to the Covid19 lock down. This has been followed up with household surveys and farmer field days to share the results of the trials as they become available.

The National Weather Service (NWS) is a key partner in the project, working with the Australian National University and CSIRO in Australia in developing more useful weather prediction models. The project will develop *Seasonal Crop Advisories* based on the weather predictions. NARI is making the weather information as provided by the NWS available for wider use through it’s website.



Figure 8: CSA trial field day

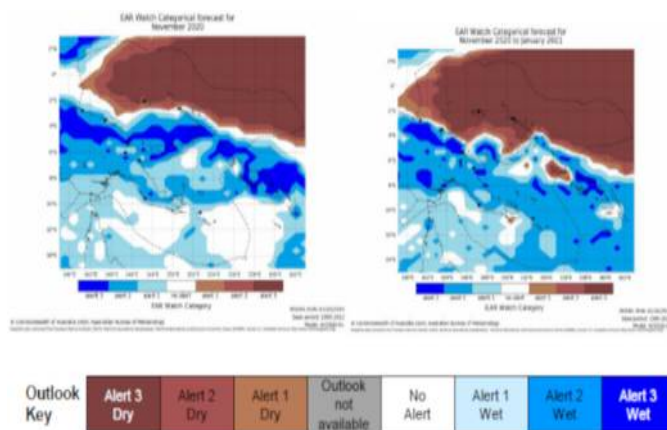


Figure 9: NWS 3 month weather forecast



Figure 11: CSA trial establishment at Bubia



Figure 10: Explaining CSA trial results with farmers

Management strategies for Banana Wilt Associated Phytoplasma

Long term management strategies for Banana Wilt Associated Phytoplasma (BWAP) requires understanding and confirmation of insect vector populations of the vectors. This aspect of the work is ongoing. The short-term strategy is to provide clean tissue culture propagated planting seeds to the affected communities in the Markham Valley.

For 2020, the MRC tissue culture laboratory provided clean planting material for BWAP management. This is a temporary measure as it will not control the problem, due to risk of re-infection. To better manage the problem, farmers need to clear affected areas in order to remove the insect vectors.

Since BWAP was first reported in 2017, NARI has worked to optimise a tissue culture protocol for mass propagation of *kalapua* bananas. Trials have been done to develop clean planting material, however control of contamination by endobacteria within the ex-plants used has been difficult. Trials are continuing to find ways to reduce the contamination as much as possible.

During the year, a nursery was established for the clean planting material for affected communities. Hardened plantlets from the laboratory are kept in this nursery before being planted out in the fields.

While the team works to understand and refine the tissue culture protocol, a small number of clean plants have been planted in four farmer fields at Antiragen, Umi, Chivasing and Orori. Two plantings were also established on the MRC Centre farm at Bubia. While distance makes regular observation difficult on the farmer fields, one of the Bubia plantings has been harvested with good results. The plantlets took almost seven months from planting to reach harvest maturity.

Future work, including a study of the re-infection rate of the clean planting material and screening of other cooking bananas for BWAP is planned for 2021. Developing a protocol for *kalapua*, confirming insect vectors and insect population, and understanding the infection hot spots will enable us to provide a better management option.



Figure 12: “insect sucrose feed” technique to confirm BWAP insect vectors



Figure 13: Mass propagation of clean kalapua seeds through tissue culture



Figure 14: Plantlets transferred to polybags and kept in the nursery



Figure 15: Inspection of clean plants in the nursery



Figure 17: Clean plantlets planted out at one of the farmer fields in Orori, Mutzing



Figure 16: Harvest at Bubia from clean plants

Highlands Sweetpotato Research

Sweetpotato remains the most important traditional staple crop in PNG in terms of production volume as well as consumption. It is also evolving into an important commodity traded domestically creating employment along the value chain. Reducing losses and improving productivity are key to farmer food and economic security.

NARI has a long-term investment in helping farmers and other supply chain actors increase their productivity and efficiency to have greater supply of quality sweetpotato for consumers and greater returns for the growers. Most of this research has been funded with support from the Australian Government through ACIAR, targeting improvements to the sweetpotato supply chain to encourage operators to use improved technologies, practices and marketing arrangements (*HORT/2014/097*); sustaining soil fertility in support of intensification of sweetpotato cropping systems for improved future food and income security (*SMCN/2012/105*); and developing improved crop protection options in support of intensification of sweetpotato production (*HORT/2014/083*).

The projects involved support from Australia with key PNG partners from FPDA and farmers in the sweetpotato production hubs in the Asaro Valley (Eastern Highlands, Minj (Jiwaka) and Mul and Nebilyer (Western Highlands).

The NARI contribution to the marketing and value chain aspect centred around development of a clean, Pathogen Tested (PT) planting material scheme. This was achieved through the Tissue culture Laboratory and establishment of two "igloo" screen houses at the HRC Aiyura research centre. The cleaned Pathogen Tested (PT) materials are selected from the farmer's choice of variety, which are mostly specific to their region.



Figure 18: An igloo or screen house for sweetpotato plantlets at HRC Aiyura

Table 4: PT sweetpotato cleaned through Tissue Culture laboratory

	Sweetpotato PT Variety	Production Hub
1	<i>Waghi Besta Minj 2</i>	Minj, Jiwaka Province.
2	<i>Gimane</i>	Asaro, EHP.
3	<i>Rachael</i>	Nebilyer & Mul, WHP
4	<i>Korowest</i>	Mul, WHP
5	<i>Beauregard</i>	Requests from multi locations
6	<i>Wanmun</i>	WHP

The Aiyura screen house facilities have the capacity to supply up to 20,000 sweetpotato PT cuttings at any one time. The supply in 2020 was down slightly from 21,462 in 2019 to 14,042 due to lower demand related to Covid19. The role of NARI is to supply new seed stock of PT sweetpotato vines to the contact farmers in the production hubs. These farmers use their own screen house facilities, which have been introduced through the project, to further multiply the planting materials for their own production and distribution to their networks of sweetpotato growers. The scheme has generated a new income source for commercial clean vine producers through sales of vines to other farmers as well as increasing the yield and quality of roots produced in sweetpotato crops. Commercial sweetpotato growers are beginning to access new markets, including direct sales to supermarkets, small-scale processing to produce flour for use in biscuit, cake and noodle production, and as stock feed for pigs and chicken.

NARI continues to transfer sweetpotato varieties with current or future commercial potential into tissue culture for a virus elimination process. It takes up to two years to clean a sweetpotato variety following a strict protocol for it to be declared 'free of viruses' and enter the PT sweetpotato scheme. Under this project we were able to clean two additional commercial varieties, *Korowest* and *Rachael* from the Western Highlands Province, aside from the other four varieties already available. *Korowest* and *Rachel* have now also been supplied to farmers in WHP.

In our second area of sweetpotato research, different options of soil fertility management have been tested and concluded after several cycles. The major research options covered organic fertilisers, mineral fertiliser rates, and fallow systems or crop rotation practices using carrot and peanut. The organic trials included application of coffee pulp and manure following carrot and grass fallow rotations. All treatments have consistently shown improved productivity with higher yields up to 39 tonne per hectare highlighting the importance of soil nutrient management in raising productivity of sweetpotato production

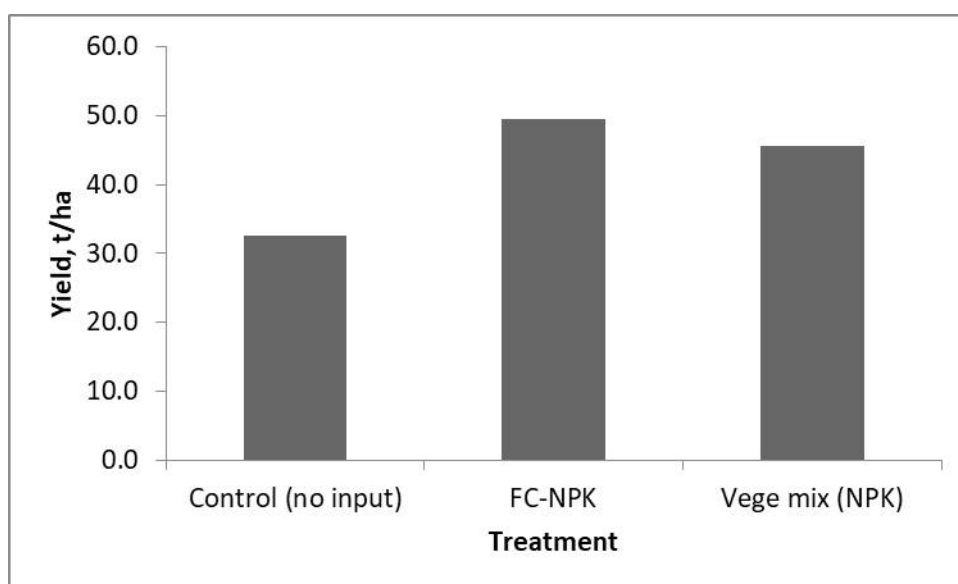


Figure 19: Marketable tuber yields from premix mineral fertiliser trial (Season 1)

Two farmers who participated in the commercial fertiliser trials, have now taken to regularly using mineral fertiliser in their sweetpotato crop, with yields increasing to more than 30 tonne per hectare.

The third research area aimed to develop, test, and promote the adoption of sustainable solutions to the major crop protection threats to sweetpotato. The study focused on evaluating the impact of soil management interventions on the incidence of pests and diseases; developing and evaluating the effectiveness of novel pest management options; and evaluation and adoption of 'best-bet' combinations of integrated pest and disease management (IPDM) options. The main pest of concern has been the sweetpotato weevil (*Cylas formicarius* and *Euceptes postfaciatus*).

Two novel interventions have shown promise. The most promising has been the use of pheromone traps to attract and kill the weevils. The simple traps contain a pheromone lure and can be constructed with materials available in households. Male *Cylas formicarius* weevils are attracted to the trap and caught. Records show that between 450 – 900 weevils are caught in a 2-week interval at trial sites. NARI, in partnership with FPDA have started to roll out training workshops for the construction and use of pheromone traps across the selected sweetpotato production hubs. Work with barrier plants to both repel the two weevil species and encourage beneficial predatory insects is ongoing.



Figure 20: Barrier plants used in trial plot at Asaro in EHP



Figure 22: Pheromone trap



Figure 21: Counting weevils caught in trap

Galip Nut Production and Marketing

Piloting value chains of quality galip primary and secondary product (kernel, oil)

Galip (*Canarium indicum*), an indigenous tree crop for Papua New Guinea continued to dominate the research and development programs for the Islands Regional Centre, Keravat in 2020. Phase 2 of the project was launched at the beginning of 2020 with an inception meeting at Kerevat.



Figure 23: Stakeholders at the inception meeting for the Phase 2 Galip project

The project is funded by ACIAR, and led by Griffith University partnering with researchers from University of Adelaide and National Agricultural Research Institute, PNG. There are 4 objectives:

1. Improve the commercial viability of business models for galip nut processing
2. Foster private sector participation in the galip value chain in both the domestic and export markets
3. Empower women to participate in the galip value chain
4. Enhance nut supply and quality by improving production.

Covid19 gave some challenges in the implementation of the project activities. In the absence of international partner visits, fortnightly video conferencing became a key tool. The advent of Covid19 forced the departure of the New Zealand Company, Equanut, terminating its contract with NARI to use the galip pilot factory at Kerevat to process and test the international markets.

Buying was much improved this season with 70 tonnes purchased and 540 kg of product processed. From this 128kg was supplied to CPL in November.

Table 5: Galip nut packaged products produced during 2020

Galip Product	Product Type	Volume (pkts)	Total Weight (kg)
Natural	100 gram	2178	217.8
Peeled	100 gram	1019	101.9
Roasted	100 gram	1075	107.5
Peeled	60 gram	813	48.78
Roasted	60 gram	1081	64.86
Total		6166	540.8 kg



Figure 24: Galip products sold at CPL supermarket in Port Moresby

Galip research

Three processing trials were conducted from July to December 2020

- Assessing rejects and floats from NIP galip buying and depulping
- Hot water depulping trial
- Drying trial using different methods of drying Nut In Shell (NIS).

Two studies were conducted from early July to December to investigate Galip Weevil (*Ectatorhinus magicus*) ecology, population dynamics, distributional trend and impact on *Canarium indicum* in East New Britain and New Ireland provinces.

- In situ versus ex situ testing of alternative host plant range of *Ectatorhinus magicus* (Curculionidae: Molytinae), in East New Britain and
- Investigating distributional trend of *Ectatorhinus magicus* population and its impact on *Canarium indicum* in East New Britain and New Ireland

Four tree improvement and floral biology studies were initiated covering:

- Fruit development
- Crop forecasting and length of harvesting season
- Tree and nut characterisation
- Assess reproductive biology of trees including timing of receptivity, fruit set and pollinators using the following methods:
 - Survey tree collections at NARI to assess the incidence of hermaphrodite trees
 - Survey the ratio of male to female trees in the NARI plantings.
 - Identify male and female trees that could be used in a breeding program.
- Galip pollination to assess the percentage of fruit set with cross-pollinated, open-pollinated and bagged flowers



Figure 25: Taking month 5 fruit measurements



Figure 26: Control pollination – Bagged galip flower panicle

Rice Foundation Seed

NARI has released six rice varieties. Two cold tolerant varieties are maintained and multiplied at the Highlands Regional Centre at Aiyura under upland conditions. Four lowland varieties are maintained at the Momase Regional centre at Bubia under irrigated paddy conditions.



Figure 27: Rice foundation seed at Bubia

Following discussion with Kumul Agriculture Limited, NARI redeveloped 9 hectares of paddy fields at MRC Bubia to ensure adequate capacity to supply foundation seed to certified seed growers supporting large scale rice planting.

With assistance from the Taiwanese Technical Mission team (ICDF) at Bubia, NARI has instituted a plan to expand its rice variety improvement and upgrade seed handling and storage facilities to provide both high quality foundation seed and training to certified seed growers.



Figure 28: Women checking Bubia rice crop



Figure 29: Aerial view of Bubia rice paddies



Figure 30: Harvesting cold tolerant rice varieties at Aiyura

TECHNICAL AND ANALYTICAL SERVICES



Chemistry Laboratory Testing Services

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

The laboratory has state of the art equipment, including Inductive Coupled Plasma Optical Emission Spectroscopy, Atomic Absorption Spectrophotometers, ultra-High Pressure Liquid Chromatography, UV Spectrophotometer, Bomb Calorimeter, and bench top DO/pH/EC meter allowing quality analytical and diagnostic services covering:

- soil fertility tests,
- plant leaf nutritional analysis,
- water testing on chemical, physio-chemical and bacteriological qualities/pollutants from different ground water and saline water bodies including environmental samples, and
- proximate analysis in natural products (stock feeds and food) to determine their chemical composition.



Figure 31: Water analysis

The Laboratory has 17 staff comprising nine technical and professional staff and eight support staff, with a through-put of 12,000 tests valued at K315,000.00. The Covid19 pandemic is attributed to a 40% drop in revenue.



Figure 32: Staff at the Chemistry Laboratory at Kila Kila

Key reports:

- 2020 continued a clean safety record with no record of negative laboratory incidences or accidents.
- Approximately 1,000 samples received and 12,300 tests conducted for 290 clients. Estimated revenue of K315,290.00 with K152,000.00 transferred to HQ as revenue. The bulk of the tests, 10,383, are for water analysis.
- On laboratory quality management system, the laboratory had another full compliance audit on ISO/IEC 17025 accreditation to PNG Laboratory Accreditation Scheme managed by the National Institute of Standards and Industrial Technology (NISIT). The audit gave a “Satisfactory” report, requiring minor corrective actions to address prior to re-certification.
- Under the International Atomic Energy Agency, IAEA – RAS5078 TC Project, the Project recognised NARI and NAQIA as project counterparts. The project continues to supply instrument accessories, chemical reagents and chemical standards, and standard operating procedures.
- NARI IT Support Services installed and set up the Biometric attendance record, delivered three new laptops and assisted to migrate email to the Mozilla Thunderbird email client, and assisted in other areas of networking.
- The Laboratory has successfully progressed two chemists recruited in 2018 to full Chemist status, while a third has been graded to the level of Associate Chemist.
- With reduced demand for analysis and pandemic related competition for safety equipment, 2020 saw revenue losses of almost 40% and increased costs in laboratory safety gear and other general laboratory supplies.



Figure 33: Training at MRC Biotechnology Laboratory

Tissue Culture Services

NARI has two tissue culture laboratories. The smaller laboratory at the Bubia MRC Biotechnology Laboratory has focused on research and providing clean planting material for the lowland *Kalapua* and *Yawa* varieties affected by the Banana Wilt Associated Phytoplasma. The larger facility at Aiyura is a shared facility between NARI and Coffee Industry Corporation (CIC) under an agreement signed by both parties.

NARI has been the main user of the Aiyura Tissue Culture Laboratory (TCL) over recent years, primarily to supply foundation material for the National potato seed program and Pathogen Tested (PT) sweetpotato.

The Aiyura TCL maintains tissue culture of crop species for germplasm conservation, virus cleaning (PT) and mass micro-propagation for commercial purposes. The commercial aspects generate sufficient income to cover the cost of consumables and electricity, but is not yet commercially viable. The main challenges for 2020 have been the frequent power disruptions. Generator backup is available but maintenance requirements and fuel make it a less viable option. The other challenge has been the drop in income from potato plantlet supply to FPDA. While NARI has a contract to supply 12,000 plantlets per month, FPDA has been unable to absorb more than six months supply of plantlets. The table below contains the crops maintained at the laboratory.

Table 6: Crop species in culture

Crop species held in vitro		Varieties	Significance
1	Coffee	Geisha, Omuru2, World research varieties	Commercial
2	Irish potato	Sequoia, E2, Spunta, CIP clones, 11 others	Commercial/Food Security
3	Sweet potato	9 PT Comm Vars, 9 DT Vars, PFSP, OFSP	Commercial/Food Security
4	Kava	2 working	Commercial
5	Orchid	2 working	Commercial
6	Taro	Initiation stages	Commercial/Food Security
7	Yam	1 (African yam)	Commercial/Food Security

Kava

Initiation of Kava in tissue culture has been successful with plantlets doing well. There are 367 plantlets currently in stock. The project can now proceed with mass-propagation, but should consider that the PNG varieties from Kerevat and Laloki landraces are not in international commercial demand. A recognised variety from Fiji or another Pacific Island country is required for international competitiveness.

Potato

Potato germplasm is maintained *in vitro* for research and development purposes, including several International Potato Centre (CIP) clones introduced for Potato Late Blight (PLB) tolerance. Among these are commercial varieties, *Sequoia* and *E2* which are being mass multiplied for FPDA on a contract basis. Eleven commercial varieties were introduced into the TCL from the Unitech Biotechnology Centre (UBC). These need to be screened for viruses and assessed, before they can be considered for the national seed potato scheme.

FPDA has not been able to absorb the contracted plantlet production. As screen house space allowed, the excess potato plantlets were planted out in make-shift beds in the screen-house to produce mini-tubers under strict quarantine procedures. The intention for this is to produce early generation seed potatoes following minimum seed potato standards for research purposes for and access by NARI scientists.

Sequoia G0 (mini-tubers) have been harvested and stored. Hopefully, these will be planted out on the field to raise G1 and G2 which can then be used for field studies. CIP clone *E2* is yet to be harvested as it is a late maturing variety. These are available as certified seed lots for further multiplication and/or ware potato production.

Sweetpotato

Early maturing and drought tolerant sweetpotato (*WHCK 019- EM*; *SSYK 026 – DT*; *SKK 10 – DT*; *PRAP 469 – EM*) are maintained *in vitro*; however they are not pathogen tested and need to be screened for pathogens.

Pathogen tested, disease-free varieties are being maintained. Several, including *Northern Star Variety*; *Wanmun*; *Maraso*; *Whagi Besta*; *Beauregard (BGD)*; *Minj2 (WBMJ2)*; *Gimane*; *Korowest*; and *Rachel* have been rolled out in the current ACIAR/TADEP project and are gaining popularity among the sweetpotato farmers.

Coloured flesh potatoes are also becoming popular among health-conscious consumers. Orange flesh and purple flesh varieties, *Korowest*; *Pingi Pongi (Gumine Purple)*; *Kerot Hagen* are being maintained.

Maintenance of field based collections is difficult and problematic, particularly with viruses. The economics of alternate tissue culture conservation is being considered.



Figure 34: Pathogen tested varieties

Staff and student training

The TCL received student class visits from the University of Goroka (UOG) and University of Technology. The lab engaged a final year student from UOG for industrial training for three months. Another graduate of applied science from Poly-technical College is currently engaged as a trainee. The lab technical staff have expressed their desire to matriculate and pursue further studies. They need the necessary support in this drive, as all of them have spent considerable length of time at the lab.

TC Lab upgrade

NARI has embarked on upgrading the TCL for improved operations and future accreditation. The lab has operated under serious compromising conditions with old air conditioners and unreliable power supply to the facility. Major electrical and other equipment are being replaced or upgraded.

- Ten split air conditioner units have been installed in place of the aged wall units
- A standby generator, freezer, and refrigerator is planned for 2021
- Minor renovation was done to provide improved storage



Figure 35: TCL growth room

Entomology Services

NARI's entomology research and services in 2020 covered work on:

1. National Agricultural Insect Collection
2. Sweet potato weevil
3. Galip weevil
4. Fall army worm
5. Rice Brown Plant Hopper

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 sixteen Orders.

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 have become a key area of concern with a need for urgent funding support to upgrade the facility and allow it to continue to serve the wider agricultural research and development community.

Two **Galip Weevil** (*Ectatorhinus magicus*) studies were conducted in the latter half of 2020 to investigate the weevil ecology, population dynamics, distributional trend and impact on *C. indicum* in East New Britain and New Ireland provinces.

- Testing of alternative host plant range of *Ectatorhinus magicus* in East New Britain.
- Distribution of *Ectatorhinus magicus* population and its impact on *Canarium indicum* in East New Britain and New Ireland



Figure 36: Insect collections help in pest identification



Figure 37: Galip weevil damage

Fall Army Worm, *Spodoptera frugiperda*, continued its move through PNG. NARI joined other key agencies and stakeholders in monitoring the spread and developing recommendations for management. NARI is preparing an information bulletin for distribution.

Sweetpotato Weevil (*Cylas formicarius*) and **West Indian Sweetpotato Weevil (*Euscepes postfasciatus*)** is a major pest. Work in 2020 has continued on two promising approaches for management.

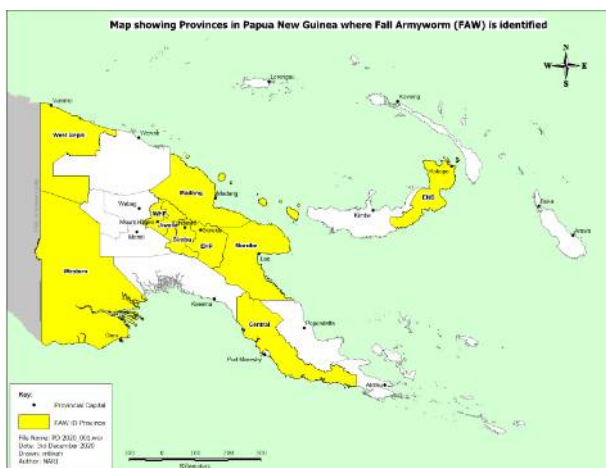


Figure 38: Fall Army Worm distribution

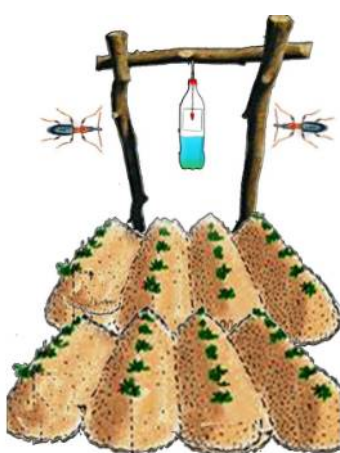


Figure 39: Sweetpotato weevil pheromone trap

Pheromone traps have shown success in Jiwaka and Western Highlands provinces. An information bulletin is in preparation to encourage wider use of the technology.

The other approach, requiring more research uses a fungus found in soils. The work is in collaboration with the Papua New Guinea University of Technology (PNGUOT), building on previous studies using the fungus *Metarhizium anisopliae*. The results as seen in the photo have been impressive with the orange fleshed *Beauregard* variety.

Much of this work is supported under an ACIAR funded project, “*Developing improved crop protection options in support of intensification of sweetpotato production in Papua New Guinea*”

Rice Brown Plant Hopper (BPH), *Nilaparvata lugens*, can pose a problem with non BPH tolerant rice varieties.. While NARI resistant varieties are not affected, these are sometimes not preferred by farmers and consumers. Work has been done overseas to encourage beneficial predator insects to manage the levels of BPH. A proposal to test this as a more environmentally friendly and economic management method has been submitted for work in 2021.



Figure 40: Results with *Metarhizium* sweetpotato weevil management (PNGUOT)

Information and Knowledge Management Services

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.

Newsletter

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.

Shows and field days

Due to the Covid 19 Pandemic, the Agricultural Innovation Show and annual provincials shows were not held. However, NARI publications were still displayed and distributed whenever possible. Information was also made available to officers on project activities to display to farmers during their meetings.

One such opportunity was at Wasab village, north coast of Madang, where a small information and technology display was set up. The theme was on Community Resilience, which saw innovations developed by NARI and partners exhibited. Besides the solar rice mill, the solar water harvester, NARI hybrid taro, selected high yielding cassava & sweetpotato, corn, mung beans, rice and African yam were displayed.

Toktoks on sweetpotato and cassava flour processing, Yam and taro mini setts, various aspects of rice production, and chicken production were displayed and later distributed to farmers.



Figure 41: NARI Nius front cover



Figure 42: Display of NARI technologies at Wasab, 21 August, 2020

Media relations

We continue to maintain an effective networking with the mainstream media to create increased awareness on NARI AR4D activities. Articles published with the two daily newspapers (*Post Courier* and the *National*), radio and EMTV are shown in the following tables.

Agricultural interest articles

The National	<ul style="list-style-type: none"> • <i>Rural farmers receive training</i> • <i>Addressing coconut disease</i> • <i>NARI trains poultry farmers</i> • <i>Call for market chain</i> • <i>Partnership to address food security</i> • <i>Bosavi farmers receive drought-tolerant crops</i> • <i>Villagers revive agro</i> • <i>Agriculture can eliminate poverty, reduce malnutrition, says NARI boss</i>
Post Courier	<ul style="list-style-type: none"> • <i>The growing galip industry</i> • <i>Farmer Anno driving agriculture in Teptep</i>
ELCPNG Radio	<ul style="list-style-type: none"> • <i>Dr Sergie Bang-discussion on food security</i>
EMTV	<ul style="list-style-type: none"> • <i>Dr Sergie Bang-discussion on food security</i>
Grow PNG Ltd	<ul style="list-style-type: none"> • <i>Sustainable supply chain vital for food security</i> • <i>NARI develops clean kalapua seeds</i> • <i>Simple and appropriate village technology (Kisar)</i>



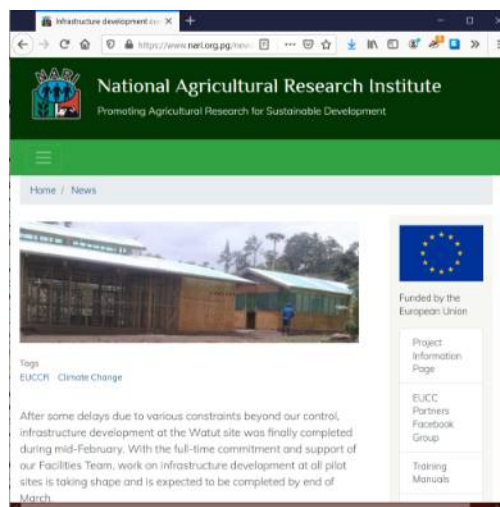
Regular National Newspaper Focus Column

- 1 *Galip: A crop of growing interest*
- 2 *Women undergo farming training*
- 3 *Raising good village chickens*
- 4 *Efforts to conserve sweetpotato varieties*
- 5 *Efforts to address learning needs*
- 6 *The importance of gender in agro*
- 7 *Gender outlined in projects*
- 8 *Promoting women leadership through farmer resource centres*
- 9 *Women, youth vital in farming*
- 10 *Supply chain vital for food security*
- 11 *Soil management practices*
- 12 *Benefits of preserving sweetpotato for food security*
- 13 *Addressing soil fertility for resilience among vulnerable communities*
- 14 *Addressing soil fertility*
- 15 *Sweetpotato as food security*
- 16 *Benefits of preserving sweetpotato for food security*
- 17 *Resource centres can enhance farmer information*
- 18 *Resource centres can enhance farmer information*
- 19 *Processing of staple crops is important*
- 20 *Inclusive farming models can build productive communities*
- 21 *Processing of local crops vital*



Agricultural Interest stories in NARI Nius, website, Facebook

1. Galip project to benefit rural farmers
2. Developing weather information to aid farmers
3. Shelter is vital village chickens
4. NARI sustains crop seeds for food security
5. NARI analyses rice from East Sepik
6. Incentive Fund visits Kerevat
7. Food security crucial during SOE: Dr Bang
8. Women can make a big difference in agriculture
9. Sambio receives last solar rice mill
10. Joining the fight against Covid-19
11. Fall Army Worm another threat in PNG
12. Project looks at conserving sweetpotato varieties
13. Machinery to aid seed multiplication
14. Partnership looks to address food security
15. Fish farm has potential to supply of fish fingerlings
16. Rice farmer extends rice production
17. Using organic fertiliser can improve sweetpotato yield
18. Processing staples can address food security
19. Clean banana seeds for Markham
20. Rice farmer reaping benefits for rice farming
21. Project looks at multi-skilling staff
22. Bargam farmers receive solar rice mill
23. Lead farmer supporting agriculture services in Teptep
24. Maintaining rice varieties in the field
25. Training enables mother to earn extra income
26. Farmers in Bali/Witu want to improve farming
27. Visitors impressed with galip processing facility
28. Agriculture can eliminate poverty, reduce malnutrition
29. ACIAR PNG Country Manager visits galip factory
30. Teptep farmers buy mini mills to process wheat
31. Sharing knowledge through resource centres
32. Study to document local knowledge and practices
33. EU project team to monitor trainers' progress
34. Galip processing, a good agribusiness model: UNRE students
35. Activities picking up in Teptep
36. Huon farmers growing pathogen tested sweetpotato
37. Tribute to Paul Van Wymeersch
38. Rice harvest at Bubia looks promising
39. Livestock research seeing positive results in feed making
40. Staff take on new roles at Kerevat
41. Agriculture students visit galip facility
42. New weather stations set up in five sites
43. NARI's work motivates farmer in Kabwum



NARI Toktoks

The NARI Toktoks are a great source of information for farmers.

They are mostly in simple English and easy to understand. Some of the Toktoks are translated into Tok Pisin and Motu specifically targeting the speakers from the southern region and those who can understand instructions better in Tok Pisin.

Toktoks inform farmers of practices that can be adopted to improve production of food and livestock, explain steps on how to grow, maintain and harvest food crops, protect crops from pest and disease attacks as well as construction of technology that is suitable for village farms.

The most popular Toktoks over 2020 have been those on rice production, poultry production, and processing of sweetpotato and cassava into flour for use in bakery products such as doughnuts and snacks such as crisps and sago pop.

We will continue to provide up-to-date information on improved farming practices and ideas on innovative technologies in simple reading formats such as the Toktoks to better inform and inspire smallholder crop and livestock producers to improve productivity and increase profitability.

Copies of the Toktoks can be found on the Website www.nari.org.pg, or email: naripng@nari.org.pg, call: 79864776/76061118 or drop in at the Momase Regional Centre Library at 10 Mile, Bubia, Lae, Morobe Province.



Library

NARI has been at the forefront of electronic library usage with leadership of the original National Agricultural Information System (NAIS).

Current work has involved cleaning out redundant records in the original library system, identifying and collating missing research documents, and providing electronic documents or web links to all records.

To better serve these records, we are developing a web based, public access database of full text resources. This system also includes essential “cite while you write” capability with the open source Zotero reference manager, available from www.zotero.org. A prototype database has been tested. Figure 44 illustrates the web database functionality with the Zotero reference manager (figure 45)

NARI Research Publications 2000-2019 (preliminary list sorted by Document type / First Author)

Title	First Author	Co-authors	Date	Type
Egg production potentials of Black Australorp with Shaver Brown, and Shaver Brown with Hyline Brown crossbred laying hens on low energy layer concentrate diet	Ahizo, J.	Kabila, K. Palau, W. Ayalew, W. Glatz, P.	2013	Book(let)
Survey on the current status of smallholder pig production in Morobe Province	Amben, S.	Michael Dom, Workneh Ayalew	2015	Book(let)
Growing healthy sweetpotato: best practices for producing planting material	Dennien, Sandra	Homare D., Hughes M., Lovatt J., Coleman E. and Jackson G.	2013	Book(let)
Past, Present and Future Prospects of Pig Production to Achieve Vision 2050	Dom, Michael	Ayalew, P. Glatz, R. Kirkwood and P. Hughes	2014	Book(let)
Yam germplasm collection in Papua New Guinea	Gendua, P.	Risimeri, J.B and Gunua, T.G	2004	Book(let)
General Information: galip processing and quality Control.	Hannet Dalsie	Nevenimo Tio	2015	Book(let)
Soil fertility in sweetpotato based cropping systems	Kirchhoff, G.	et.al.	2009	Book(let)
Harvesting and processing pepper	Nevenimo, Tio		2002	Book(let)
How to Grafting Citrus	Nevenimo, Tio		2002	Book(let)
Pepper	Nevenimo, Tio		2002	Book(let)
Pepper support	Nevenimo, Tio		2002	Book(let)
How to Prune Pepper	Nevenimo, Tio		2003	Book(let)
Growing Apples in PNG	Nevenimo, Tio		2004	Book(let)
Pepino a new fruit crop for the highlands of Papua New Guinea	Nevenimo, Tio		2004	Book(let)

Figure 43: Collating research documentation

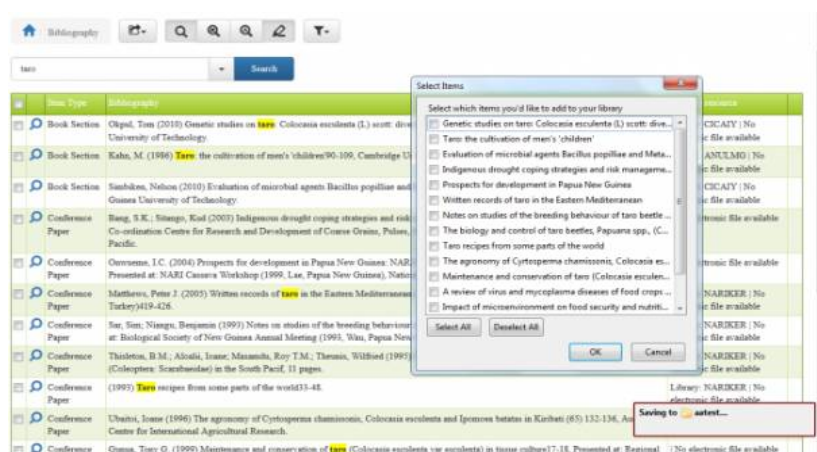


Figure 44: Prototype reference library with cite capability

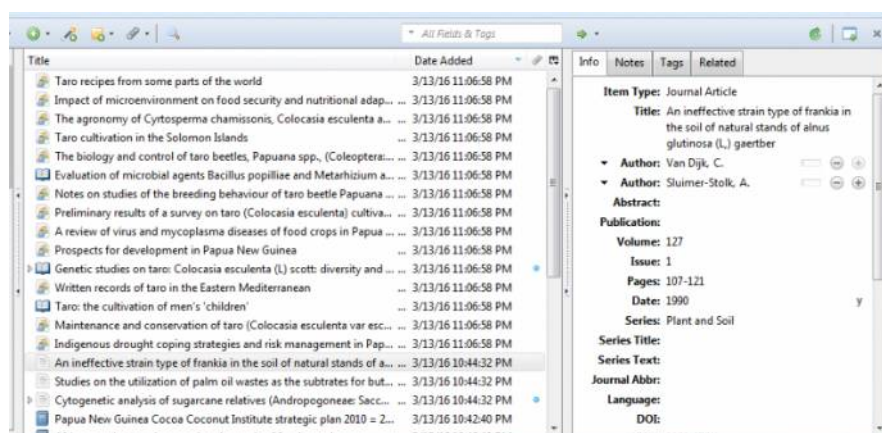


Figure 45: Zotero interface

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Finance

Income sources and trends

The GoPNG recurrent budget allocated to NARI for 2020 increased from K9.56m allocated in 2019 to K11.06m, but was still far short of the budget estimate of K25m requested.

Funding was received for one of the two ongoing PIP projects. The Research and Development Project received K1m in a revised appropriation following the supplementary budget. The El Nino Drought Project progressed through K4.95m funding held from prior allocations.

Internal revenue, generated from sales of produce and services, consultancy, and tenders, contributed K1.46m. Grants received for collaborative Donor Projects were transferred to the respective projects account for spending on planned project activities with cost recovery as appropriate.

Table 7 shows the changes in funding allocations by source for 2018 to 2020.



Figure 46: Finance team members holding NASFUND award

Table 7: Sources of Income (millions): 2018-2020

Income Source	2018	2019	2020
Grants from GoPNG – Recurrent	9.70	9.56	11.06
Grants from GoPNG – Public Investment Program	2.75	1.70	1.00
Collaborative projects	0.36	0.01	0.09
Sales of produce & others (tenders, consultancy, GST etc)	2.07	2.31	1.46
Total Income	14.88	13.58	13.61

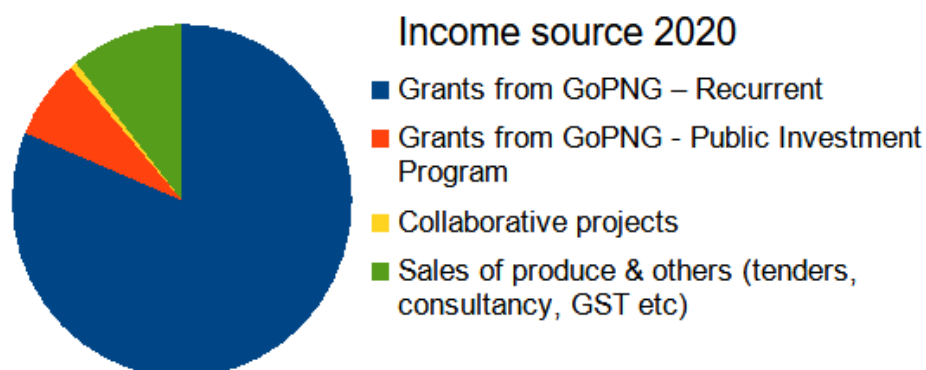


Figure 47: Sources of Income by Category

While the new allocations of PIP funding were reduced, there were K6.7m in PIP funds carried forward from previous allocations for the current projects (Table 8: PIP Funding Appropriation and Expenditure).

Table 8: PIP Funding Appropriation and Expenditure

Project	Funds 1/1/2020	New Allocation 2020	Expenditure 2020	Balance 31/12/20
El Nino Drought Events Preparation	4,955,379.00	0.00	2,219,997.00	2,735,382.00
Research and Development	1,743,843.00	1,000,000.00	1,879,401.00	864,442.00
Total PIP	6,699,222.00	1,000,000.00	4,099,398.00	3,599,824.00

The Institute's detailed income and expenditure statement for the year ending December 2020 is given in Table 9. This provides actuals for both Recurrent and PIP funds for 2020.

Table 9: Income and Expenditure

Items	Descriptions	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total 2020
Opening Balance						
	Bank Balance	6,942,365.61	6,181,663.58	5,516,359.59	4,567,429.75	6,942,365.61
Income						
	Appropriation Recurrent	2,684,913.00	2,286,745.00	3,170,600.00	2,919,834.00	11,062,092.00
	Appropriation PIP	500,000.00	500,000.00	-	-	1,000,000.00
	Income-Sales of Produce and Services	145,501.70	207,527.31	193,026.26	229,675.75	775,731.02
	Income- Consultancy	-	-	-	24,153.86	24,153.86
	Income-Tenders & Others	110,001.87	95,111.75	121,156.64	336,621.44	662,891.70
	Income-Projects	-	81,312.00	-	8,600.00	89,912.00
	Total Income	3,440,416.57	3,170,696.06	3,484,782.90	3,518,885.05	13,614,780.58
Expenditure						
111	Salaries & Allowances	1,959,099.03	1,337,683.00	1,858,581.34	1,137,600.74	6,292,964.11
112	Wages	677,468.40	672,108.03	788,785.27	815,590.29	2,953,951.99
114	Leave Fares	14,134.80	5,447.60	7,890.40	80,736.50	108,209.30
116	Educational Subsidies	16,000.00	-	13,000.00	-	29,000.00
121	Travel Expenses	140,270.02	85,182.65	98,491.20	187,511.80	511,455.67
122E	Utilities-Electricity	107,054.67	90,752.34	80,335.65	106,022.51	384,165.17
122T	Utilities-Telephone	9,278.86	8,067.77	6,224.58	6,851.25	30,422.46
122-O	Utilities-Others	49,838.17	47,223.97	41,405.45	69,134.10	207,601.69
123	Office Materials &Supplies	17,694.14	18,528.18	20,888.60	41,775.22	98,886.14
124	Operational Materials & Supplies	184,437.98	193,759.98	622,822.88	222,934.75	1,223,955.59
125	Transport & Fuel	33,347.21	34,603.32	24,823.58	20,964.22	113,738.33
128	Routine Maintenance	160,550.93	146,860.29	129,252.66	88,169.75	524,833.63
128	R&M Substantive	91,165.24	59,635.77	76,562.80	36,002.13	263,365.94
135	Other Operational Expenses	193,714.66	172,880.32	35,506.50	192,027.55	594,129.03
141	Gratuities	122,615.00	-	57,630.40	275,513.71	455,759.11
221	Furniture & Office Equipment	91,378.82	107,739.66	115,300.72	78,755.29	393,174.49
222	Purchase of Vehicles	-	504,341.51	198,755.89	128,361.52	831,458.92
224	Plant, Equipment & Machinery	333,070.67	351,185.66	257,454.82	336,944.20	1,278,655.35
	Total Expenditure	4,201,118.60	3,836,000.05	4,433,712.74	3,824,895.53	16,295,726.92
	Closing Balance	6,181,663.58	5,516,359.59	4,567,429.75	4,261,419.27	4,261,419.27

Expenditure

Expenditure by category is shown in Table 10 and Figure 48. Salaries and wages constituted 61% of the total expenditure in 2020, with little difference from 2018 to 2020.

Capital expenditure during 2020 increased from previous years with 70% as capital expenditure on major infrastructure, machinery and equipment from the development projects in line with the project's planned activities while the 30% from the recurrent funds were as scheduled replacements.

Operational expenses showed a marked decrease with down-scaling of operational activities due to a cut in the government budget to NARI and unforeseeable low cash flow experienced with GoPNG during 2020. The Management has focused on regular and routine costs such as personnel emoluments and other basic operational activities required for the daily upkeep when faced with very tight cash flow during 2020.

Table 10: Expenditure by Category: 2018-2020 (million Kina: % in brackets)

Expenditure Category	2018	2019	2020
Salaries/wages & other Benefits	9.66 (64)	10.17 (56)	9.84 (61)
Operational Expenses	5.18(35)	7.29(40)	3.95(24)
Capital Formation	0.14(1)	0.63(3)	2.50(15)
Total Expenditure	14.98	18.09	16.29

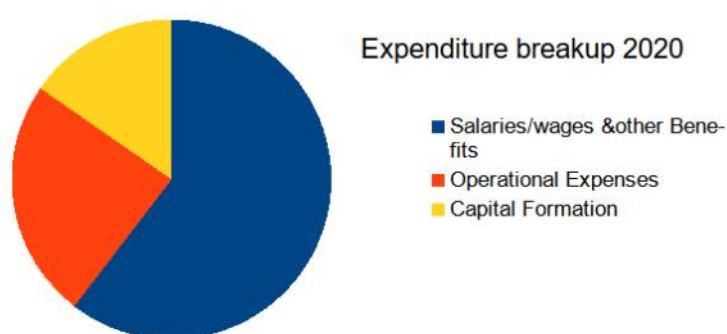


Figure 48: Expenditure by Category

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 2020 audited financial report for the 2019 fiscal year has also received an unqualified audit

report. The 2020 accounts have been audited, awaiting certification. The latest audited Balance Sheet extracted from the 2020 audit report is provided as Table 11.

NATIONAL AGRICULTURAL RESEARCH INSTITUTE
BALANCE SHEET
AS AT 31 DECEMBER 2020

Table 11: Balance Sheet 2020

	<i>Notes</i>	2020 Kina	2019 Kina
ASSETS EMPLOYED:-			
FIXED ASSETS	3	296,264,193.99	295,564,908.98
Work-In-Progress (Buildings)	4	-	-
CURRENT ASSETS	5		
Debtors and Prepayments		582,022.06	320,100.17
Stock		0.00	-
Petty Cash		516.70	462.05
Cash at Bank		2,301,423.68	6,942,365.61
Biological Assets		214,766.90	224,056.50
Interest Bearing Deposit		7,136,433.55	6,000,000.00
		10,235,162.89	13,486,984.33
CURRENT LIABILITIES			
Creditors and Accrued charges	6	949,982.93	1,228,496.37
Provision for Employee Benefits – Gratuity		1,520,568.81	864,859.77
		2,470,551.74	2,093,356.14
NON CURRENT LIABILITIES			
Deferred Income		2,700,000.00	2,700,000.00
Provision for Employee Benefits – LSL		500,545.46	481,844.04
		3,200,545.46	3,181,844.04
NET ASSETS		300,828,259.68	303,776,693.13
Representing:			
Capital Grant	2 (e)	1,229,570.94	1,927,044.62
Assets Revaluation Reserve	2 (d)	373,354.86	373,354.86
Assets Revaluation Reserve – Land	2 (d)	273,370,000.00	273,370,000.00
Government Equity and Reserves			
Government Grant (Revaluation of Assets)	2 (d)	12,581,579.85	12,581,579.85
Government Contributions		344,829.80	344,829.80
Surplus/(Deficit) from Income and Expenditure		12,928,924.22	15,179,884.00
		300,828,259.68	303,776,693.13

Human Talent Management and Development

The Government's recurrent funding in 2020 for personnel emolument costs enabled increased recruitment of scientific and technical officers. A total of twenty-four (24) new officers were engaged during the year increasing the total staffing levels from 104 officers in 2019 to 129 officers at the end of 2020. This represents a 23% increase in staffing levels; and the various categories of staff are presented in Table 12 below.

Planned retirement of long serving and medically infirm ancillary staff continued with 11 serving employees retired during the year. The Institute has now properly retired a total of 53 permanent ancillary staff during 2019 and 2020; and will continue with the retirement program as funds become available.

Emphasis on staff training and development continued in 2020 with a total of thirteen (13) officers currently doing post graduate training programs. This represents 10% of current contract officers released for concentrated training.

Roll out of the centralised HR administration and payroll management system throughout NARI was completed during the year; with an electronic database information system progressively developed.

Table 12: Staff Categorised as contract and ancillary staff as of 31st December 2020

LOCATION	CONTRACT	CADETS	ANCILLARY	TOTAL	PERCENT (%)
Head Office	37	0	42	79	19.2%
Aiyura	15	0	40	55	13.4%
Tambul	8	0	30	38	9.2%
Laloki	13	0	27	40	9.7%
Bubia	30	0	62	92	22.4%
Kerevat	15	0	71	86	20.9%
Kilakila	11	0	10	21	5.2%
TOTAL	129	0	282	411	100%

Of the various staff categories engaged, fifty-eight (58) percent of current contract officers are engaged in science and research activities, whilst 42 percent are management, technical and support staff as shown below.

Table 13: Contract Staff Categorised by Position Roles as at 31st December 2020

Staff	Grades	Non PNG	PNG	Sub Tot	HQ	HRC	HAH RC	SRC	Chem Lab	MRC	IRC	Total	%
Executives	13,14, Ex4	1	1	2	2	0	0	0	0	0	0	2	1.6%
Senior Managers	10 to 12	3	5	8	7	0	0	0	0	0	1	8	6.2%
Research Coordinators	8 to 11	0	5	5	0	1	1	0	1	1	1	5	3.9%
Scientists and Research Officers	4 to 11	0	67	67	4	10	4	9	7	23	9	67	51.9%
Technical Officers	4 to 15	1	15	16	12	1	0	1	1	1	0	16	12.4%
Management Support Staff	2 to 9	0	31	31	12	3	3	3	2	4	4	31	24.0%
Cadets	3	0	0	0	0	0	0	0	0	0	0	0	0%
Total Staff		5	124	129	37	15	8	13	11	30	15	129	100%

Gender balance of contract officers in employment continued to improve through selective appointments with two (2) female officers in senior management positions; and the female gender ratio improved from 30.8% in 2019 to a current level 36.4% as at the end of 2020. Over 51% of recruitment in 2020 was in favour of female appointments.

Table 14: Gender Balance of Contract Officers as at December 2020.

CATEGORY	TOTAL STAFF		APPOINTED		ATTRITION	
Gender	M	F	M	F	M	F
Executive	2	0	0	0	1	0
Senior Management	7	2	2	1	0	0
Scientific and Research Staff	48	22	9	7	3	0
Technical	13	4	2	1	0	0
Management Support	12	19	0	5	0	0
TOTAL	82	47	13	14	4	0
Percentage	64%	36%	48%	52%	1%	0

The seventeen (17) year running average in employee attrition as at December 2020 is currently at 9.0%, whereas over 52% of all current employees have provided over 10 years of service to the Institute.

Provided below are the staff currently doing long term training programs on post graduate courses. There are eight (8) officers on Masters programs, two (2) officers doing Bachelor degrees, two (2) officers on Diploma courses, and one (1) on a certificate course.

Table 15: Number of staff on Post Graduate Term Training in 2020

Name	Work Location	Training	Institute
Susie Antiko	Kerevat	Bachelor in Management	University of Natural Resources, Vudal
Boney Wera	Aiyura	Masters in Plant Breeding	Massey University, New Zealand
William Sirabis	Aiyura	Masters in Soil Science	University of Hawaii, Manoa Campus
Winnie Maso	Aiyura	Masters in Agricultural Science	University of Queensland, Australia.
Stanley Amben	Tambul	Masters in Animal Science	James Cook University, Northern Territory
Karo Gebo	Head Office	Masters in Telecommunications	On-line program, Atlantic International University, USA
Anna Boyope	Tambul	Bachelor in Public Administration	University of PNG, Waigani Campus
Arthur Roberts	Bubia	Masters in Aquaculture	Flinders University, Australia
Elly Solomon	Bubia	Masters in Animal Sciences	Massey University, New Zealand
Jeremiah Ahizo	Tambul	Masters in Agriculture Science	University of Melbourne, Australia
Benny Wasika	Kerevat	Certificate in Agriculture	OSICA, Kokopo
Gloria Wingawe	Bubia	Diploma in Office Administration	HTC, Lae
Martina Gengkawa	Bubia	Diploma in Accounting	ITI, Lae

Assets and Facilities

The year 2020 was affected by the Covid 19 Global Pandemic but activities under the Assets and Properties Division continued with the upkeep and maintenance of assets and properties at six NARI locations in PNG.



Figure 49: New perimeter fencing at Sir Alkan Tololo Research Centre, Bubia

Land Management

The hard work by the Management and Council paid off when Land Lease Titles for the land at Tambul was issued to NARI to secure it for research. Ongoing work involves securing the boundaries of NARI land properties at six locations by installing boundary markers, steel fences and planting live fences.

During this period the Institute also conducted valuation and surveying of its land and applied for Land Titles for its remaining portions of land.

Assets Management

The work to update the Institute's asset bin-card inventories and fix assets register progressed from HQ and MRC with a lot of support from respective regional centres by engaging casual assets officers to update the fixed assets register and inventories of NARI assets. Also in progress simultaneously is the documentation of an asset management manual which will be part of the Institute's Management Standards.

During this period new assets were procured and registered while functioning assets such as vehicles, equipment, machinery and furniture were identified, recorded and disposed off through competitive tender. Those not sold were written off and removed responsibly. The tender process gave first opportunity to NARI staff to bid and buy these assets. Remaining assets were tendered to the public.

Other existing plant, vehicles, machinery and equipment were maintained by the Institute. Management revised user pay systems for use of its vehicles, equipment and other services and the funds generated from this system were used to repair and maintain these assets.

Property Management

We continue to maintain our existing facilities with the modest funds appropriated to our section. A number of houses, buildings, plants, machinery, equipment and vehicles were repaired and maintained for use.

The Lae - Nadzab road expansion created an opportunity to improve the fence along the front of the Head Office. The steel spike fence that used to be there is now replaced with the “Pukpuk” fence. This type of fence is very sturdy with excellent durability and is attractive. The cost of materials to construct the “Pukpuk” fence was K214,000 and was erected by the NARI construction team in two months. The fence is being constructed in two stages. The first stage is to fence the property replacing the old fence. The second stage will be the installation of the sliding gates. This will be done as soon as the road work is completed at the front of Head Office.

We will revisit proposals for other infrastructure development and resubmit for funding to maintain houses, buildings and related services such as roads, drainage, water and electricity services. This is required due to the increased number of staff being recruited.

Special Projects

Also during this period this division was given specific responsibility with the EUCCR Climate Change project to construct 10 nursery and poultry hatchery sheds at 10 sites that are vulnerable to drought due to Climate Change. This will be completed in 2021.



Figure 50: Prototypes developed for EUCCR sites

Information and Communication Technology

The ICT team has the responsibility for the internal NARI network, Internet accessibility, and computer hardware.

The major change for 2020 was the move from an internally hosted email system to an external system with the “nari.org.pg” email domain hosted by the Zoho Professional and Secure email service. This has greatly boosted reliability and accessibility while reducing ongoing cost of operation. It has also provided a calendar and file sharing capability.

The second major change involved a switch in ISP services from Telikom (PNG) Ltd to Digicel (PNG) Ltd and upgrade in available bandwidth. The main internet connection from HQ remains with DataCo at this point. The Digicel switch was commissioned in February 2020 and has improved communications through better internet accessibility and availability at all the regional centres.

An in house network file sharing system was established in March 2020 giving staff at all centres access to network shares for scanning and some file sharing. The Zoho system also provides limited file sharing, up to 100Gb in total. This helps reduce the load on the email service and bandwidth requirements through reduced email attachments.

The improvements to the internet system has allowed improved IT support to staff across all centres with reduced support response and connection time. The upgraded internet has also allowed effective use of Zoom conferencing, both internally and with our donor partners. This became increasingly important under Covid19 restrictions. Dedicated video conferencing equipment has been installed at HQ and additional equipment sets are under procurement for each regional centre.

Other key achievements:

- We are replacing ageing computers with notebooks. This improves reliability, particularly in regional centres with more frequent power outages.
- NARI has adopted the LibreOffice Office suite, and Thunderbird email package as an effective replacement for Microsoft Office with the Outlook email client. We are also encouraging consistency in language and spelling through adoption of English AU as a standard.
- The NARI website was migrated to an external web host provider. This has improved access by external visitors who make up the target audience. The visibility for the European funded climate change actions was also improved with a comprehensive makeover. This will be extended to the other areas of the website in 2021.
- A leave management database system was finalised and tested and is now operational.
- A biometric attendance clock has proved successful at HQ and was extended to all centres over 2020.



Figure 51: Staff at head office using the biometric attendance clock.

Appendices

Appendix 1: Professional Publications

Eyland, David, Catherine Breton, Julie Sardos, Simon Kallow, Bart Panis, Rony Swennen, Janet Paofa, et al. 2020. "Filling the Gaps in Gene Banks: Collecting, Characterising, and Phenotyping Wild Banana Relatives of Papua New Guinea." *Crop Science*, November. <https://doi.org/10.1002/csc2.20320>.

Kallow, Simon, Kevin Longin, Natalia Fanega Sleziak, Steven B. Janssens, Filip Vandelook, John Dickie, Rony Swennen, Janet Paofa, Sebastien Carpentier, and Bart Panis. 2020. "Challenges for Ex Situ Conservation of Wild Bananas: Seeds Collected in Papua New Guinea Have Variable Levels of Desiccation Tolerance." *Plants* 9 (9): 1243. <https://doi.org/10.3390/plants9091243>.

Pandi, Janet, Phil Glatz, Rebecca Forder, and Kapil Chousalkar. 2019. "Effects of Different Papua New Guinea Sweetpotato Varieties on Performance and Level of Enteric Pathogens in Chickens." *Animals* 9 (4): 188. <https://doi.org/10.3390/ani9040188>.

Roberts, Arthur, Elly Solomon, Martin Lobao, and M.T. Dom. 2019. "Bio-conversion of Fermented Kitchen Waste or Sweet Potato Roots by Black Soldier Fly (*Hermetia illucens*) Larvae in an Open Shed Environment." *Journal of South Pacific Agriculture* 22: 1–9.

Sardos, J., J. Paofa, G. L. Sachter-Smith, E. Togabalguguwa, I. Van den Houwe, and Nicolas Roux. 2019. "Report of the Banana Collecting Mission to the Province of West New Britain (WNB), Papua New Guinea, from September 30th to October 12th, 2019." Trip Report. Montpellier, France: Bioversity International.

Omot, N., B. Komolong, G.-J. Stads, Raywin Ovah, N. T. Pham, and A. Nin-Pratt. 2019. ASTI Country Brief: Papua New Guinea. Washington D.C.: IFPRI, APAARI, NARI.

Appendix 2. Genetic Resources

Status of National and working collections of ex situ and in-vitro collections of crop species and status of livestock numbers at NARI Centres in 2020

Collections	Location	Count
Banana national collection	Laloki	212
Banana working collections	Bubia	68
Banana Atoll collection	Keravat	9
Yam national collection	Laloki	71
Taro national collection	Bubia	322
Taro working collections	Keravat	6
	Laloki	10
Sweet potato national collection (highlands)	Aiyura	709
SP Breeding lines	Aiyura	83
Sweet potato working collection	Laloki	8
	Bubia	202
Sweet potato Atoll collection (Keravat)	Keravat	34
Aibika national collection	Laloki	40
Aibika working collection	Bubia	5
	Keravat	11
Cassava national collection	Laloki	113
Cassava working collections	Bubia	4
	Keravat	42
Rambutan	Keravat	16
Mango	Keravat	6
Taun	Keravat	4
Cashew	Keravat	4

Carambola	Keravat	8
Cocoa	Keravat	21
Pepper	Keravat	4
Cardamon	Keravat	3
Kava	Keravat	8
Nutmeg	Keravat	2
NERICA rice	Bubia	38
Soil stress tolerant rice	Bubia	16
Aromatic rice	Bubia	8
Bacterial blight resistant rice	Bubia	8
Brown plant hopper tolerant rice	Bubia	8
Other rice varieties	Bubia	23
Irish Potato (Tissue Culture)	Aiyura TCL	26
Sweetpotato (Tissue Culture)	Aiyura TCL	52
Sheep	Labu	39
Goats	Labu	48
Pigs	Labu	26
Ducks	Labu	138
Rabbits	Labu	15
Village Chicken	Labu	74
Tilapia (brood stock)	Labu	n/a
Sheep	Tambul	81
Goats	Tambul	19
Cattle	Tambul	21
Ducks	Tambul	18
Village Chicken	Tambul	22
Tilapia (brood stock)	Tambul	262



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