



NARI Strategic Implementation Plan 2022-2026

Corporate Plan No.2/2022

Promoting Excellence in Agricultural Research for Sustainable Development

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

- any branch of biological, physical and natural sciences related to agriculture;
- cultural and socio-economic aspects of the agricultural sector, especially of the smallholder agriculture; and
- matters relating to rural development and of relevance to PNG.

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

The Institute's Strategic Objective (purpose) is to enhance productivity, efficiency, stability and the 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 PNG through scientific research, knowledge creation and information sharing.

The Vision for NARI is "*Prosperous PNG Agricultural Communities*". NARI's core values are Leadership, Innovativeness, Integrity, Communication and Organisational Excellence.

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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NARI Strategic Implementation Plan 2022-2026

(Corporate Plan 2/2022)

National Agricultural Research Institute

Lae, Papua New Guinea

2022

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Foreword

Papua New Guinea is richly endowed with both renewable and non-renewable natural resources. In spite of this attractive resource scenario, PNG still ranks poorly on social indicators, showing last in the Pacific on the Human Development Index (HDI). Overcoming these requires people and communities to be empowered to participate in economic growth and national development. Development of PNG's agriculture sector is key to addressing the key challenges of access to healthy and nutritious diets, resilience to environmental and economic pressures, and participation in economic opportunities.

Agriculture offers great promise for growth, poverty reduction, and environmental services in PNG where the majority of our population live in rural areas and earn their livelihoods from agriculture, and supported by fisheries and forest resources utilisation. Agriculture must be considered to be the primary focus for rural development and the most important means for economic growth and social wellbeing in the country. If focused as the central agenda for development, outcomes arising from agriculture will contribute substantially and sustainably to the development outcomes of other sectors, such as health, education, law and justice and even infrastructure, thus creating a positive multiplier impact, taking advantage of synergies and complementary programs among sectors.

In July 2021 the National Agricultural Research Institute (NARI) finalised the draft of the second NARI Strategy and Results Framework (SRF) 2022-2031. This represented a major milestone in the Institute's ambition to continue effectively contributing to improving PNG's welfare, especially of smallholder farmers and rural communities. The new SRF signals confidence in the Agricultural Research for Development (AR4D) paradigm adopted by NARI in 2011, and continues the emphasis on NARI as a results-oriented learning organisation.

While the SRF aligns with the National Development Goals and provides the overall direction for the Institute, it is important to carefully map out the different steps it will need to take to achieve this and deliver tangible outputs and outcomes to impact on lives of our major clients, the smallholder farmers and rural communities in the country.

The NARI Strategic Implementation Plan 2022-2026 (SIP) is the second tier corporate planning document providing NARI managers, researchers, donors and partners a guide to AR4D implementation for the first five years of the SRF (2022-2031).

The Institute is aware that achievement of the institutional Strategic Objective for “enhanced productivity, efficiency, stability and sustainability of the smallholder agriculture sector”, will also require the out-scaling and up-scaling of such pilot level successes to accomplish wider impacts. Increasing NARI capacity to effectively take up its role in initial facilitation of out-scaling and up-scaling will be progressively addressed.

Successful delivery of the Strategy and Results Framework not only requires clear plans, but also adequate resourcing in finance and a revision of the Institute's organisational management structure taking into account the lesson's learnt from previous and current performance of the structure and what is required to take NARI into the future. The SIP (2022-2026) provides the basis for this review.

I take this opportunity to express appreciation and commend the efforts of the NARI staff and especially our stakeholders for their contributions and effort in developing the NARI SIP 2022-2026. This plan will guide the resourcing of the Institute, planning and implementation of projects, and provide a road-map to achieving impacts in the lives of rural communities over the next five (5) years.



Warea Orapa
a/Director General

Acronyms and Abbreviations

ADD	Agricultural Development Domains
AR4D	Agricultural Research for Development
ASTI	Agricultural Science and Technology Indicators
BWAP	Banana Wilt Associated Phytoplasma
CBD	Convention on Biological Diversity
CSA	Climate Smart Agriculture
DAL	Department of Agriculture and Livestock
DOI	Digital Object Identifiers
FAO	Food and Agriculture Organisation
FAW	Fall Army Worm
GESI	Gender Equality and Social Inclusion
GHG	Green House Gases
GIS	Geographic Information Systems
GoPNG	Government of PNG
GR	Genetic Resources
GRFA	Genetic Resources for Food and Agriculture
HT / HR	Human Talents / Human Resources
ICT	Information and Communication Technology
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
ME&L	Monitoring and Evaluation and Learning
M&SME	Micro and Small to Medium Enterprises
MTDP	Medium-term Development Plan
NARI	National Agricultural Research Institute
NAIC	National Agricultural Insect Collection
NCD	National Capital District
NGO	Non Government Organisation
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
PKCL	Prof. Kola Chemistry Laboratory
PME&L	Planning, Monitoring, Evaluation, and Learning
PNG	Papua New Guinea
POETCom	Pacific Organic and Ethical Trade Community
RA	Result Area
RBM	Results Based Management
RC	Regional Centre
R4D	Research for Development
SDG	Sustainable Development Goals
SIP	Strategic Implementation Plan
SME	Small to Medium Enterprises
SO	Strategic Objective
SPC	The Pacific Community
SRF	Strategic Results Framework
StARS	National Strategy for responsible sustainable development
ToT	Training of Trainers

PNG NATIONAL AGRICULTURAL RESEARCH INSTITUTE

Strategic Implementation Plan 2022-2026

1. Introduction

The PNG National Agricultural Research Institute Strategic Implementation Plan (SIP) is the second level plan in the NARI Agricultural Research for Development (AR4D) planning and implementation process (Figure 1).

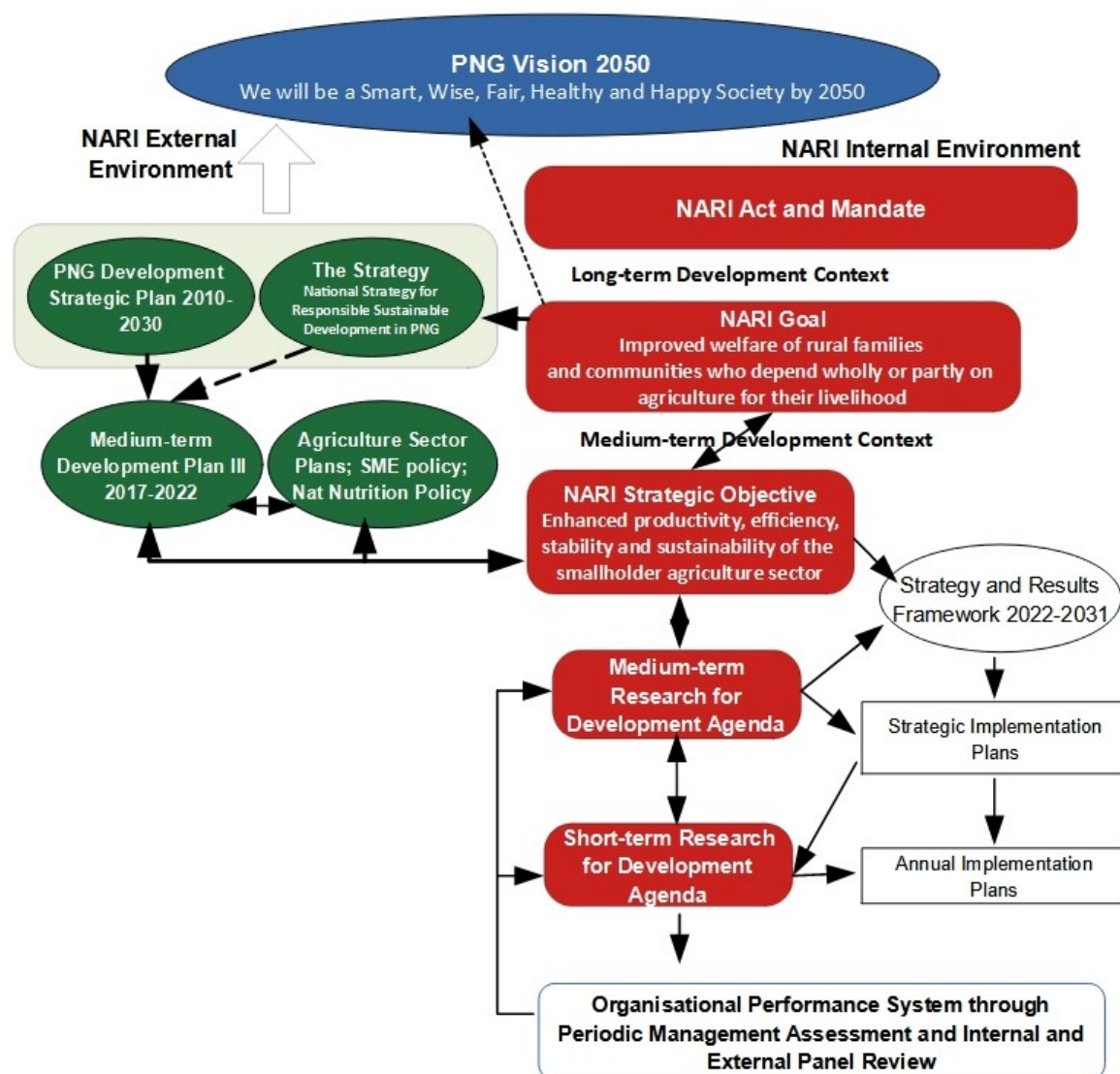


Figure 1: NARI Planning and Implementation Process and contribution to sectoral and national development

While the Strategic Results Framework (SRF II) provides the overall strategic direction towards achieving the Institute's objectives and the contribution of NARI towards key

agricultural development outcomes through research for development, the SIP documents Key Result Areas within the three identified agricultural development priorities highlighted in the SRF II. The Result Areas outline the short-to medium term results that the Institute aims to achieve during the term of the Plan. Achievement would include the generation of research outputs such as new technologies, practices, information, policies, strategies and innovative approaches and models that will address specific priority constraints or opportunities in agricultural development experienced by smallholder agricultural communities in different Agricultural Development Domains (Annex 1). The NARI planning and implementation process aims to ensure results, through research outputs, which are relevant and generated along agricultural development pathways that lead to outcomes and impacts at the agricultural system level, and ultimately contribute to the major development challenges the country is facing. The SIP is an operational plan for an initial 5-year period that intends to match the Institute's medium-term aspirations outlined in the SRF II with a modest increase to NARI's current research capacity in terms of available skills, competencies, funding sources and other resources (Figure 1).

The SIP provides information on targets and intermediate results to be achieved from implementation of priority project and program portfolios within the seven Result Areas in the time frame of 5 years with an understanding that investment and delivery of results in some Result Areas will continue in the next 5-year planning period. The plan is intended not only to guide NARI managers and staff on AR4D planning and implementation in the Institute but will also inform government and development partners and donors on the current focus and priorities of the Institute. Figure 1 shows the alignment of the SRF and SIP with sector and national development policies.

Development of the Strategic Implementation Plan

The three priorities NARI will focus on in the next 10 years, as outlined in the SRF II, with the delivery of AR4D outputs and outcomes are as follows:

Priority 1: Markets, Value Chains and Trade - contribution to economic resilience and development by enhancing agricultural value chains and innovations;

Priority 2: Contribution to enhanced resilience of rural communities and agro-eco systems to climate, economic and demographic changes and associated threats to livelihoods and the environment;

Priority 3: Contribution to the enhanced consumption of healthy and sustainable diets by rural and urban households;

A results-based planning approach was used to define the cascading result statements at different impact and outcome levels linking country, sector and institute priorities (Annex 1). This forms the basis for the identification of relevant and necessary AR4D outputs and outcomes that the Institute, with the assistance of partners in the agriculture sector and beyond, will commit to delivering over the next 10 years, and specifically in the 5-year period of this plan (Figure 2).

The mandate of NARI is very broad and covers all areas of agricultural research including natural resource management with all its biophysical and social aspects that form agricultural systems in the country. The key reference points for the planning of relevant programs and projects are seven Result Areas across the three major priorities (Annex 1). These define specific areas of investment and intervention covering NARI's mandate, and link to the higher level of results defined in the SRF II.

The SRF II outlined the myriad of agricultural development needs where AR4D can make a significant contribution in facilitating the changes in agricultural development that will lead to the improved livelihoods the country envisions as its long-term future. To better understand the underlying issues and derive relevant responses and actions, it was necessary to undertake a detailed planning and prioritisation process. Prioritisation processes were also applied to develop a focused AR4D agenda, that can be supported with the resources available to the Institute.

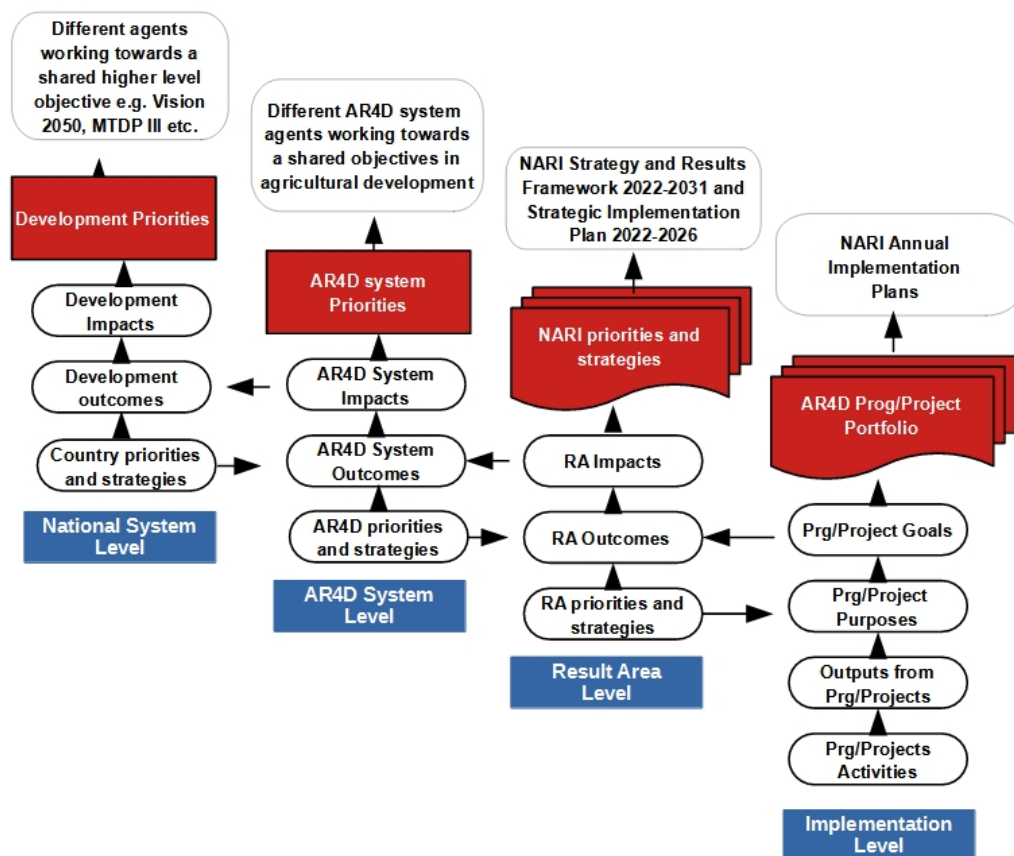


Figure 2: Interconnected level of planning, implementation and delivery of AR4D results

Much of this work was progressed by a Strategic Planning Team composed of Senior staff of the Institute. A Strategic Planning and Prioritisation Workshop was run from 28 June –

7 July 2021 to enable participation of NARI research managers and scientific staff in identifying sub-level results in each of the Result Areas. In order to take into account the diversity in biophysical, social and socio-economic settings in PNG, the ADD framework (Annex 1) was used in constraints and objective tree analyses (Annex 2) to derive possible interventions for different domain clusters in relation to their economic opportunities, resilience and food and nutritional security. This was followed by an exercise prioritising investment in value chain research and other economic opportunities. External stakeholders were also involved in this prioritisation exercise. Following the workshop, all scientific and technical staff in the NARI centres were invited to give their assessments. The ranking of value chains and economic opportunities considered is shown in Annex 3.

The following sections outline the planned achievements in form of research outputs and immediate outcomes in each of the priority Result Areas and associated portfolios of programs and projects. Three cross-cutting areas have been identified with strategies and actions applicable across the different Result Areas and along the Impact Pathway. The latter part of this plan provides the major corporate strategies to strengthen the Institute management systems with improved efficiency and effectiveness. Figure 3 shows the underlying Theory of Change along the impact pathway on how research will make a major contribution to effecting necessary changes at different levels.

2. Implementation plans

2.1 Priority 1 – Economic Development and Value Chains

Economic Development is a key agenda by the PNG Government and the agriculture sector offers many opportunities to contribute to that agenda by building resilient value chains that offer income earning opportunities from agricultural production, processing and marketing of fresh and processed produce. The SRF II outlines in more detail the changes that need to be facilitated for the sector to rise to its potential.

There are two Result Areas that will guide NARI to design relevant programs and project portfolios to generate AR4D results. The first area is to diagnose, foresight and gather evidence on investment options for AR4D. The second Result Area will focus on specific priority value chains of national importance including associated wider issues around the enabling environment in which the value chains and its actors are operating.

2.1.1 Result Area - Foresighting and Advocacy

Strategic objective:

Strategic directions for investment in agricultural development explored and advocated based on assessments of domestic and international market demand, trends and opportunities for food and industrial agricultural products

The first Result Area under Priority 1 is designed to conduct strategic research in identifying AR4D investment opportunities and gathering information that will inform policy and priority setting at national and institutional level.

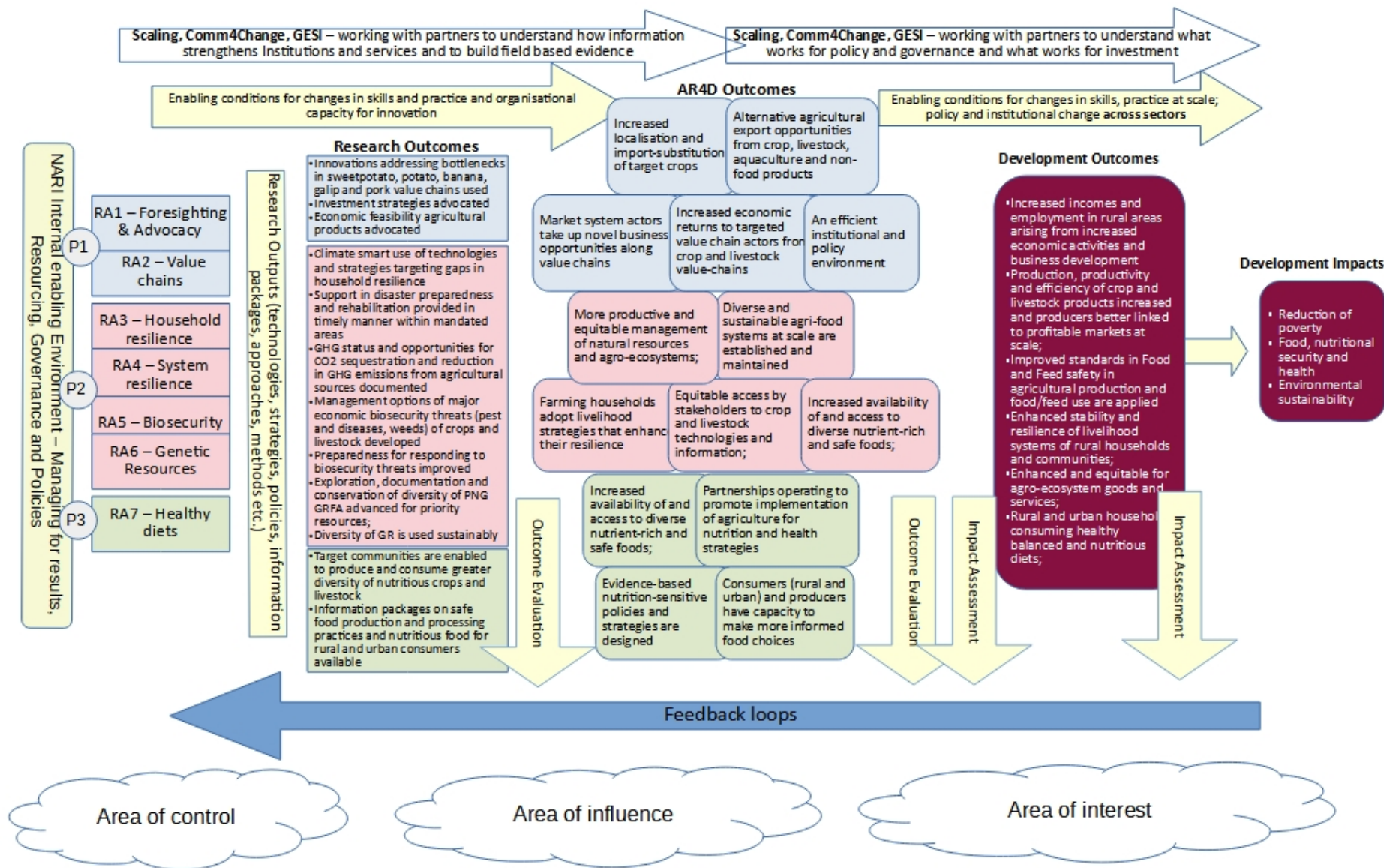


Figure 3: Theory of Change for of the contribution of AR4D in the achievement of System outcomes and Development Outcomes and Impacts

This RA has two sub-objectives with the first component dealing with the higher macro-level assessments of exploring the future directions and associated constraints and opportunities in agricultural development while the second component examines more concrete opportunities in economic development in the agriculture sector to come up with recommendations on feasibility, potential rates of return on investment in agricultural research for development.

An important part in this Result Area is advocacy at national level to influence policy and strategic directions at various levels of government, institutions as well as donor investment. The linkages to AR4D system and development outcomes and impacts is shown in Figure 3.

2.1.1.1 Investment Strategies

PNG is undergoing a transformation process from primarily subsistence-based production systems and livelihoods towards systems that produce products and commodities for sale in domestic and export markets. This transformation needs to be supported with necessary investment in capital, human capacity development, infrastructure and development of non-farm businesses underwritten by enabling policies. In a resource constraint environment, decisions need to be made to prioritise investment options in this transformation process that produce high returns to the investment with desirable impacts on the target populations. This component of RA 1 is designed to make a contribution at this macro-level with strategic research analysing and assessing options and generating data and information that inform policy planning and help to direct investment by government and donors in agricultural development (Table 1).

Table 1: Anticipated results from assessment of investment strategies

1. Investment Strategies	Strategic objective: Investment strategies for agricultural transformation assessed and advocated
Outputs	<ul style="list-style-type: none"> • Information on costs and benefits of key agri-food system and investment options that are inclusive, pro-poor and targeted to promote economic growth; • Increased capacity and networking in the design of agricultural transformation strategies; • Information on future research needs and partnerships in policy analysis and data-driven investment opportunities; • Policy and strategy papers on future economic investment options and research investment; • Relevant databases on research investment, Agriculture Science and Technology Indicators (ASTI) and other information developed and maintained; • Communications tools used and stakeholder interactions facilitated to share information and advocate identified strategies;

Immediate outcomes	<ul style="list-style-type: none"> Investment in agriculture and AR4D increased by GoPNG, donor agencies, private enterprises; Increased rates of return on investment in AR4D from better targeting and decision making
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2.1.1.2 Market and Production Opportunities

This component is closely related to the first component in RA2 but the focus will be the assessment of specific opportunities in agriculture based economic development. As an important strategy, NARI will carry out feasibility studies on a range of agricultural products, both fresh and processed to determine their potential to be developed into commodities that are produced at larger scale for sale in domestic and overseas markets. Annex A3.2 shows a list of such potential economic opportunities as assessed by NARI staff and external stakeholders as part of the strategic planning process.

The assessments will incorporate considerations of suitable land areas that match agro-ecological requirements, *ex ante* assessments on economic returns to investment and impacts in terms of rural development and economic development of target communities and other actors in the value chain. Other opportunities to be explored for raising returns to value chain actors include e.g. organic certification of produce to access niche markets. NARI has been assigned responsibility as part of the MTDP III to act as a facilitator for organic certification. The Institute will work closely with POETCom, the ‘governance’ body of the organics movement in the Pacific that is supported by the Secretariat of the Pacific Community (SPC).

Table 2: Anticipated results from assessment of economic opportunities

2. Economic opportunities	Strategic Objective: Economic feasibility of fresh, processed and non-food agricultural production at different scales assessed and advocated
Outputs	<ul style="list-style-type: none"> Information on economic feasibility for selected crop and livestock for large scale farming (e.g. rice, spices, breadfruit, taro, yam, tropical and temperate fruits and nuts etc.) Information on economically feasible agricultural production sites mapped. Information on prospective investment opportunities in the agriculture sector accessed by government agencies, PNG owned companies and small holder farmers. Information on opportunities and feasibility for organic certification for selected crop and livestock products; Policy and strategy papers on future economic investment options and research investment;

Immediate outcomes	<ul style="list-style-type: none"> • Investment in agriculture and AR4D increased by GoPNG, donor agencies, private companies; • Policy and institutional reforms draw on information from policy briefs and databases to revise strategies and policies in agriculture based economic development
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2.1.2 Result Area - Value Chain Support

Strategic Objective

Improved technological, practical and economical approaches and adaptations for agricultural systems through facilitated innovation, foreign direct investments, and adoption processes along specific and related value chains

The second Result Area focuses on specific value chains and uses a whole-value chain approach to address key bottlenecks that require research innovation for greater efficiency and productivity and ultimately greater returns to value chain actors. There are five value chains that NARI will initially focus on during the 5 year period of this plan, viz. Sweetpotato, Potato, Banana, Galip nut, and Pork Product Value chains. Much of this work will carry forward into the next 5-year planning period. In case of sweetpotato, potato and banana value chains a thorough value chain mapping and analysis of the pending issues where research can make a major contribution is priority, followed by the development of targeted portfolios of activities in each of the value chains. The SIP is a dynamic document and priorities can be revised as part of an on-going M&E and Learning process.

2.1.2.1 Value chain innovations for sweetpotato, potato and banana

Sweetpotato (*Ipomea batatas*) and banana (*Musa spp.*) are the two leading staple crops in PNG in terms of production and consumption. They have an important role in subsistence systems but especially sweetpotato has become an increasingly important crop for income generation at different scales. Potato (*Solanum tuberosum*) on the other hand was introduced and promoted in the country as a crop for cash income generation in the high-altitude highlands. It's short maturity time of three months makes it also an attractive crop to diversify systems for food security and production is expanding in the highlands of the coastal regions throughout the country, such as Goilala, Pomio, Kabwum, Menyamya and Raikos Districts.

Sweetpotato and potato have received substantial support through research for development interventions over the past more than 30 years but with the need for economic development and strengthening of domestic value chains in support of national food security, further investment is required to develop competitive industries for both crops. NARI has an on-going commitment to support investment in both value chains with targeted research for development interventions.

Banana (both cooking and dessert banana types) has received very little attention and support from research for development to explore and turn it from an important village-level food with high subsistence and informal market value, into a competitive crop that is grown on a larger scale to supply domestic rural and urban markets.

While there is an ongoing need to address bottlenecks in productivity and reduction of postharvest losses, the focus has to shift to take a more holistic approach that brings together value chain actors to participate in developing of value chain system innovations that will further improve farm productivity, reduce production and marketing costs, and address the challenges in technology uptake and market diversification.

Table 3: Anticipated results from support to sweetpotato, potato, banana value chains

1. Value chain innovations	Strategic Objective: Innovations addressing key bottlenecks in sweetpotato, potato and banana are used along the value chain
Outputs	<ul style="list-style-type: none"> • In-depth value chain mapping and research needs assessment for sweetpotato, potato and banana • Information and technology package on small scale commercial banana production; • Potato and sweetpotato varieties meeting end-user requirements; • Soil management package for sweetpotato production systems • Appropriate business models for micro-enterprises developed supporting target value chains; • Investment portfolios available for interested private sector operators; • Suitable mechanisation options available for different scales of operation in production and processing; • Production and Quality standards and Standard operating procedures available for downstream processing; • Gaps in availability of guidelines, protocols and systems for production of certified planting material of sweetpotato, potato and banana addressed;
Immediate expected outcomes:	<ul style="list-style-type: none"> • Knowledge on improved practices in production and postharvest management in sweetpotato, potato, banana value chains used by value chain actors in target areas; • Increased farm productivity and consistency in the supply of targeted produce; • Establishment of appropriate farm business/enterprise models in targeted value chains emerging; • Increased use of market information by participating commercial farmers and aggregators

Table 3 shows a range of anticipated results for the three priority value chains. Planned outputs may be revised based on the outcomes of the value chain mapping exercise.

2.1.2.2 Galip Value chain support

NARI has an on-going commitment to support the development of the Galip Nut Value Chain. The Galip nut (*Canarium indicum*) is an indigenous resource, unique to only a few

countries in the Pacific with a proven potential to become an important crop for income generation at different scales. Over more than 20 years, first DAL and subsequently NARI have worked with assistance of the European Union and Australian Centre for International Agricultural Research (ACIAR) to explore and realise the potential of this tree crop to turn it from an important village-level food and trading commodity with high cultural value into a commercially viable industry supplying domestic export markets. Considerable progress has been made with a limited supply of high quality Galip products now available in the domestic market and focus has to shift to the development and adaptation of technologies to production systems that will ascertain the supply of the raw products for an expansion of the industry aside from further promotion and advocacy in increasing investment into the development of this industry (Table 4).

Table 4: Anticipated results from Galip value chain support

2. Galip Nut Value Chain	Strategic Objective: Improved knowledge on current key bottlenecks in production, processing and marketing in the Galip value chain
Outputs	<ul style="list-style-type: none"> • Commercial viability of business models for galip nut processing improved; • Appropriate business models for micro-enterprises developed and capacity of operators increased; • Improved production technologies developed (harvesting practices, on-farm processing; • Information on management options and strategies for the Galip weevil • Investment portfolios available for interested private sector operators; • Suitable mechanisation options available for different scales of operation; • Production and Quality standards and Standard operating procedures available;
Immediate expected outcomes	<ul style="list-style-type: none"> • Increased volumes for Galip nut processed by current processors and sold in retail outlets in PNG • Increased establishment of Galip plantations or inter-cropping; • Increased investment by GoPNG and private sector in Galip AR4D, production, processing and marketing;

2.1.2.3 Pork product value chain support

The pork production value chain is a new commitment in terms of the breadth of scope that NARI will engage in for this important commodity. Pig production at village level is an important activity primarily for its cultural significance but also considerable economic importance in the subsistence economy. Most of the domestic supply is produced by a few larger scale producers but there is an emerging group of micro and SME scale pig producers that need to be fostered to enable their transition into the formal market space.

The recent incursion of African Swine Fever which severely impacted pig production in the main Highland Provinces of Hela, Southern Highlands and Enga has highlighted the need to deploy a whole-value-chain approach in order to manage this disease as part of improved biosecurity and husbandry practices on-farm. AR4D interventions will address a number of current issues including nutrition, genetics, reproduction and management.

Table 5: Anticipated results from Pork value chain support

3. Pork Product Value Chain	Strategic objective: Availability of lower cost locally produced pigs and pork products in selected retail outlets or open market increased in target provinces
Outputs	<ul style="list-style-type: none"> • Effective research collaboration and networks between NARI and NAQIA on animal health & diseases. • Capacity of selected smallholder farmers on improved production practices and animal Health & welfare management tailored increased productivity and production increased. • Value chain mapping and key determinants influencing output across the value chain documented; • Safe & economically sustainable models for multiplication, supply & easy access for quality replacement stocks developed. • Demand & key requirements in production, processing and marketing to support niche markets for pork meat determined; • Awareness on biosecurity standards and practices conducted. • NARI staff and partner capacity on para-veterinary skills and knowledge increased.
Immediate expected outcomes:	<ul style="list-style-type: none"> • Production of pig and pork products in target provinces showing incremental increases over time; • Improved access to productive breeding stock; • Health of pig herds and hygiene of production environment in target piggeries improved; • Improved knowledge on value chain actors on cost effective production, processing and marketing of pigs and pork products

2.2 Priority 2: Resilient Systems

Priority 2 is addressing threats and risks to livelihoods and agro-ecosystem arising from climatic, economic and demographic changes the country is experiencing. Households relying on their traditional subsistence systems for their livelihoods are highly vulnerable to food insecurity and disruption of income generating activities due to the impact of increasing frequency of severe weather events and more unpredictable weather patterns. High population growth and migration of people closer to areas with better access to services will be putting increasing pressure on agricultural land with good and medium potential requiring a shift to more sustainable production practices that are environmentally

sustainable, make use and conserve the great diversity in genetic resources the country has and deals with a range of biosecurity threats and issues already impacting on agricultural production systems. Four Result Areas have been identified under this priority (Annex 1) that target the different constraints and opportunities under this priority in line with the AR4D strategies documented in the SRF II. Over the next 5 years, NARI will be focusing mostly on three of the Result Areas, viz. Household resilience, Genetic resources and Biosecurity management. The fourth Result Area, Agro-eco System resilience, is important especially to address research needs in relation to environmental sustainability of the chosen development path in agricultural system development including the impacts of climate change on systems in light of the commitment made in National Climate Compatible Development Management Policy 2014, to half carbon emissions by 2030 and become carbon neutral in 2050. Presently, NARI has little capacity to address the various issues. The focus in the next 5 years will be to build more capacity in systems research including relevant capacities to address relevant aspects of climate change adaptation and mitigation.

2.2.1 Result Area - Household Resilience

Strategic Objective:

Smallholder farming and rural communities have an increased adaptive capacity to cope with abiotic stresses due to seasonal weather patterns, climate change or natural disasters

Result Area 3 is focusing on addressing household resilience issues exacerbated by Global Climate Change and increasing the adaptive capacity of vulnerable communities. There are two sub-objectives in this RA. The first sub-objective is addressing the AR4D needs in responding to gaps in technology, strategy and delivery systems that will contribute to communities and households empowered to manage risks to their livelihoods better. The second sub-objective targets disaster response and NARI's contribution towards a disaster prevention and efforts of rehabilitation of agro-eco and food systems after disasters such as severe El Nino and La Nina events or other types of disasters.

2.2.1.1 Climate Smart Solutions

Climate change has shown to have a significant impact on food availability and stability as well as income earning activities. Climate smart solutions are aimed at developing the technical, policy and investment conditions to sustainably adapting and building resilience from household to national level and contribute to mitigate Green House Gas (GHG) emissions.

The contribution of AR4D in this area is critical and will be guided by application of the ADD framework to understand the specific interventions and the combination of technologies and practices that would form a resilience strategy for a particular biophysical and socio-economic setting targeting climate-vulnerable, food insecure communities. NARI will be building on the work that has been done over the past 10 years in working with communities to respond to technology and strategy gaps in household resilience but also strengthen communities in collective action that will increase their adaptive capacity to changes they are encountering as a direct effect of climate change related severe weather

events as well as indirect impacts from intensification of commercial crop and livestock production on food and eco-systems exacerbated by climate change.

The Institute will continue to develop crop varieties tolerant to abiotic stresses and consider needs for improved breeds which are more productive and better adapted to the changing environment. NARI will make available a suit of crop and livestock species for integration and diversification of traditional systems and more sustainable farm operations that are shifting towards commercial production. Other technologies and practices will include adaptation of low-cost irrigation and soil water management practices, post-harvest and storage options of farm produce. An important area is the transfer of such technologies, strategies and practices. NARI will continue to apply and adapt approaches and models for equitable local adaptation planning and governance, and developing innovative incentives and mechanisms for scaling up.

Table 6: Anticipated results for Climate Smart Solutions

1. Climate Smart Solution	<p>Strategic objective</p> <p>Climate smart use of technologies and strategies targeting gaps in household resilience to climate change induced stresses and other shocks in diverse agro-ecologies and food systems by target communities</p>
Outputs	<ul style="list-style-type: none"> • Vulnerability assessment information and maps • Baseline on traditional cropping calendars for representative areas and regions documented • Diversified climate resilient portfolios of crop varieties and species as well as livestock strategies and technologies adapted to climate risks available to stakeholders; • Relevant farm practices and strategies from production to marketing (e.g. soil moisture management, storage, on-farm processing, use of seasonal farm advisory) to mitigate risks to household resilience developed and adapted; • Livestock feeding strategies and better utilisation of existing and novel feed and forage resources advanced to supply-to-demand feed products as milled, fermented or fresh materials • Scaling approaches applied for wider awareness and adoption of climate smart innovations in target areas;
Immediate outcomes	<ul style="list-style-type: none"> • CSA products and approaches integrated into ADD production systems at scale • responsive networks and partnership models for community support operating

2.2.1.2 Disaster response

NARI has an active role to play in disaster management in the country, working with front line mandated government agencies and other partners to contribute in disaster mitigation and rehabilitation of agricultural production systems following a disaster event. This

support mostly revolves around the supply of planting material and breeding stock in the aftermath of the event. In case of monitoring and mitigation of impacts of severe El Nino and La Nina events, the Institute will contribute with relevant information products and packages that help communities plan and adapt their cropping cycle for this event disseminated through relevant communication channels.

NARI will also continue to work with the National Weather Services in building up capacity with data support to improve seasonal forecasting for more accurate prediction of severe weather events. Partnerships with other organisations such as National and Provincial Disaster Centres, NGOs and donors will be important for improving on effectiveness in disaster response.

Table 7: Anticipated results from Disaster Response interventions

2. Disaster response	Strategic objective: Support in disaster preparedness and rehabilitation provided in timely manner within mandated areas
Outputs	<ul style="list-style-type: none"> • Sufficient quality planting material and breeding stock available at NARI Centres as foundation material for rehabilitation after disaster events; • Local seed/planting material and breeding stock production centres supported with foundation stock; • Information packages available on management of severe El Nino events (before, during and after the drought) • Weather data available from all NARI Centres to stakeholder
Immediate outcomes	<ul style="list-style-type: none"> • Timely response and contribution to agricultural disaster rehabilitation; • improved forecasting and preparation for severe El Nino and La Nina events; • responsive networks and partnership models for community support operating

2.2.2 Result Area – Agro-eco system resilience

Strategic Objective:

Sustainability of managing agro-systems and catchment areas in ADD clusters with high population density and intensified agricultural systems improved

As mentioned earlier, there will only be limited engagement in this RA for the current planning period with a focus on building capacity in addressing climate mitigation strategies relevant to the smallholder agriculture sector. There is a need to assess the current status, and to innovate to reduce the emissions of GHG from increasing agriculture in PNG. Some areas of agricultural production, particularly cattle and rice paddy production, are among the leading agricultural contributors to GHG buildup in the atmosphere. International research is ongoing to counter these threats and any push to promote the increased agriculture needs to be supported by suitable climate safe innovations. There is also potential to utilise productive agriculture to sequester additional

carbon dioxide (CO₂) from the atmosphere. As PNG seeks to increase its agricultural output, three areas for attention will be CO₂ sequestration and the building of soil carbon, reduction of methane emissions from ruminants; and methane emissions from rice paddies.

Table 8: Anticipated results from Climate Change mitigation research

GHG agricultural mitigation opportunities	Strategic Objective: GHG status and opportunities for CO ₂ sequestration and reduction in GHG emissions from agricultural sources documented
Outputs	<ul style="list-style-type: none"> • Assessment of GHG emissions from agricultural sources in PNG • Assessment of opportunities for CO₂ sequestration and building of soil carbon levels. • Guidelines for climate safe agricultural practice.
Immediate outcomes	<ul style="list-style-type: none"> • Improved knowledge on risks and mitigation of climate threats from agricultural production in PNG

2.2.3 Result Area – Biosecurity

Strategic Objective:

Biotic agro-ecosystem threats are sustainably managed by smallholder farmers at different scales of operation

Biosecurity involves preventing the introduction of exotic as well as the management of endemic pests, diseases and weeds. Management of Biosecurity is also important in facilitation of trade and opening up opportunities for export of agricultural products and commodities. While NAQIA has a leading mandate in overall Biosecurity management including the development of relevant Biosecurity legislation and policies related to trade, NARI has a major role in conducting relevant research in the management, monitoring and surveillance especially of endemic biological pest and disease threats to agricultural, horticultural, agro-forestry, and aquaculture production systems, as well as natural ecosystems.

The major concern is on pests, diseases and invasive weeds that are causing significant losses to economically important crops and livestock but also posing threats to smallholder livelihoods. NARI's role will be in two major areas, viz. Biosecurity management and Biosecurity preparedness (Annex 1). In the coming 5 years, NARI will be focusing on the Biosecurity management aspects with the development of management options for a number of current pests and diseases that are impacting important crops and livestock as well as tightening internal procedures to ensure that all planting materials and breeding stock distributed are free of known pests and diseases. The Institute will contribute to Biosecurity preparedness as required and in response to requests by NAQIA as lead agency, and other national and regional agencies.

Table 9: Anticipated outputs for management of Biosecurity Threats

1. Biosecurity Management	Strategic Objective: Management options of major economic biosecurity threats (pest and diseases, weeds) of crops and livestock developed
Outputs	<ul style="list-style-type: none"> • Fall Army Worm Management Package and associated information available and capacity built for use by different stakeholders; • Additional environmentally safe options available to vegetable producers for effective management of Diamond-back moth; • Integrated management approaches for African Swine Fever control operating in small-scale piggeries in PNG Highlands as part of improved value chain management; • Improved understanding of the biology, population dynamics and management options of the Galip Weevil; • Effective management strategies of Banana-associated phytoplasma in affected areas in Morobe and Madang; • Information on presence of BWAP related disease in other banana growing regions • Information on agricultural pests in PNG available online; • Capacity built in invasive weed management, especially high priority invasive plant species already damaging agro-ecosystems in PNG including prickly <i>Mimosa pigra</i>, <i>Piper aduncum</i> (Wild daka), African tulip tree (<i>Spathodea campanulate</i>), mollases, and <i>Rottboelia</i>. • Standard operating manuals and procedures applied for production of quality, and pest- and disease-free planting material and breeding stock;
2. Biosecurity preparedness	Strategic Objective Preparedness for responding to biosecurity threats improved
Outputs	<ul style="list-style-type: none"> • Contributions to incursion Management Plans and risk assessments; • Contribution to data bases developed for pest alert and incursion threats by NAQIA for stakeholder advise and planning. • Pest & Disease diagnostic capacity increased in supporting the sector;
Immediate outcomes for both sub-objectives	<ul style="list-style-type: none"> • Risks in corn production from FAW better managed and yield stability improved; • Increased use of BWAP management strategies in affected areas and increased production of preferred banana varieties such as Kalapua; • Improved production and quality of vegetable crops; • Reduced losses of Galip trees from Galip weevil attached and confidence in setting up Galip plantations increased; • Increase in production and quality of agricultural (fresh and processed) products

2.2.4 Result Area – Genetic Resources

Strategic Objective:

Diversity of genetic resources is maintained and used for strengthening sustainable and inclusive farming systems responsive to market demands and climate change

PNG has a considerable agro-biodiversity for most of the traditional staple crops, traditional vegetable and fruit and nut species. They constitute an important heritage and basis for food security and the advancement of commercial crop and livestock production in the country. NARI is the custodian of this diversity. There is a need to conserve but also utilise indigenous and local genetic resources but also introduce new genetic resources in a targeted manner to adapt to climatic and commercial changes. This is in line with ‘The Strategy’, which calls for a more responsible management of the country’s natural resources, prevention of loss of biodiversity and ecosystem services.

PNG is also a signatory to international treaties that govern the management, exchange and use of Genetic Resources (CBD – Convention on Biological Diversity) and more importantly for the agriculture sector, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). As a member of the FAO, the country is also required to report on the status of Genetic Resources to the Commissions on Genetic Resources for Food and Agriculture. As part of the ITPGRFA the country has committed itself to conserve and use PGRFA, promote and protect Farmer Rights and submit to the multilateral system of access and benefit sharing of PGRFA. This Result Area has two sub-objectives capturing the scope of the NARI activities.

2.2.4.1 Genetic Resources Management

The management of Genetic Resources (GR) includes the collection, documentation and conservation of Genetic Resources for Food and Agriculture (GRFA). NARI is the centre or a secondary centre of diversity for a range of important crops such as sweetpotato, taro, banana and Plant Genetic Resources (PGR) collections have been established for those crops mostly ex-situ and diversity described and recorded. There are however many more important crops that have not received much attention in capturing and documenting its diversity. Many of those with economic potential either as a food crop, through use of plant parts and components in cosmetics, pharmaceuticals or bio-pesticides. Such crops include Breadfruit (*Artocarpus altilis*), Pandanus spp. (e.g. *Pandanus conoideus* – Marita), Pitpit (*Saccharum edule*), Winged Beans (*Psophocarpus tetragonolobus*) and many more. As part of this sub-objective, NARI will continue to manage existing PGR collections, expand collections (existing and new), characterise and document PGR under its mandate. This will also enable the reduction or prevention of the genetic resource erosion that is happening at an accelerated rate due to the harsh climatic conditions for all species and the selection by the farmers for a few desired traits in many of the staple crops.

A small research activity will collect breadfruit, beans, taro, yam and aibika (*Abelmoschus manihot*). An important activity will be the upgrading of PGR databases and sharing of the information into international databases. Part of that will be the assignment of unique Digital Object Identifiers (DOI) to sweetpotato accessions that will enable PNG to track and trace PGR that the country has shared into the multi-lateral system of the International Treaty on Plant Genetic Resources, Food and Agriculture (ITPGRFA). Other planned

activities include the piloting of alternative conservation approaches such as *in-situ* conservation for sweetpotato, rationalisation of collections to identify core collections representing the genetic diversity of sweetpotato in the country. As the PNG National Focal Point on PGR, NARI will continue to do the coordination and reporting on compliance with provisions stated in the ITPGRFA and implementation of relevant activities as well as other commitments arising from membership in the FAO Commission on Plant Genetic Resources.

Far less work has been done in relation to livestock genetic resources. NARI will progressively work on documenting the range of diversity of poultry and pig breeds, and other livestock including aquaculture species in the country.

Table 10: Anticipated results for Genetic resources management

1. GR Management	Strategic Objective: Exploration, documentation and conservation of diversity of PNG GRFA advanced for priority resources;
Outputs	<ul style="list-style-type: none"> • A pilot in-situ conservation approach to sweetpotato genetic resources is tested in four districts; • Sweetpotato cultivars characterised, phenotyped, evaluated, documented, pre-bred for traits of importance to adaptation and resilience; • Information on GRFA is available to stakeholders in PNG and international community; • Germplasm of root and tuber crops, fruits and nuts, rice, wheat, maize, OP vegetable seed maintained for further research and development purposes with minimum losses; • Breeding stock of village chicken, cross-breeds, ducks, goats and pigs maintained at NARI centres; • Breadfruit collection established and collections of taro, yam and aibika expanded; • Core collection of sweetpotato identified and conserved <i>in-vitro</i> • Genetic characterisation of local livestock (chicken, pigs, goats, sheep) breeds • Fact sheets on poultry and pig breeds in PNG • Compliance with contracting parties to ITPGRFA obligations • Genetic resources for FA management strategy updated;
Immediate outcomes	<ul style="list-style-type: none"> • Extensible in-situ biodiversity conservation approach developed for sweetpotato; • Research and development in plant genetic resources is strengthened in PNG; • Diversity of GR maintained and safe-guarded for the future; • Kuk Research Centre is established as Centre for Sweetpotato GR Collection

2.2.4.2 Genetic Resources Use and Access

The large diversity of GRFA, especially the PGR, is a major asset in assuring food and nutritional security and opening up economic opportunities and has to be used to enhance productivity, nutritional value of crops and diversity of systems for stronger resilience. The focus during the planning period will be on the use of participatory breeding approaches in developing new sweetpotato varieties. The traits of interest are early maturity, drought resistance, high level of beta-carotene (orange fleshed) and anthocyanin (purple fleshed). NARI will continue work it has started in making available a range of vegetable species (open-pollinated) to stakeholders and testing of disaster response kits of crop seed that can provide nutritious food in a short period of time after a disasters. Other work planned is the on-going evaluation of rice varieties to support growing smallholder and commercial rice production as well as the release of new improved corn varieties. In support of the new World Bank funded PNG Agricultural Commercialisation and Diversification Project that has a component on supporting spice production, NARI will facilitate the import of improved essential oil and spice germplasm as per needs of spice growers. That may include citronella, cardamon, pepper, vanilla or other material. Other crop improvement objectives will be aligned with needs arising from value chain assessments to respond to market and consumer demand for particular traits in crop varieties or in response to other arising needs due to abiotic and biotic stresses.

More focus will also be placed on the genetic improvement of livestock. NARI will be looking at using artificial insemination techniques as well as conventional breeding to selectively develop new breeds of chicken, goat and pigs. Introduction of new breeds of chicken is another strategy to be considered.

Access to quality seed is an on-going problem faced by stakeholders. NARI has an important role to play in the overall seed system of crops and has been actively looking into working with other partners in the sector to improve access. This is an on-going effort by the Institute. In the planning period NARI will improve on its internal procedures to make available high quality foundation planting material and breeding stock in required quantities. This will include, but is not limited to, expanding capacity for Pathogen Tested (PT) sweetpotato production at MRC, IRC and SRC, further testing and expansion in use of small scale solar operated incubators in district level small-scale hatcheries and working with Provincial partners and any private sector interests in building capacity in setting up and managing local seed and breeding stock supply facilities. PNG does not have a seed policy and there is no regulation, standards or guidelines on variety release and seed production and sale except for potato seed. NARI will continue to contribute with relevant information to such policy developments.

Table 11: Anticipated results for Genetic Resources Use and Access

2. Genetic Resources Use and Access	<p>Strategic Objective:</p> <p>Diversity of GR is used sustainably enhancing diversity and adaptation of crops and livestock to social, economic and ecological conditions</p>
Outputs	<ul style="list-style-type: none"> • Locally adapted sweetpotato varieties (early maturing, drought tolerant, purple and orange fleshed) bred with farmers' participation; • Tissue Culture protocols for yam mass-multiplication • Seed systems enhanced to promote adapted sweetpotato varieties and other crops; • Seeded crops such as vegetables, legumes and pulses assessed for improvement and utilisation; • Improved rice and corn varieties released; • New spice and essential oil varieties introduced and basic information generated; • New Crop varieties and livestock breeds available with traits that are meeting end-user demand; • Standard operating procedures operating in all NARI centres for production of foundation crop planting materials and breeding stock; • Facilities, equipment and infrastructure in place for production and post harvest processing and safe storage of seed and planting material at NARI centres; • Facilities, equipment and infrastructure in place for improved supply of poultry breeding stock at NARI Centres; • Stakeholders access to and supply with quality breeding stock and planting material of priority crops and varieties improved;
Immediate outcomes	<ul style="list-style-type: none"> • Increased capacity to supply quality assured seed or planting material and breeding stock free of pest and diseases for growers and producers at NARI Centres; • Supply of improved crop varieties and breeds based on end-user needs and consumer demand

2.3 Priority 3: Nutritious Food and Healthy Diets

Priority 3 is covering the contribution that NARI will make in addressing the serious systemic problem of malnutrition in the country. There are important linkages between agriculture and nutrition. The overall contribution of NARI will be in three areas.

The first area is the diversification and enrichment of food systems with nutritious foods and this area is closely linked to Result Area 6 – Genetic Resources.

The second area is focused on addressing protein deficiency and aims at increasing the consumption of high value animal-based protein to address the prevalence of stunting.

The third area of intervention is to support the work of other partners with incorporating nutritional messages and information into learning materials used in Training of Trainer (ToT) programs on crop and livestock production, use and consumption of food and contributing relevant information to promote nutrition sensitive policies and greater investment into this area.

The ADD cluster framework will guide in targeting communities most prone to poor nutritional outcomes as well as help to understand the wider context of the natural and socio-economic environment that may influence the food-system of communities.

This priority has one Result Area with two sub-objectives that NARI will be contributing to with relevant interventions (Table 12). Over the planning period NARI will be extending its research for development into Districts in Morobe and Madang that are showing consistently very poor nutritional outcomes. The core of the work will revolve around the roll-out of the family poultry farming systems but also consider other small livestock and aquaculture.

Table 12: Nutritious Food and Health - Anticipated outputs for the planning period

RA Nutritious Food and Health	Strategic Objective: Increased access to and use of safe and affordable nutritious food by consumers in rural and urban areas in PNG supported
1. Improved Diets	Strategic objective: Target communities are enabled to produce and consume greater diversity of nutritious crops and livestock
Outputs	<ul style="list-style-type: none"> Improved capacity of households to practice sustainable village poultry farming and other appropriate livestock systems in target communities and districts; Enhanced active involvement in households and community on equitable use and consumption of livestock and fish products from village poultry or other livestock/aquaculture systems;
2. Advocacy on safe and nutritious food	Strategic objective Information packages on safe food production and processing practices and nutritious food for rural and urban consumers available
Outputs	<ul style="list-style-type: none"> Information generated on threats to food safety and health from unsafe crop and livestock production and processing practices; Information materials produced and disseminated on nutritional properties of crop and livestock products
Immediate outcomes for both sub-objectives	<ul style="list-style-type: none"> Increased number of households practising sustainable village poultry farming or other livestock/aquaculture systems in selected communities in Momase with known protein deficient diets; Consumers have capacity to make more informed food choices for healthier diets that meet their needs and preferences

Cross-cutting Areas:

Three Result Areas have been considered cross-cutting to the three Priorities and Result Areas within, because defined strategies are applicable across the whole research agenda. The cross-cutting nature of the identified areas applies across the seven Result Areas but needs to be equally considered as part of the AR4D interventions along the impact pathway (Figure 3). The first area is the scaling of R4D innovations, the second is Gender, Youth and Social inclusion and the third area is Communication for Change. The following is a brief description of the major strategies to be used and anticipated outputs for the planning period (Table 13).

2.4.1 Scaling of outcomes and impacts of R4D innovations

Scaling of outcomes and impacts from research innovations remains one of the greatest challenges that the AR4D community is facing. Scaling in a wider context needs to encompass all factors that influence change processes necessary to achieve a larger scale impact. In the context of the SIP, the scaling strategies focus on the assessing and adapting approaches and processes to support and strengthen networks and interactions between system actors. Also included are actions that generate data and outputs that inform policy making processes and development as well as facilitation of dialogues with policy makers in the AR4D system. Development of strategic partnerships and networks, and enhancing efficiency in working with partners is another cornerstone in NARI's approach to scaling. It is also important to improve NARI's Planning, Monitoring, Evaluation and Learning (PME&L) system, to be able to make statements on achievements of outcomes and impacts.

Table 13: Cross-cutting Areas – Anticipated outputs for the planning period

2.4.1 Scaling of research innovation outcomes and impacts	Strategic objective: Improved understanding on and availability of key drivers and innovations that enhance desirable system changes in scaling of AR4D output and outcomes
Outputs	<ul style="list-style-type: none"> • Inclusive and equitable partnership models and improved institutional arrangements for scaling of research outputs and providing sustainable support to target value chains, vulnerable communities and other target beneficiaries; • Research outcomes and impacts assessed and key drivers of success determined; • Technical feasibility and commercial viability of research outputs determined; • Systems and processes in place for upscaling of supply of planting material and breeding stock; • Innovative learning approaches and activities in knowledge transfer and information access to reach rural communities in ADDs developed and applied; • Policy and Strategy papers informing on policy interventions to strengthen and improve scaling of interventions across Result areas and; • Events organised enabling exchange and sharing of insights into lessons

	<p>learnt from R4D interventions among stakeholders and policy makers;</p> <ul style="list-style-type: none"> • Stakeholders supported with efficient and affordable analytical services;
2.4.2 Gender, Youth and Social Inclusion	<p>Strategic objective: Agricultural innovations process is gender sensitive, inclusive and responsive of needs and aspirations of youth and other disadvantaged social groups</p>
Outputs	<ul style="list-style-type: none"> • Information access takes into account education and literacy (basic and technical literacy such as use of ICT) as well as a client friendly design of NARI's infrastructure. • Assessments on the specific needs of gender, youth and other vulnerable groups are incorporated in the design of projects and programs to ensure that interventions enable equal participation and opportunity to access benefits across different social groups • R4D programs are tailored to capture the interest of young people in the rural areas using approaches in capacity building and communication appropriate for the targeted age groups;
2.4.3 Communication for Change	<p>Strategic objective: Communication innovations effectively support delivery of research outcomes</p>
Outputs	<ul style="list-style-type: none"> • Communication Strategy • GIS databases and applications • Scientific, technical and general information accessible from on-line platforms and other media platforms; • Internal Information system with on-line databases on research management, Finance, HT and Assets management
Immediate outcomes for Cross-cutting areas	<ul style="list-style-type: none"> • Farming households adopt livelihood strategies that enhance their nutritional status and resilience to climate, physical, and biological shocks, stresses and risks • Youth and women influence individual and collective resource management and decision making process at community household and system levels • Stakeholder have increased access to crop and livestock technologies and socioeconomic, technical and scientific information • Farming and agricultural business decision making is based on reliable data, analytical results and proven scientifically sound information and advise; • NARI's partners in public and private agricultural support organisations and advisory services have acquired skills and knowledge on improved agricultural practices, strategies and management system

2.4.2 Gender and Social Inclusion

Gender equality has been proven worldwide to be an important factor in reducing poverty and achieving sustainable development. Countries that have higher gender equality have

higher economic growth. PNG has also subscribed to the agenda of the SDGs not to leave anyone behind. The large proportion of young people living in rural areas requires special actions to engage them productively. Research conducted by NARI and its partners needs to address the needs and aspirations of men, women, young people as well as other disadvantaged groups among target beneficiaries. Gender Equality and Social Inclusion (GESI) considerations need to be incorporated firmly in the PME&L cycle of the Institute. This may include planning of specific interventions targeting women, youth or other socially disadvantaged groups and mainstreaming of GESI into Institute operations. Result Area 1 – Value chains should prioritise rural and agriculture based entrepreneurship along the agri-food supply chains to open up opportunities for youth employment. Table 16 shows some more specific strategies and results the Institute is targeting for the reporting period.

2.4.3 Communication for Change

Effective communication is a key for establishing successful partnerships, helping different stakeholders understand and comprehend information and receive feed-back that is necessary to make assessments on the effectiveness of interventions and to inform the forward planning process. Communication needs to be supported with the right type of tools and infrastructure and staff with communication skills required for their line of work. In the reporting period, NARI will continue to build up its capacity in effective communication. A communication strategy will be developed that provides the more detailed approaches to be used. Information generation, packaging and dissemination are key components in a communication strategy and NARI will strengthen its efforts in improving the quality and appropriateness of different information products to inform stakeholders increasingly using ICT. More specific results in this area are shown in Table 13.

3. Strengthen Institutional Efficiency and Effectiveness

Organisational structures, system, policies and processes built on common institutional values are the foundation for an environment conducive for the Institute staff to work in and come together to deliver planned results outlined in NARI's Strategic Implementation framework. The SRF II points out the major constraints and opportunities that NARI is facing as an organisation tasked to deliver relevant research outputs and outcomes and contribute actively in realising development impacts to final beneficiaries. In summary, the major issues to be addressed and changes to be promoted include:

- The chronic under-funding of the Institute and support for AR4D and the need for diversification of income sources for the Institute and raising of the recurrent funding levels;
- The on-going need to manage change and promote changes in mindsets, attitudes and perceptions on what constitutes agricultural research and the role it plays in a system;
- Changes in the role of NARI regional centres from a research station to a multi-functional centre demonstrating best agricultural practice and serving as hubs for scaling of agricultural innovations;

- Changes in mobilising multidisciplinary and cross-organisational teams to address AR4D challenges and opportunities.

Broad strategies have been outlined in the SRF II on achieving the targeted results in institutional efficiency and effectiveness in AR4D delivery. The following sections provide more detailed strategies and results to be targeted for the next 5 years.

Targeted medium-term results for improving the Institute Internal Environment:

- *High visibility of the Institute's progress and achievements;*
- *Improved institutional arrangement, policies and increased investment in AR4D and agricultural development;*
- *AR4D agenda is resourced with adequate resources (expertise, financial and material resources);*
- *An enabling internal value-based institutional policy environment created and maintained*
- *Legislation reviewed to enable better governance and to enable NARI to improve capacity to address related functions which have been outside of current mandates.*

3.1 Managing for Results

Results-based management (RBM) is one of the key pillars in NARI's strategy. RBM involves:

- the definition of strategic objectives that articulating the result or achievement to be reached
- the scoping of expected outputs or sub-level results that are necessary and sufficient to achieve the strategic objective;
- on-going monitoring and assessment of performance, integrating lessons learnt into future planning; and,
- improved accountability, based on continuous feedback to improve performance.

The NARI strategy is built on a framework of cascading results to be achieved at different levels in the impact pathway. The Institute has spent considerable efforts in incorporating RBM principles into the planning of its investment into AR4D and this will be carried on with the preparation of Annual Implementation Plans aligned with the SIP framework. Further improvements need to be made in the design and implementation of M&E systems and frameworks at different implementation levels as well as establishing effective feedback loops to incorporate lesson's learnt into future planning. That will also enable the Institute to showcase more effectively the value of investing in AR4D to GoPNG, donor and the wider public. A key measure to progress development of more effective M&E&L in the Institute is the recruitment of a Senior M&E officer to lead the development of a M&E system and use of M&E frameworks in implementation and reporting of programs and projects portfolios. Alternatively, if recruitment is delayed, short-term expert consultancies to develop the M&E system will be considered. Gradually, capacity across rank and file of NARI needs to be built up to improve data collection and reporting of

achievements against well defined indicators. Key deliverables in this area are shown in Table 14.

Table 14: Key deliverables for Results-based Management

Output
Annual Corporate Implementation Plans are prepared in timely manner directing implementation of priority interventions for the reporting period
Institute M&E system – Stage I Basic capacity for M&E at project level
Institute M&E system – Stage II Institute level framework
Institute M&E system – Stage III Integrated system for tracking, reporting of M&E information

3.2 Resourcing the Institute

Since its establishment in 1996, adequate resourcing in terms of financial, material and human resources has been a challenge for NARI. Funding levels have nominally increased over the years but have reached a plateau since about 2011 and allocation is on average 9.8 Million Kina/annum (Annex 5, Table A). However, funding in real term has steadily declined using 2000 as base year and taking changes in the CPI into consideration (Annex 5, Table A). Staffing levels never exceeded more than 140 total contract staff and at present (2021), NARI has 109 contract staff. This is similar to the levels in the early years of the Institute (Annex 5, Table B and only 58 scientific and technical staff actively engaged in research implementation including five Principal/Senior Scientist. This is compared to for example in 2002, when the Institute had 68 scientific and technical staff including 16 Principal/Senior scientists plus 4 expatriate Principal scientist externally funded (Annex 5, NARI Biannual Report 2001-2002). Research capacity has significantly declined over the years and is likely at its lowest point since the Institute was established.

NARI has been entrusted with considerable land resources and infrastructure (roads, farm building, offices, laboratories, staff housing) and is tasked to deliver relevant research outputs and outcomes for all aspects relating to the biophysical, social and socio-economic development of the agriculture sector. In addition, it is to provide technical, analytical, diagnostic and advisory services and information. Given such broad mandate, current resourcing is insufficient by far considering the actual funding needs for delivering on that mandate at a scale that registers nationally.

NARI's seven establishments across the country require a minimum base funding and sufficient number of staff to secure, maintain and provide a basic level of mandated services. In order to deliver on its research mandate, the Institute also needs secured funding to maintain a core body of qualified and experienced scientific and technical staff. For example, it takes 10 years or more for a staff to develop into a scientist who can lead conceptualisation, planning and implementation of impact oriented research, hence requiring a considerable investment for staff development and ensuring that staff are retained.

As part of the development of the SIP, a review was undertaken to establish a necessary level of qualified staffing, and the associated cost to enable basic service delivery from its establishments. As part of the current NARI Strategy, the main functions of NARI Regional Centres (RC) include:

- Representation of NARI in the region,
- Support and facilitation of on-station research activities,
- Maintenance of Collections of Genetic resources;
- Focal points for access to information and technologies (esp planting material and breeding stock) by stakeholders in the region;
- Hubs to demonstrate, coordinate and facilitate the piloting and scaling of research innovations;

In line with those functions, the following management areas were considered in the assessment:

- Management and management support
- NARI Centre Maintenance (land, buildings, plants and equipment, vehicles)
- Maintenance and conservation of Genetic Resource for Food and Agriculture
- Provision of technical and analytical/diagnostic services
- Access to planting material, breeding stock and information and capacity building of stakeholders
- Basic level of AR4D delivery

Table 15 shows the current staff numbers (Status January 2022), the associated cost and the 2022 allocation from the GoPNG recurrent budget.

The allocation is for 128 contract staff vs 112 current staff and 240 ancillary staff vs 260 current staff in that category. The Institute has an approved staffing ceiling for contract staff of 155 positions, i.e. there are currently 43 vacancies but total allocation of funds for personal emoluments does not allow for recruitment on those vacancies.

An assessment of staffing levels in the different categories of mandated functional areas that would be necessary for the NARI Centres to operate at a basic level and for delivery of planned results in the mandated functional areas of NARI as per SIP, shows an even more serious discrepancy between currently available and necessary HR resources (Table 16, Annex 6).

Table 15: Staff numbers of different categories in January 2022 with associated cost and 2022 allocation from the recurrent budget

Functional areas under NARI mandate	Current staff numbers	Cost in Mil PGK	Allocation for 128 contract/240 ancillary staff in 2022 budget
Management	13	1.89	8.24
Management support	28	1.55	
Scientific and Technical	35	2	
Technical Research Officers	13	0.43	
Technical, Analytical and Diagnostic Services ¹	24	1.44	
Subtotal	112	7.68	
Centre Maintenance, security and support staff (ancillary staff)	260	2.71	1.86
Total	372	10.39	10.1

¹includes staff in NARI Chemistry lab and those involved with maintenance of PGR, production of planting material and breeding stock, skills and knowledge transfer to stakeholders;

Table 16: Actual Staffing requirements for delivery in functional areas under NARI mandate as per Strategic Implementation Plan

Functional areas under NARI mandate	Required staff number	Cost in PGK/year
Management	15	2.27
Management support	27	1.72
Scientific staff	44	3.42
Research Technical Officers	44	1.84
Technical and Analytical Services – Contract staff	36	1.97
Technical Services Support staff – Ancillary	40	0.34
Centre Maintenance, security and support staff - Ancillary	212	1.88
Total	418	13.44

The following major points can be taken from this analysis:

- Management and management support is overall sufficiently resourced with adequate number of staff and will only need minor adjustments for some positions;
- Scientific and technical staff for implementation of AR4D portfolios is seriously under-resourced to address the breadth of mandated areas as well as the ability to generate the range of outputs and outcomes to achieve measurable contribution at national level;
- Support staff for delivery of technical and analytical/diagnostic services (GR maintenance, provision of planting material, breeding stock, capacity building of stakeholders) is equally under resourced;
- There are sufficient numbers of ancillary staff for centre maintenance, security and support of basic operations but it will require substantial re-organisation to establish an efficient core body of skilled and qualified support staff at that level;

Another assessment was undertaken to assess average operating cost to cover basic operations for mandated functional areas of the Institute over the next five years taking into account an on average 5% increase in the cost of goods and services. Also factored into the assessment is the assumption that provision of technical, analytical and diagnostic services is on user-pay basis with cost of provision of services to cover most of the operational cost except cost of staff (Table 17, Details can be found in Annex 5b).

Table 17: Requirements for operational funding to maintain a necessary level of operation across mandated functional areas in all NARI Centres and establishments

Total Cost by functional areas		2022	2023 ¹	2024	2025	2026
HQ/Centre Routine Operation and Maintenance	Total	3,440,808	3,612,848	3,793,491	3,983,165	4,182,324
Technical, analytical, diagnostic services	Total	1,338,000	1,404,900	1,475,145	1,548,902	1,626,347
Basic research delivery	Total	336,000	352,800	370,440	388,962	408,410
Total		5,114,808	5,370,548	5,370,548	5,921,029	6,217,081

¹A 5% increase in cost for Goods and Services has been factored into the cost estimates for subsequent years

The comparison of estimated funding requirements and actual allocation in 2022 show huge gaps in allocation of funding for operational purposes across mandated functional areas in the Institute (Table 17). The estimates in Table 18 also do not include the required funding for capital formation such as construction of housing and office space to accommodate the increased number of staff necessary to respond to NARI's broad mandate with AR4D and land development and amelioration measures to increase productive arable land area in NARI Centres. Table 19 (Detail in Annex 5c) shows estimates for the required investment in capital formation over the next 5-10 years.

Table 18: Estimated operational funding requirements vs actual allocation for 2022 major expense categories

Description	Budget Code	Estimated requirements 2022	Actual allocation in 2022 budget
Travel and Subsistence	222	214,800	102,000
Office Stationeries	223	78,000	72,000
Operational Materials and Supplies	224	428,400	43,000
Transport and Fuel	225	1,193,400	96,000
Other operational expenses	227	426,480	76,000
Utilities	231	781,728	34,000
Routine Maintenance	233	1,992,000	1,137,000
Total		5,114,808	1,560,000

Table 19: Capital formation requirement summary, 2022-2026

Staff Housing	7,360,000.00
Water Supply/Irrigation	3,244,000.00
Research Support Facilities	1,000,000.00
Research Buildings	10,200,000.00
Kuk Agricultural Research Centre Rehabilitation	35,000,000.00
Total	56,804,000.00

In summary, the total funding requirement over the next 5 years is on average PGK 30.4 Million annually with a break up as follows:

HR cost (salaries, wages, personal emoluments): 67.2 Million
NARI Centre Operations: 28.3 Million

Capital Formation: 56.8 Million

Total: **PGK 152.3 Million**

It has to be noted that those figures reflect the minimum requirement to deliver the functions of the Institute at a basic level.

The following strategies and actions will be used by the Institute to address the resourcing gaps.

3.2.1 Advocacy and Visibility

NARI is the largest research organisation in the country and among the Pacific Island Countries and Territories. While the Institute is appreciated among donors and other stakeholders, it still has a low profile in GoPNG circles and the wider public with many stakeholders unclear on its mandate and sphere of responsibility and influence. More efforts will have to be made to raise NARI's profile and thus attract more attention on the importance of AR4D in agricultural development in the country and the returns of investing in this sector with increased levels of funding. The planned improvements in implementing a systematic M&E system outlined above is closely linked to this strategy. Key deliverables are shown in Table 20.

Table 20: Key deliverables for Advocacy and Visibility

Output
Avenues for increased level of advocacy and dialogue at policy level created
NARI achievements presented in diverse media and its profile raised

3.2.2 Diversify funding sources

The Institute will continue to pursue national and international grants available from bilateral and multilateral partners that will enable the implementation of NARI priorities and anticipated results in the SIP. This will be an ongoing activity to identify calls for applications for competitive grants as well as the engagement with resident representatives of donor agencies as part of the drive for advocacy and visibility outlined in Section 3.2.1.

The other strategy for increasing funding is to increase the efficiency of overall NARI operations especially at NARI's Regional Centres. The major drive will be to more efficiently and effectively use its landholdings and infrastructure for generation of internal revenue to support Institute maintenance cost. There are various opportunities that NARI can pursue either from production and sale of agricultural products, sale of services to formal establishment of a business arm that operates as an autonomous entity under the NARI Act. In order to address more effective revenue generation, NARI plans for the following key deliverables (Table 21).

Table 21: Key deliverables for increased efficiency and revenue generation

Outputs
Business plans for key internal revenue activities completed and implemented

Chemistry laboratory Business plan developed
Legal and operational framework for establishment of a NARI Business arm developed
NARI centre management structure and systems adjusted for improved delivery on assigned functions including revenue generation
Analysis of national and international practice to support development of a policy for industry funding support to research through levies or other mechanisms.
Active engagement with GoPNG and donors result in annual award of diverse research for development grants and funding support

3.2.3 Investing in Human Talent

The core of any organisation are its Human Resources also referred to as Human Talent which is an expanded definition as part of a wider strategic management. The term “Human Talent” is to recognise that for innovation to happen other talents aside from technical skills and knowledge, such as imagination, visioning, creativity, non-technical knowledge, intuition, communication, leadership, learning ability, the ability to work in teams are equally important.

Strategic management and development of Human Talent involves:

- Formulating strategies that consider human talents as strategic assets
- Creating an organisational culture that promotes, nurtures, and develops human talents;
- Designing organisational systems and structures that enable attracting and managing all human talents;

The analysis conducted as part of the SIP development highlights a range of gaps in the resourcing of the Institute in terms of number, required level of skills across all levels of staff, required scientific disciplines and qualifications, levels of seniority as well as proportional distribution of staff in different categories. Most of those issues have carried through since the establishment of the Institute in 1996. Overall, PNG still has a shortage of manpower with advanced higher degree qualifications and/or relevant experiences and competencies in key biological and social agricultural research disciplines, monitoring and evaluation but also well qualified managers capable of managing future-oriented agricultural research centres. Hence, NARI will continue to place a strong emphasis on building capacity of its staff through formal long-term higher degree training as well as short-term skill based training to build on their knowledge, skills and attitudes and promote talents. Other strategies for HT resourcing is to work with partners and contract external the medium-term needs of the Institute. NARI aims to have a critical mass of qualified, motivated staff, and a well-balanced workforce in terms of expertise, experience, age, and gender across its various establishments. The details of NARI’s strategies and actions in meeting the demands of results-oriented agriculture research for development delivery will be captured in a Human Talent Management and Development Strategy as a priority.

The key deliverables in investing in Human Talent are captured in Table 22.

3.2.4 Improving efficiency and capacity of support system in finance and material resources management

Finance and assets management systems are the other cornerstones in providing the Institute with a solid foundation to fulfil its mandate and implement the SRF II and SIP. NARI has already a large number of assets in terms of land, buildings (offices and farm structures), farm machinery, vehicles and mechanical plant. The Institute also manages housing estates for its employees at each of its establishments. However, many of the assets are old, not fit-for-purpose or new type of facilities required to support implementation of the SIP. NARI also needs to grow with increased requirements for staff housing and office space.

Table 22: Key deliverables in investing in Human Talent

Outputs
Human Talent Management and Development Strategy (HTMDS) developed
Performance based Appraisal system operating
On-line HT Management system operating
Annual targets in HTMDS achieved

This section outlines key deliverables to ensure more efficient finance and material resource management systems are in place to support the delivery of mandated functions with adequate level of infrastructure, facilities, equipment and other resources, as well as fill gaps in NARI's capacity to support an increased number of staff with housing and amenities in regional centres. The key deliverables are summarised in Table 23.

Table 23: Key deliverables in the management of financial and material resources

Outputs
Integrated finance management system in NARI established with online access to reporting and project management information
Medium-term assets and facility management and development plan developed and annual targets met
Housing estate management policy and strategy developed for NARI establishments
Security risk mitigation strategy developed and implemented
Infrastructure Development Strategy and Implementation Plan for NARI Centres developed and implemented
NARI land resources secured with title and ownership ascertained

3.3 Governance, Policies, Processes

As stated in the SRF II, the Institute as a leading learning and knowledge organisation is striving for high integrity in leadership and stewardship that is effectively incorporated in the mechanisms, processes and structures of governance and management. The core values

of the Institute, viz. Leadership, Innovativeness, Integrity, Communication, Organisational Excellence and Relevance reflect this desire.

The implementation of the SRF II and SIP needs to be supported by a governance and management structure, processes and policies that mainstream the core values and effectively translate the strategy outlined in the SRF II and SIP into action, taking into account the multi-disciplinary and multi-organisational nature of AR4D delivery.

3.3.1 Organisational Structure

NARI is currently operating under an organisational structure designed to support the implementation of the SRF I. While the SRF II is built on the same conceptual framework as the SRF I, successful delivery will require a revision of the organisational management structure taking into account the lesson's learnt from previous and current performance of the structure and requirements to take NARI into the future. A proposed structure at corporate level is shown in Figure 4. The NARI Act provides the basic governance arrangements with a Council's as the apex governance body. The next level comprises of the Director General supported by three Directors who would be responsible for the planning, coordination, implementation of all functional areas of the Institute. Aside from the revisions to the corporate management structure, there is also a need to review and revise management arrangements at the NARI Regional Centres. Overall, the aim is to have a lean and efficient management structure in place.

Changes to the organisational structure will be taken to the prescribed processes as required under the NARI Act and general orders of the PNG Public Service in consultation with the Department of Personnel Management and the NARI Council.

NARI is operating on a solid framework of management policies and processes that were put in place in the first few years after the establishment of the Institute. Most of the Management Standards however, have not been updated over the past 20 years. There is a need for development, update or revision of various policies, standard operating procedures and management processes. There is also a need to address gaps in Management policies and processes and assess relevance at various levels of implementation starting with the NARI Act as the enabling legislation of the Institute. Questions have arisen if the NARI Act in its current form can accommodate a Business Arm for revenue generation, the composition of the NARI Council requires assessment due to Ministerial reporting changes since enactment of the Act in 1996, as well as considerations around the composition of the Executive Management. Changes may be required to better align with the current needs of the Institute and for incorporating current trends in corporate management.

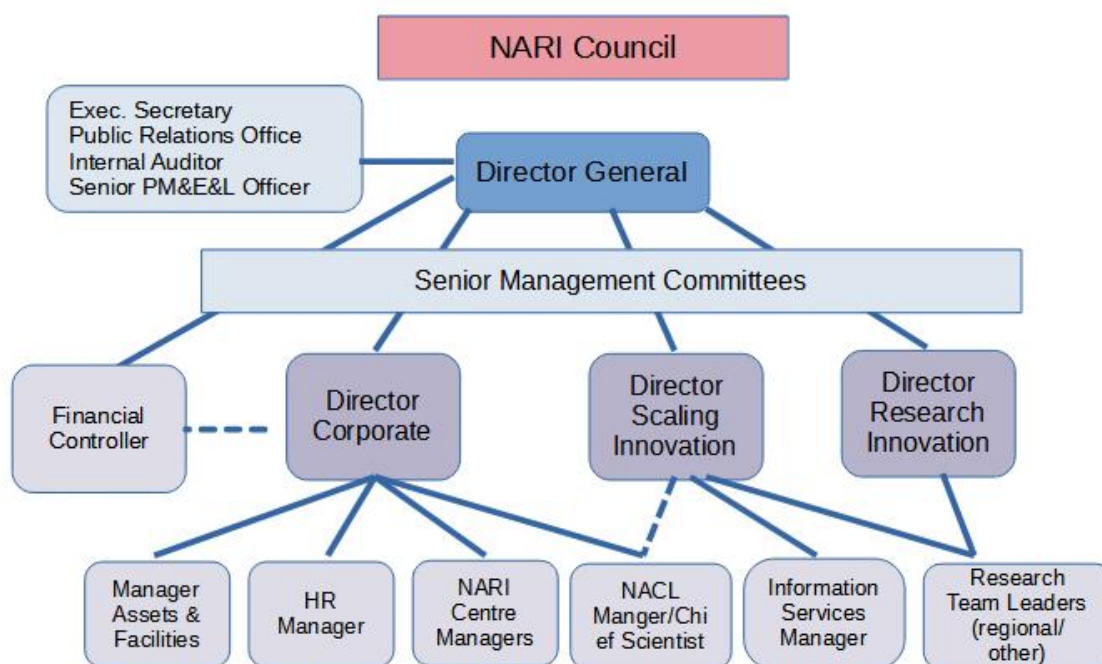


Figure 4: Proposed revised NARI organisational structure

3.3.2 Management policies and processes

The key deliverables for the result areas of governance, policies and processes are shown in Table 24.

Table 24: Key deliverables for Governance, Policies and Processes

Outputs
Revised Organisational Structure at corporate level and regional centres in place
HT Management policies updated and/or revised
Financial Management and procurement policies and processes updated
ICT management policy developed
Review of the NARI Act

Looking forward

The SIP 2022 – 2026 is the second-tier document in the NARI Corporate Planning Framework guided by the priorities and expected medium-term AR4D and longer-term development outcomes. The SIP 2022-2026 will be implemented through annual workplans as the third-tier planning level. The annual workplans will summarise the deliverables to be expected from all funded activities of the Institute planned for the respective period.

The AR4D approach recognises that development pathways are changing continuously and the emphasis has to remain on flexibility and the ability to respond to stakeholder needs and if necessary re-prioritise the Institute strategies, actions and re-direct resources towards arising needs. Hence, periodic reviews of the SIP implementation progress will determine if revisions will be necessary. This will be incorporated in the institutional M&E framework.

Appendix

Annex 1. Cascading result statements for country, sector and institute priorities

	NARI Strategy and Result Framework			Strategic Implementation Plan	
NARI Goal	Development Outcomes	NARI SO	Targeted Results at AR4D System level	Result Areas	Sub-objectives/Programs
Improved welfare of rural families and communities who depend wholly or partly on agriculture for their livelihoods	<p>Increased incomes and employment in rural areas arising from increased economic activities and business development</p> <p>Improved standards in Food and Feed safety in agricultural production and food/feed use are applied</p> <p>Production, productivity and efficiency of crop and livestock products increased and producers better linked to profitable markets at scale</p> <p>Enhanced stability and resilience of livelihood systems of rural households and communities</p> <p>Enhanced and equitable benefits from agro-ecosystem goods and services</p> <p>Agricultural production systems are sustainably managed under changing climates and macroeconomic drivers</p> <p>Rural and urban households consuming healthy balanced and nutritious diets</p>	Enhanced productivity, efficiency, stability and sustainability of the smallholder agriculture sector	<p>Priority 1: Economic Development – Value Chains</p> <p>Increased economic returns to value chain actors from production, sale and added value of crop and livestock products;</p> <p>Increased equity, inclusion and participation of women, youth and other socially vulnerable groups in priority value chains;</p> <p>Market system actors take up novel business opportunities in production and downstream processing of crop, livestock, aquaculture or non-food products in an environmentally sustainable manner;</p> <p>An efficient institutional and policy environment that promotes productivity, food safety standards, and maintains an efficient value chain in all market levels;</p> <p>Market accessions for export of PNG's agricultural products that promote local content of market share;</p> <p>Increased localisation and import-substitution of target crops and livestock by locally based industries;</p> <p>Alternative agricultural export opportunities from crop, livestock, aquaculture and non-food products realised and reflected in the national agricultural development agenda</p>	<p>RA 1: Value Chains <i>Improved technological, practical and economically approaches and adaptations for agricultural systems through facilitated innovation, foreign direct investments, and adoption processes along specific and related value chains.</i></p> <p>RA 2: Foresighting and Advocacy <i>Strategic directions for investment in agricultural development explored and advocated based on assessments of domestic and international market demand, trends and opportunities for food and industrial agricultural products</i></p>	<p>1.1 Value chain innovations Innovations addressing key bottlenecks in sweetpotato, potato and banana</p> <p>1.2 Galip Nut Value Chain Improved knowledge on current key bottlenecks in production, processing and marketing in the Galip value chain</p> <p>1.3 Pork product Value Chain Availability of lower cost locally produced pigs and pork products in selected retail outlets or open market increased in target provinces</p> <p>2.1 Investment strategies <i>Investment strategies for agricultural transformation assessed.</i></p> <p>2.2 Economic opportunities <i>Economic feasibility of scaling production of agricultural fresh, processed and non-food products</i></p>

			<p>Priority 2. Resilient Systems Diverse and sustainable agri-food systems at scale are established and maintained and reflected in the national agricultural development agenda. Farming households adopt livelihood strategies that enhance their resilience to climate, physical, and biological shocks, stresses and risks; Equitable access by stakeholders to gender-sensitive crop and livestock technologies and up-to-date socioeconomic, technical and scientific information; More productive and equitable management of natural resources and agro-ecosystems</p>	<p>RA3: Household Resilience <i>Smallholder farming and rural communities have an increased adaptive capacity to cope with abiotic stresses due to seasonal weather patterns, climate change or natural disasters</i></p> <p>RA 4: Agro-eco system resilience <i>Sustainability of managing agro-systems and catchment areas in ADD clusters with high population density and intensified agricultural systems improved</i> not a priority for 2021-2025 period</p> <p>RA 5: Bioscurity <i>Biotic agro-ecosystem threats are sustainably managed by smallholder farmers at different scales of operation</i></p>	<p>3.1 Climate smart solutions <i>SO: Climate smart use of technologies and strategies targeting gaps in household resilience to climate change induced stresses and other shocks in diverse agro-ecologies and food systems by target communities</i></p> <p>3.2 Disaster responses <i>Support in disaster rehabilitation provided in timely manner within mandated areas</i></p> <p>4. GHG agricultural mitigation opportunities <i>GHG status and opportunities for CO2 sequestration and reduction in GHG emissions from agricultural sources documented</i></p> <p>5.1 Biosecurity Management <i>Management options of major economic biosecurity threats (pest and diseases, weeds) of crops and livestock developed</i> 5.1.1 Fall Army Worm 5.1.2 Diamond-back moth 5.1.3. African Swine Fever 5.1.4 Galip weevil 5.1.5 BWAP Management 5.1.6. Pest and disease free planting material and breeding stock</p> <p>5.2 Biosecurity preparedness <i>Preparedness for responding to biosecurity threats improved</i></p>
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				RA 6: Genetic Resources <i>Diversity of genetic resources is maintained and used as part of sustainable and inclusive farming systems responsive to market demands and climate change</i>	6.1 GR Management <i>Exploration, documentation and conservation of diversity of PNG GRFA advanced for priority resources;</i> 6.2 Genetic Resource Use and Access <i>Diversity of GR is used sustainably enhancing diversity and adaptation of crops and livestock to social, economic and ecological conditions</i>
			Priority 3. Nutritious Food and Healthy Diets Increased availability of and access to diverse nutrient-rich and safe foods; Partnerships operating to promote implementation of agriculture for nutrition and health strategies for agri-food value chain/food system innovations and interventions at scale; Evidence-based nutrition-sensitive policies are designed accompanied by effective implementation strategies; Consumers (rural and urban) and producers have capacity to make more informed food choices among healthier and safe foods that meet their needs and preferences	RA 7: Nutritious food and health <i>Increased access to and use of safe and affordable nutritious food by consumers in rural and urban areas in PNG supported</i>	7.1 Improved diets <i>Target communities are enabled to produce and consume greater diversity of nutritious crops and livestock</i> 7.2 Advocacy on safe and nutritious food <i>Information packages on safe food production and processing practices and nutritious food for rural and urban consumers available</i>
Cross-cutting Areas					
a) Scaling of R4D innovations:			<i>Improved understanding on key drivers and innovations that enhance desirable system changes in scaling of AR4D out put and outcomes</i>		
b) Gender, Youth and Social Inclusion			<i>Agricultural innovations process is gender sensitive, inclusive and responsive of needs and aspirations of youth and other disadvantaged social groups</i>		
c) Communication for Change			<i>Communication innovations effectively support delivery of research outcomes</i>		

Annex 2. Agricultural Development Domains

Farming communities are much influenced by their bio-physical and socio-economic environment which is highly diverse in PNG. Therefore, geographic information system (GIS) has been used to identify and depict spatial similarities and differences in agriculture and delineate the country into various Agricultural Development Domains (ADD) (Omamo et al. 2006). Clusters of those domains are then used to conduct a constraints and objective analysis to identify possible areas of intervention through AR4D that will contribute to achieving NARI's purpose in line with its mandate and create impact on smallholder farming and rural communities. Further information on the ADD approach in general and in the NARI context can be found in Omamo et al. (2006) and Komolong et al. (2012).

A total of eight ADD clusters have been identified (Figure 1). Table A1 shows a summary of the ADD clusters, percentage of total rural population, percentage of total cultivated area per domain and provinces with the highest share of population in a particular domain.

As seen in Table 25, over 50% of the rural population and more than 80% of the cultivated land are located in areas with low access to markets and services. Most of that land also has a low to medium potential with one to several major constraints to production. Almost 40% of the population live on 18% of cultivated land area in domains with good and medium agricultural potential and within four hours travel time to the nearest service center or regional center. Demographic trends over the past 30 years are likely to continue over the coming decade. People from low agricultural potential and access to services domains will migrate into ADDs with high/medium agricultural potential and high/medium access to services (Allen et al. 2005; Bourke and Harwood 2009).

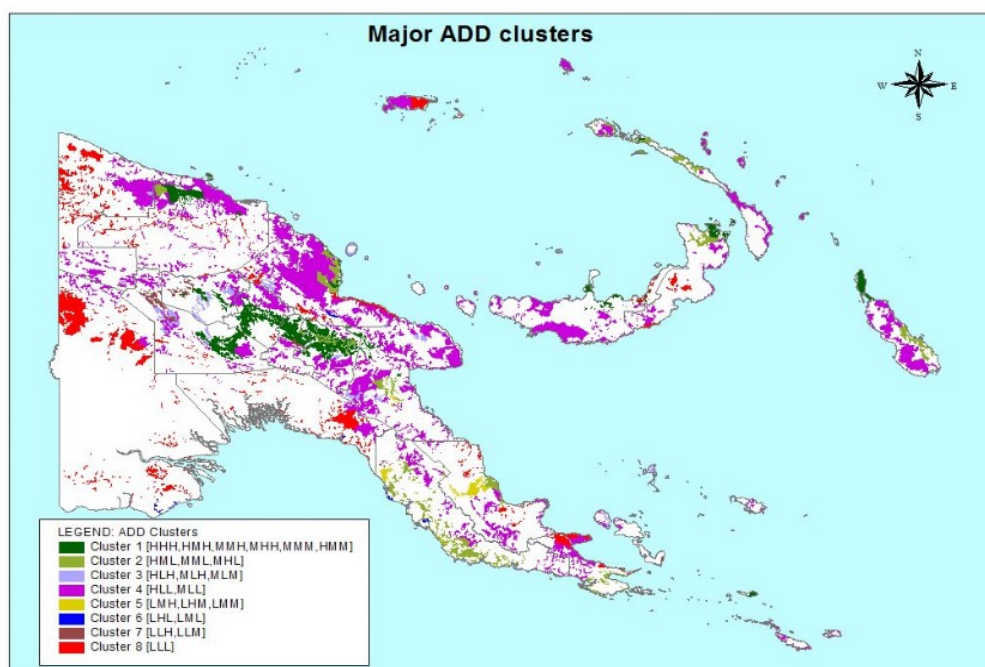


Table 25: Summary of major Agricultural Development Domain (ADD) clusters

ADD Clusters¹	ADD contained in Clusters	% of total rural population	% of total cultivated land area	Major provinces represented in the ADD²
Cluster 1: HHH	HHH	2.92	0.38	ENB (100%)
	MHH	4.1	0.61	WHP (58%), EHP (27%), Madang (15%)
	MMH	19.3	4.2	EHP (25.4), Simbu (24.0), SHP (15.5)
	HMH	6.3	1.6	WHP (63%), SHP (24%)
	MMM	6.1	2.6	ESP (30%), EHP (23%)
	HMM	0.2	0.12	EHP (100%)
	Sub-total	38.9	9.5	
Cluster 2: HHL	HML	0.4	0.4	Morobe (90%)
	MML	6.0	6.3	Central (30%), NI (17%)
	MHL	0.5	0.4	ENB (65%), Central (35%)
	Sub-total	6.9	7.1	
Cluster 3: HLH	HLH	1.3	0.3	Madang (83%), Morobe (15%)
	MLH	5.5	1.3	SHP (47.0)
	MLM	3.5	1.6	Enga (36%), Morobe (23%)
	Sub-total	10.3	3.2	
Cluster 4: HLL	HLL	1.4	1.8	ARB (40%), Simbu (35%), Milne Bay (16%)

	MLL	28.4	41.7	Morobe (21%); Madang (13%), ESP (10%), WSP (9%)
	Sub-total	29.8	43.5	
Cluster 5: LHH	LMH	0.3	0.1	Morobe (65%), Central (35%)
	LHM	0.2	0.1	Central (100%)
	LMM	1.6	0.8	Oro (68%), Central (25%)
	Sub-total	2.1	1.0	
Cluster 6: LHL	LHL	0.04	0.05	Central (100%)
	LML	0.3	0.3	Western (43%), Central (38%)
	Sub-total	0.34	0.35	
Cluster 7: LLH	LLH	1.3	0.3	SHP (58%), Simbu (31%)
	LLM	1.8	0.9	SHP (43%), Enga (39%)
	Sub-total	3.1	1.2	
Cluster 8: LLL	LLL	8.5	34.3	Gulf (22%), Western (21%)
	Sub-total	8.5	34.3	
	Total	100	100	

¹ Agricultural potential (based on slope, rainfall and soil quality; Access to services: low-4-8 hours to reach provincial capital or urban centre (more than 1000 people); moderate-1-4 hours to a provincial capital or larger urban centre (>2000 people); high-less than 1 hour to major regional centre; Population Density- low: 0 - 60 persons/km²; moderate: 61-100 persons/km²; high: 101-713 persons/km²

² e.g. MMH domain - 25.4% of the population in this domain is located in EHP

Annex 3. Ranking of value chains and other economic opportunities

A3.1 RA 1: Scoring criteria Value Chains:

The scoring will be done by all participants in the workshop. Participants can be organised again into groups and the group will discuss the criteria and individual group members then record their assessment into the prepared format based on their best knowledge.

Step 1: Human and physical environment and national importance

1. The value chain is relevant to maximum number of clusters (clusters are representative for producers participating in the value chain)

score 1 = one to two clusters involved; 2 = three to four clusters involved; 3 = five to eight clusters involved

2. Opportunity to link up neglected difficult or isolated areas

Neglected meaning: primary consideration will be access to services (areas with low income, high malnutrition, low literacy etc)

Does the value/chain or enterprise offer opportunities for producers in remote areas to participate?

1= clusters with neglected areas are unlikely to link up directly (currently no roads, air services); 2 = selected clusters with neglected areas can participate directly; 3 = good opportunity for clusters with neglected areas to link into the value chain

3. Addressing nationally important issues

What are the range of issues of national importance that are directly considered/addressed in the value chains:

- direct and immediate contribution to export orientation
- direct and immediate contribution to import substitution
- direct and immediate contribution to exploiting domestic niche market opportunities
- direct and immediate contribution to promoting organically based agriculture
- direct and immediate contribution to creating diverse gainful employment along the value chain

1 = one national important issue; 2 = two national important issues; 3 = three or more national important issues;

Step 2: Likely/Potential Impact

2. 1. Potential benefits (weight 0.3)

We need to consider what the expected outcomes from each of the value chains are. It is a given that all value chains will contribute to higher level benefits such as income generation, employment creation, increase in productivity, efficiency, sustainability at national level. Other benefits to be considered include economic and social outcomes and impacts as well as enhancement of AR4D (system) capacity (not only research capacity):

Contribution to alleviating negative impacts of HIV/AIDS, law and order ...

community welfare (social equity incl gender, youth, disadvantaged)

Increased value addition of local produce

Sustainable mobilisation of customary land resources

Increased labour productivity in target production systems

Improved use of farm resources

potential spill-over effects (e.g. addressing outcomes in other sectors, collaborations with commodity R&D org, regional application of outputs)

1 – matches one of the criteria; 2 – matches two of the criteria; 3 - matches three of the criteria; 4 – matches four of the criteria; 5 – matches five and more of criteria

2.2 Adoption likelihood (Likelihood that significant change is possible within the next 5 years) – weight 0.2

Consideration is about:

- What is involved (effort required to make things happen)
- Presence of new or on-going investment by GoPNG/Donors/Private sector
- much under NARI and Partners control or many externalities (including from other sectors)

5 = not very complex, 3= complex, 1= very complex; scored either 1, 3 or 5

Step 3: Feasibility (scientific potential and research capacity)

3.1 Scientific potential (weight 0.1)

This criterion assesses the chances that successful research can be undertaken. This is a function of the availability of research tools and techniques in the appropriate fields. ‘Research’ involves different disciplines (biophysical, social, socio-economic) and different types of research (basic, adaptive, strategic, applied);

Note: there are also research needs in extension (Outscaling/Upscaling) .

1. Already many scientific advances (status of existing knowledge, availability of research tools and techniques) have been made in AR4D areas (by NARI and/or partners or in the global pool of knowledge) associated with the Value Chain, i.e. there are good chances that successful research can be undertaken; if yes – **give 2 points**
2. Little scientific advances made in AR4D areas (by NARI and /or partners or in the global pool of knowledge) associated with the Value chain; some tools, methods, approaches etc. available if yes – **give 1 point**
3. A range of networks and partnerships exist in the country, region, internationally relevant to the Value Chain (if such networks etc exist to draw on for research it is a yes) if yes – **give 1 point**
4. There is potential for AR4D outputs and outcomes to make a contribution to global pool of knowledge (i.e. the research outputs need to be original so they can be published in Journals; relevance to international community) if yes – **give 1 point**

Add up total points to determine score for scientific potential (weight 0.2)

3.2 Research Capacity (weight 0.4)

This criterion refers to NARI’s ability to assemble an effective research team to deliver research outputs. It assesses the likelihood that NARI will be able to put together an effective team.

Research capacity (5 = good, 3 = some, 1=little), weight 0.4

Produce a total aggregated score: Step 1-3

Prioritisation of Value chains – Results

	Prioritisation of Value Chains	Final aggregate score
1	Increased poultry production by micro and small poultry enterprises and effective linkages to markets and consumers;	5.47
2	Improved quality of produce and adoption of best management practices along the fresh product (vegetables) value chain	5.39
3	Market-oriented sweet potato farmers and supply chain operators used improved technologies in farming and production, and mediums of marketing platforms.	5.29
4	Increased availability of affordable fresh potato and processed potato products in domestic and export markets;	5.18
5	More affordable supply of locally produced pork products with increased returns to pork value chain actors	5.09
6	Increased domestic rice production from profitable production systems enabling smallholder farmers to scale production	5.02
7	Increased production of quality spice products from improved production systems and effective linkages among value chain actors	4.81
8	Improved production and marketing of quality taro and selected taro products into domestic markets by growers and other actors in the supply chain	4.79
9	Enhanced productivity, efficiency and profitability in the Galip value chain	4.70
10	Village-based mini-feed mills drawing on local resources and agricultural by-products are effectively producing livestock and fish feed in selected communities	4.68
11	Enhanced productivity of inland fish farming enterprises in ecologically integrated ponds using adapted management systems supplying consistently quality products to markets	4.66
12	Improved supply of affordable locally produced honey with increased profitability to producers and marketers	4.59
13	Supply chain for banana into urban markets and supermarkets or other formal markets improved	4.54
14	Increased supply of peanuts from smallholder systems meeting food safety standards to local consumers;	4.45
15	Mushroom production, consumption and marketing promoted as an alternative emerging industry for niche domestic markets	4.08

16	Agro-tourism opportunities established and implemented by farming communities to diversify livelihood options	3.94
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A3.2 Prioritisation of other economic opportunities by pairwise comparison

Prioritisation methodology: Compare the final list of economic opportunities/value chains pairwise with each other. The following criteria can be considered in the comparison:

1.comparative and competitive advantage for PNG to supply domestic/export markets

2.national importance and potential beneficiaries in rural communities

3.potential for inputs from agricultural research

4.capacity in the AR4D system to work on this opportunity

5.complexity

	Project 1	Project 2	Project 3	Project 4	Project 5	Total Score	Rank
Project 1		P1	P3	P1	P1	3	2
Project 2			P3	P4	P2	1	4
Project 3				P3	P3	4	1
Project 4					P4	2	3
Project 5						0	5

Prioritisation of economic opportunities – Results

Opportunity		Average score
1	Quality flour and starch from major root and tubers crops	6.5
2	Opportunities in spices	5.9
3	Economical feasibility of cash crops and livestock for large scale farming	4.9
4	Opportunities for tropical fruit	4.4
5	Black soldier fly larvae as feed and fuel	4.3
6	Breadfruit	4.1
7	Opportunities for indigenous nuts	4.1
8	Market opportunities peanut products	4.0
9	Essential oils, oils or other non-food products	3.8
10	Opportunities for temperate fruits	2.7

Annex 4. Assessment Framework for achieving results in Results Areas 1-7

Result Statements Strategic Objectives/Outputs	Indicators of Success	Means of Verification/Data source	Assumptions
Priority 1 Economic Development and Value Chains			
Result Area 2. Foresighting and Advocacy Strategic directions for investment in agricultural development explored and advocated based on assessments of domestic and international market demand, trends and opportunities for food and industrial agricultural products			
Output 1: Investment Strategies Investment strategies for agricultural transformation assessed and advocated	<ul style="list-style-type: none">Investment in agriculture and AR4D increased by GoPNG, donor agencies, private companies;Increased rates of return on investment in AR4D from better targeting and decision making	Budget allocations to AR4D institutions from GoPNG and Donors; ASTI reports	Interest and commitment by AR4D organisations to enhance collaboration; supporting national policy environment
Output 2: Economic opportunities Economic feasibility of fresh, processed and non-food agricultural production at different scales assessed and advocated	<ul style="list-style-type: none">Investment in agriculture and AR4D increased by GoPNG, donor agencies, private companies;Policy and institutional reforms draw on information from policy briefs and databases to revise strategies and policies in agriculture based economic development	Budget papers by GoPNG and donor strategies for agriculture sector; National policies and strategies	
Result Area 2. Value Chain Support Improved technological, practical and economically approaches and adaptations for agricultural systems through facilitated innovation, foreign direct investments, and adoption processes along specific and related value chains.			
Output 1: Value chain innovations Innovations addressing key bottlenecks in sweetpotato, potato and banana are used along the value chain	<ul style="list-style-type: none">Knowledge on improved practices in production and post harvest management in sweetpotato, potato, banana value chains used by value chain actors in target areas;Increased farm productivity and consistency in the supply of targeted produce;Establishment of appropriate farm business/enterprise models in targeted value	Stakeholder survey reports; Annual Reports, M&E reports;	Adequately resources partners available and committed to support jointly agreed work programs

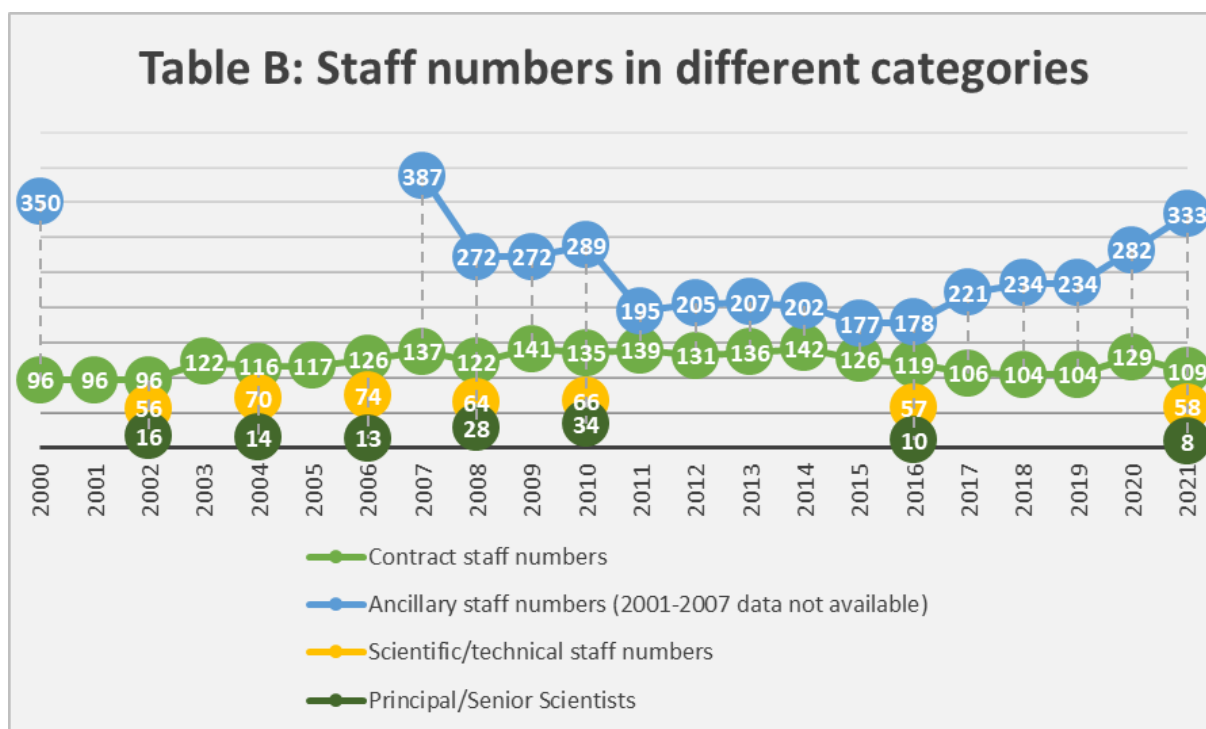
Result Statements Strategic Objectives/Outputs	Indicators of Success	Means of Verification/Data source	Assumptions
	chains emerging; • Increased use of market information by participating commercial farmers and aggregators		
<i>Output 2: Galip value chain</i> Improved knowledge on current key bottlenecks in production, processing and marketing in the Galip value chain	• Increased volumes for Galip nut processed by current processors and sold in retail outlets in PNG; • Increased establishment of Galip plantations or inter-cropping; • Increased confidence and investment by GoPNG and private sector in Galip AR4D, production, processing and marketing;	Stakeholder survey reports; Records from the NARI factory; Annual Reports; Budget allocations	On-going commitment of current partnerships in implementation of work programs
<i>Output 3: Pork product value chain</i> Availability of lower cost locally produced pigs and pork products in selected retail outlets or open market increased in target provinces (SHP, WHP, Enga)	• Production of pig and pork products in target provinces showing incremental increases over time; • Improved access to productive breeding stock; • Health of pig herds and hygiene of production environment in target piggeries improved; • Improved knowledge on value chain actors on cost effective production, processing and marketing of pigs and pork products	Sample surveys in target provinces; NARI Annual and technical reports; M&E reports;	Formation of cross-organisational partnerships successful; Disruption of law and order issued minimised in target provinces

Result Statements Strategic Objectives/Outputs	Indicators of Success	Means of Verification/Data source	Assumptions
Priority 2. Resilient Systems			
Result Area 3. Household resilience Smallholder farming and rural communities have an increased adaptive capacity to cope with abiotic stresses due to seasonal weather patterns, climate change or natural disasters			
Output 1: Climate smart solutions Climate smart use of technologies and strategies targeting gaps in household resilience to climate change induced stresses and other shocks in diverse agro-ecologies and food systems by target communities	<ul style="list-style-type: none"> • CSA products and approaches promoted are integrated into ADD production systems at scale; • Responsive networks and partnership models for community support operating 	Stakeholder surveys; Project and Annual M&E reports;	AR4D capacity available in wider NARS for appreciation of role of NARI and roles of other partners
Output 2: Disaster response Support in disaster preparedness and rehabilitation provided in timely manner within mandated areas	<ul style="list-style-type: none"> • Timely response and contribution to agricultural disaster rehabilitation; • Improved forecasting and preparation for severe El Nino and La Nina events; • Responsive networks and partnership models for community support operating 	Stakeholder surveys; Project and Annual M&E reports;	Relevant GoPNG bodies at national and provincial level provide required leadership
Result Area 4. Agro-ecosystem resilience Sustainability of managing agro-systems and catchment areas in ADD clusters with high population density and intensified agricultural systems improved			
Output 1: Climate Change Mitigation GHG status and opportunities for CO2 sequestration and reduction in GHG emissions from agricultural sources documented	<ul style="list-style-type: none"> • Research and technical publications on GHG status available to stakeholders from NARI 	Annual M&E reports	Relevant expertise can be sourced in-country
Result Area 5. Biosecurity Biotic agro-ecosystem threats are sustainably managed by smallholder farmers at different scales of operation			
Output 1: Biosecurity Management Management options of major economic biosecurity threats (pest and diseases, weeds) of crops and live-stock developed	<ul style="list-style-type: none"> • Increased use of pest and disease management strategies in targeted crops and production systems; • Increase in production and quality of agricultural (fresh and processed) products 	Survey of targeted agricultural production systems, markets;	Relevant expertise available

Result Statements Strategic Objectives/Outputs	Indicators of Success	Means of Verification/Data source	Assumptions
Output 2: Biosecurity preparedness Preparedness for responding to biosecurity threats improved	<ul style="list-style-type: none">• P&D threats diagnosed in-country in timely manner to initiate response strategies• All stakeholders respond to incursion of biosecurity threats as per incursion management plans	Reports from NAQIA, NARI laboratories; Reports on incursion response actions; Annual reports	NAQIA and other NARS provide leadership and willingness to collaborate; GoPNG is responsive to needs of the sector
Result Area 6 Genetic Resources Diversity of genetic resources is maintained and used for strengthening sustainable and inclusive farming systems responsive to market demands and climate change			
Output 1: GR Management Exploration, documentation and conservation of diversity of PNG GRFA advanced for priority resources;	<ul style="list-style-type: none">• Communities in four districts (Menyamy, Teptep, Usurufa, Rigo) apply strategies to maintain and conserve sweetpotato biodiversity• Research and development in plant genetic resources is strengthened in PNG;• Diversity of GR in ex situ, in vitro and in situ collections maintained and safe-guarded for the future	Project reports, Genebank records, Annual reports;	Relevant GoPNG departments and policy makers support with necessary resources and domestic policies
Output 2 GR use and access: Diversity of GR is used sustainably enhancing diversity and adaptation of crops and livestock to social, economic and ecological conditions	<ul style="list-style-type: none">• New and improved crop varieties and live-stock breeds released to stakeholders;• Quality Foundation material supplied to stakeholders in adequate numbers;• Access to NARI crop varieties and breeding stock in all provinces in PNG;	Annual M&E reports;	
Priority 3. Nutritious Food and Healthy Diets			
Result Area 7. Safe and nutritious Food Increased access to and use of safe and affordable nutritious food by consumers in rural and urban areas in PNG supported			
Output 1: Improved diets Target communities are enabled to produce and consume greater diversity of nutritious crops and	<ul style="list-style-type: none">• Increased small livestock production and consumption in selected communities in Momase region compared to baseline;	Stakeholder surveys; Project and Annual M&E reports;	Other sector agencies contribute and collaborate in interventions and activities;

Result Statements Strategic Objectives/Outputs	Indicators of Success	Means of Verification/Data source	Assumptions
livestock	<ul style="list-style-type: none"> increased diversity in diets in target communities from production of greater diversity of food crops; 		AR4D capacity available in wider NARS for appreciation of role of NARI and roles of other partners
Output 2: Advocacy on safe and nutritious food Information packages on safe food production and processing practices and nutritious food for rural and urban consumers available	<ul style="list-style-type: none"> Information packages produced Information packages disseminated to diverse group of stakeholders 	Annual M&E reports	
Cross-cutting - Scaling: Output: Improved understanding on key drivers and innovations that enhance desirable system changes in scaling of AR4D out put and outcomes	<ul style="list-style-type: none"> Recommendations made on successful approaches in scaling of research outputs; NARI information, technologies and services reach greater number of stakeholders compared to baseline 	Survey reports; Annual M&E reports	Appreciation and collaboration by stakeholders in the sector and beyond; AR4D capacity available in wider NARS for appreciation of role of NARI and roles of other partners
Cross-cutting – Gender, Youth and Social Inclusion: Agricultural innovations process is gender sensitive, inclusive and responsive of needs and aspirations of women, youth and other disadvantaged social groups	<ul style="list-style-type: none"> High level of participation of women, youth (male and female) and/or other socially disadvantaged groups interventions targeting socially disadvantaged groups incorporated in the portfolio of projects and activities 	Annual M&E reports; period M&E evaluation reports	Community support and participation; willingness to share values, beliefs and aspirations; willingness to allow engagement with socially disadvantaged groups
Cross-cutting – Communication for Change: Communication innovations effectively support delivery of research outcomes	<ul style="list-style-type: none"> Diverse portfolio of communication tools used to reach stakeholders; Stakeholders have knowledge of and use of NARI communication tools; 	Annual M&E reports; period M&E evaluation reports	

Annex 5a. Trends in recurrent funding and staffing levels



Annex 5b. Funding estimates to cover required operational costs for mandated functional areas of NARI for period 2022-2026

Total Cost by functional areas		2022	2023	2024	2025	2026
HQ/Centre Routine Operation and Maintenance	Total	3,440,808	3,612,848	3,793,491	3,983,165	4,182,324
Travel and Subsistence	222	136,800	143,640	150,822	158,363	166,281
Office Supplies	223	54,000	56,700	59,535	62,512	65,637
Operational Materials and Supplies	224	218,400	229,320	240,786	252,825	265,467

Total Cost by functional areas		2022	2023	2024	2025	2026
Transport and Fuel	225	574,200	602,910	633,056	664,708	697,944
Other operational expenses	227	196,080	205,884	216,178	226,987	238,336
Utilities	231	606,528	636,854	668,697	702,132	737,239
Routine Maintenance	233	1,654,800	1,737,540	1,824,417	1,915,638	2,011,420
Technical, analytical, diagnostic services	Total	1,338,000	1,404,900	1,475,145	1,548,902	1,626,347
Travel and Subsistence	222	12,000	12,600	13,230	13,892	14,586
Office Supplies	223	12,000	12,600	13,230	13,892	14,586
Operational Materials and Supplies	224	192,000	201,600	211,680	222,264	233,377
Transport and Fuel	225	571,200	599,760	629,748	661,235	694,297
Other operational expenses	227	194,400	204,120	214,326	225,042	236,294
Utilities	231	85,200	89,460	93,933	98,630	103,561
Routine Maintenance	233	271,200	284,760	298,998	313,948	329,645
Basic research delivery	Total	336,000	352,800	370,440	388,962	408,410
Travel and Subsistence	222	66,000	69,300	72,765	76,403	80,223
Office Supplies	223	12,000	12,600	13,230	13,892	14,586
Operational Materials and Supplies	224	18,000	18,900	19,845	20,837	21,879

Total Cost by functional areas		2022	2023	2024	2025	2026
Transport and Fuel	225	48,000	50,400	52,920	55,566	58,344
Other operational expenses	227	36,000	37,800	39,690	41,675	43,758
Utilities	231	90,000	94,500	99,225	104,186	109,396
Routine Maintenance	233	66,000	69,300	72,765	76,403	80,223
Total		5,114,808	5,370,548	5,639,076	5,921,030	6,217,081

Annex 5c: Required Capital Formation for 2022 - 2026

									Year					Subtotal Detail	Subtotal Summary
Description	Source	Priori ty	Category	Location	Type	Rate	Qty	Total	2022	2023	2024	2025	2026		
Housing	Recurrent	2	Staff Housing	Bubia	2 bedroom duplex	480,000	2	960,000		480,000		480,000		960,000	
	Recurrent	2	Critical Staff Housing	Laloki	2 bedroom duplex	480,000	2	960,000	480,000		480,000			960,000	
	Recurrent	2	Critical Staff Housing	Kilakila	3 Bedroom duplex	480,000	2	960,000		480,000		480,000		960,000	
	Recurrent	2	Critical Staff Housing	Keravat	2 bedroom duplex	500,000	6	3,000,000	1,000,000	1,000,000		1,000,000		3,000,000	
	Recurrent	2	Critical Staff Housing	Tambul	2 bedroom duplex	500,000	2	1,000,000				500,000	500,000	1,000,000	
	Recurrent	3	House	Tambul	Training accomodation- 4 bedroom share units- 120sqm	480,000	1	480,000				240,000	240,000	480,000	
															7,360,000
Fence	Recurrent	1	Research Support Infrastructur	Bubia/ Labu	Pukpuk fence	784,000	1	784,000	392,000	392,000				784,000	

			e												
	Recurrent	1		Laloki	Chainmesh fence-	780,000	1	780,000	390,000	390,000				780,000	
	Recurrent	2		Keravat	Chainmesh fence-	1,260,000	1	1,260,000	630,000	630,000				1,260,000	
	Recurrent	1		Aiyura	Barbed wire fence-	420,000	1	420,000		210,000	210,000			420,000	
															3,244,000
Water Supply	Recurrent	1	Water Supply	Laloki	New Tank, Water pump	300,000	1	300,000	150,000	150,000				300,000	
	Recurrent	1	Bore water	Aiyura	New Tank, Water pump	400,000	1	400,000	200,000	200,000				400,000	
Bubia	Recurrent	1		Bubia	New water Bore and pump	300,000	1	300,000		300,000				300,000	
															1,000,000
Multi Purpose Research Building	PIP/ Recurrent	1	Research Facilities	Laloki	Sheds from Atlas Steel-12mx36m	2,000,000	1	2,000,000	1,000,000	1,000,000				2,000,000	
	PIP/	1		Bubia	Sheds from Atlas	2,000,000	1	2,000,000	1,000,000	1,000,000				2,000,000	

	Recurrent				Steel-12mx36m										
	PIP/ Recurrent	1		Keravat	Sheds from Atlas Steel-12mx36m	2,500,000	1	2,500,000		1,250,000	1,250,000			2,500,000	
	PIP/ Recurrent	1		Aiyura	Sheds from Atlas Steel-12mx36m	2,250,000	1	2,250,000		1,125,000	1,125,000			2,250,000	
Goat Research Building	PIP/ Recurrent	1	Goat Research Shed	Tambul	Galv Steel/Timber str. Bld. 8mx12m	150,000	1	150,000		150,000				150,000	
	PIP/ Recurrent	1		Bubia	Galv Steel/Timber str. Bld. 8mx12m	150,000	1	150,000		150,000				150,000	
	PIP/ Recurrent	1		Laloki	Galv Steel/Timber str. Bld. 8mx12m	150,000	1	150,000		150,000				150,000	
	PIP/ Recurrent	1		Keravat	Galv Steel/Timber str. Bld. 8mx12m	150,000	1	150,000		150,000				150,000	
Poultry Research Building	PIP/ Recurrent	1	Building	Tambul	Timber Bld. 8mx12m	150,000	1	150,000			150,000			150,000	
	PIP/ Recurrent	1		Bubia	Timber Bld. 8mx12m	100,000	1	100,000			100,000			100,000	

	PIP/ Recurrent	1		Laloki	Timber Bld. 8mx12m	100,000	1	100,000			100,000			100,000	
	PIP/ Recurrent	1		Keravat	Timber Bld. 8mx12m	100,000	1	100,000			100,000			100,000	
Piggery Research Building	PIP/ Recurrent	1	Building	Tambul	12 sow units- Concrete & Steel Bld	100,000	1	100,000				100,000		100,000	
	PIP/ Recurrent	1		Bubia	12 sow units- Concrete & Steel Bld	100,000	1	100,000				100,000		100,000	
	PIP/ Recurrent	1		Laloki	12 sow units- Concrete & Steel Bld	100,000	1	100,000				100,000		100,000	
	PIP/ Recurrent	1		Keravat	12 sow units- Concrete & Steel Bld	100,000	1	100,000				100,000		100,000	
Research farms development	PIP/ Recurrent	1		Centres	road/drainage/ irrigation/ subfencing/										10,200,000
Kuk Agricultural Research Centre Rehabilitation ¹	PIP			Kuk				35,000,000	15,000,000	8,000,000	4,000,000	4,000,000	4,000,000	35,000,000	35,000,000

1 The Kuk Agricultural Research Centre, outside Mt Hagen, is a valuable state asset in a central location. It has only recently been recovered. Detailed costing for the rehabilitation is available from NARI.

Grand Total								56,804,000	20,242,000	17,207,000	7,515,000	7,100,000	4,740,000	56,804,000	56,804,000
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Annex 6. Staffing requirements for implementation of the SIP across different categories vs current (status Jan 2022) staffing level

Designation	Type ²	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Chem /NAIC
Management																	
Director General	C	1	1	1							1						
Director 1	C	1	1	1							1						
Director 2	C	1	1	1							1						
Director 3	C	1	0	1							0						
Financial Controller	C	1	1	1							1						
Manager - Assets & Facilities	C	1	1	1							1						
Centre Manager/Chem Lab Manager	C	6	5	0	1	1	1	1	1	1		1	0	1	1	1	1

² C – Contract staff; A – Ancillary staff

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
HR Manager	C	1	1	1							1						
Information Services Manager	C	1	0	1							0						
Senior M&E officer	C	1	0	1							0						
RDC	C	0	2	0								1	0	1	0	0	
Management Support																	
Exec Secretary	C	2	2	2							2						
Executive Officer to Council	C	0	1	0							1						
Properties Officer	C	1	1	1							1						
Assets Officer	C	1	1	1							1						

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
Accountant/Internal Auditor	C	1	1	1							1						
Accountant	C	1	2	1							2						
Accounts Associate/Assistant	C	10	11	4	1	1	1	1	1	1	4	2	1	1	1		1
Human Resource Officer	C	1	1	1							1						
Human Resource Assistant	C	1	1	1							1						
Farm Manager - Crops & Livestock	C	5	0	0	1	1	1	1	1			0	0	0	0	0	
IT Manager	C	0	1	0							1						
IT Officer- Support	C	1	1	1							1						
IT systems officer	C	1	1	1							1						

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
M&E officer	C	1	1	1								1					
Public Relations Officer	C	1	0	1							0						
Admin Assistant/Receptionist	C	0	3										1			1	1
NARI Centre Maintenance (land, buildings, plants and equipment, vehicles)																	
Admin Assistant/Receptionist	A	7	4	1	1	1	1	1	1	1	1			1	1	1	0
Procurement & Logistics Officer	A	1	1	1							1						
Janitor	A	10	10	2	2	2	1	1	1	1	4	2	2			1	1
Gardener	A	6	1	1	1	1	1	1	1		1						
Admin driver/School driver	A	15	15	3	3	3	2	2	2		4	1	3	2	1	3	1

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
Facility Assistant/Inventory clerk	A	5	4		1	1	1	1	1		1		1		1	1	
Tractor Driver	A	5	6		1	1	1	1	1		1	1	1	2		1	
Watchmen supervisor	A	6	3	1		1	1	1	1	1	1		1	1			
Watchmen	A	88	88	1	32	19	10	11	13	2	1	32	19	10	11	13	2
R&M Supervisor	A	5	2		1	1	1	1	1			1	1				
Carpenter/painter	A	9	11		2	2	2	1	2		3	1	4	1	1		1
Electrician	A	5	2		1	1	1	1	1			1	1				
Plumber	A	5	5		1	1	1	1	1		1	2	2				
Auto Mechanic/Driver Mechanic	A	5	1		1	1	1	1	1							1	

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
Small engine Mechanic	A	4	3		1	1	1		1		1	1				1	
Farm machine operator	A	11	8	1	2	2	2	2	2		3	4			1		
Field Supervisor	A	0	1												1		
Farm Labour/General Labour	A	25	38		5	5	5	5	5		2	5	3	19	5	4	
General Labour R&M	A	0	2								2						
Information, Capacity building, Technical and Diagnostic Support Services (Planting Material/Breeding Stock/Capacity Bld)																	
IT Officer- Data Management	C	1	1	1							1						
Information Liaison Officer	C	1	0	1							0						
Librarian	C	0	2	0							1		1				

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
Scientific Editor	C	1	1	1							1						
Technical Editor	C	1	1	1							1						
Information Media Officer	C	0	1	0							1						
Media Development officer	C	2	0	2													
Information and Communication Officer	C	0	1	0							1						
Publications Assistant	C	1	1	1							1						
GIS Officer	C	1	1	1							1						
TC Manager	C	1	1				1							1			
Technical Officer- PGR (including TC lab)	C	9	4		2	2	2	1	2			2	1	1			

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
Technical Officer - LGR,	C	5	1		2	1		1	1			1					
Information & Capacity Building (Outreach)	C	5	1		1	1	1	1	1			1					
Chief Scientist Chemlab	C	1	1							1							1
Senior Technical Officers Chemlab (analytical services)	C	4	1							4							1
Scientist (lab analysis)	C	0	5														5
Technical Officers Chemlab	C	2	0							2							
Technical Officer – Curator NAIC	C	1	1							1							1
Laboratory Attendant	A	8	5		2	1	3			2				3			2

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
Farm (technician) attendants- Plant Genetic Resources	A	19	35		5	4	4	2	4			3	22	2	3	5	
Farm (technician) attendants- Livestock LGR	A	13	15		4	3		3	3			6	2		5	2	
Core staffing for research delivery - Scientific and Technical																	
Principal scientist-Agronomy/breeding	C	1	0		1												
Principal Scientist - Agronomy/PGR	C	1	0						1								
Principal Scientist - Crop protection	C	1	0				1										
Principal Scientist – Food technology/post harvest	C	1	0		1												
Principal Agricultural Economist/social science	C	1	1		1							1					
Principal Scientist-Extension/Scaling/Adoption	C	1	0	1													

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
Principal Scientist - Animal Health & Nutrition	C	1	1		1							1					
Principal Scientist - Animal Husbandry & Breeding	C	1	1						1			1					
Scientist-Agronomy/breeding	C	3	4				1	1	1			2		1		1	
Scientist - Crop protection	C	6	5		2	1	2			1		2	1	2			
Scientist – Food technology/postharvest	C	2	1		1	1							1				
Scientist - Agricultural Economics	C	4	3		2	1	1					2				1	
Business and Marketing officer	C	3	4		1		2					1	1	2			
Scientist- Agronomy/Soils	C	3	2		2		1					1		1			
Scientist-social science/Extension/Scaling/Adoption	C	3	5		1	1		1				1	1		2	1	
Scientist - Animal Health & Nutrition	C	5	3		2	1		1	1			1	1		1	0	

Designation	Type	Total SIP	Total current	Staff requirement for SIP implementation							Current staffing (status November 2021)						
				HQ	MRC	IRC	HRC	HHRC	SRC	Chemlab /NAIC	HQ	MRC	IRC	HRC	HHRC	SRC	Cheml /NAIC
Scientist - Animal Husbandry & Breeding	C	3	2		1	1			1							2	
Scientist Agronomy/PGR	C	2	1			2							1				
Scientist Tree breeding/management1	C	2	0		1		1										
Scientist Agronomy/Climate change	C	11	5		2	3	2	2	2			2	1	1	1		
Technical Officer -Agronomy/(Tree) Breeding	C	7	4		2	1	2	1	1				3	1			
Technical Officer - Crop protection	C	3	1		1	1	1					1					
Technical Officer - Post harvest/preservation	C	5	0		1	1	1	1	1								
Technical Officer – Agronomy/Soil	C	4	2		1	1		1	1				1	1			
Technical Officer - Animal Health & Nutrition	C	8	1		2	2		2	2			1					

[illegible]



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