



PAPUA NEW GUINEA  
NATIONAL AGRICULTURAL RESEARCH INSTITUTE

# **Strategy and Results Framework 2022-2031**

# **Strategic Implementation Plan 2022-2026**

## **Summary**

**Key extracts from NARI Strategy and Results  
Framework 2022-2031 and Strategic Implementation  
Plan 2022-2026**



# **NARI Strategy and Results Framework and NARI Strategic Implementation Plan**

## **Summary**

**Summary extracts from the NARI Strategy and Results Framework 2022-2031 and Strategic Implementation Plan 2022-2026**

**National Agricultural Research Institute**

**Lae, Papua New Guinea**

**Corporate Plan No. 4/2022**

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# Table of Contents

<b>PART I Extract from the NARI Strategy and Result Framework 2022-2031</b> .....	<b>1</b>
<b>1. The Institute</b> .....	<b>1</b>
<b>2. PNG Development Challenges</b> .....	<b>1</b>
<b>3. Agriculture Research for Development</b> .....	<b>1</b>
3.1 Contribution of Agricultural Research for Development to PNG Development Targets.....	1
3.2 Major threats, constraints and opportunities in agricultural development.....	3
<b>4. Agricultural Research for Development – A Strategy and Results Framework</b> .....	<b>4</b>
4.1 Development of the Strategy and Result Framework.....	4
4.2 Targeting for Impact and Major beneficiaries.....	5
4.3 Agriculture Research for Development Priorities and Strategies.....	6
4.4 Delivery at scale.....	9
<b>PART II Extract from Strategic Implementation Plan 2022-2026</b> .....	<b>9</b>
<b>2. Implementation plans</b> .....	<b>10</b>
2.1 Priority 1 – Economic Development and Value Chains.....	10
2.1.1 Result Area - Foresighting and Advocacy.....	12
2.1.2 Result Area - Value Chain Support.....	12
2.2 Priority 2 Resilient Systems.....	13
2.2.1 Result Area - Household Resilience.....	14
2.2.2 Result Area – Agro-eco system resilience.....	14
2.2.3 Result Area – Biosecurity.....	15
2.2.4 Result Area – Genetic Resources.....	16
2.3 Priority 3 Nutritious Food and Healthy Diets.....	17
Cross-cutting Areas:.....	17
<b>3. Strengthening Institutional Effectiveness</b> .....	<b>19</b>
3.1 Managing for Results.....	19
3.2 Resourcing the Institute.....	20
3.3 Governance, Policies, Processes.....	21
3.3.1 Organisational Structure.....	21
3.3.2 Management policies and processes.....	22
<b>Annex 1. Agricultural Development Domains</b> .....	<b>23</b>
<b>Annex 2. Outcome Matrix</b> .....	<b>25</b>
Annex 4. Assessment Framework for achieving results in Results Areas 1-7.....	29

## Foreword to the summary SRF / SIP

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.

This second NARI Strategy and Results Framework (SRF) 2022-2031 (and supporting NARI Strategic Implementation Plan, 2022-2026), represents 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.

Our strategy aligns and will contribute directly to the achievement of the GoPNG Development Goals, in particular to promote economic activity and reduce poverty, to improve food and nutrition security, to promote sustainable resource management, and respond to climate change challenges. These also cascade from the UN Sustainable Development Goals (SDGs) the PNG Vision 2050 and PNG's DSP 2030, which share a common 2030 target date with our framework.

We must extend our focus on women and young people, focus to provide economic opportunities and improved diets and nutrition, particularly among mothers and young children, and intensify our work on climate-smart agriculture. These are all given new emphasis in our research agenda, along with identifying novel opportunities, strengthened value chain support, and continuing research efforts to improve the productivity of new and traditional staple food crops, livestock and aquaculture, and the sustainability of our natural resources and environment.

In this new ten year SRF 2022-2031, we have taken note of our internal challenges and aspirations, but we have also proactively sought and taken on board the views of our external partners and stakeholders. The new priority areas clearly articulate the research strategies, which with the supporting technical services and institutional structure provides a firm foundation for the research and partnerships needed to deliver on PNG's National development goals, across the diverse Agricultural Development Domains, over these next ten years from 2022-2031.

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 scaled outcomes in the first five years of the SRF (2022-2031).

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 building, guiding the resourcing of the Institute, planning and implementation of projects, and providing a road-map to achieving impacts in the lives of rural communities over the next five (5) years

Effective agricultural research for development is key to PNG's development aspirations, and the 85% of the population who are rural based and depend on productive agriculture to escape the poverty trap of the rudimentary subsistence agriculture systems. While the Strategy and Results Framework and Strategic Implementation Plan provide a clear platform and pathway for the future, NARI cannot do it alone. We call on our partners and stakeholders to work with us to share in achieving our common aspirations in fulfilling our national development plans and objectives.

## **PART I Extract from the NARI Strategy and Result Framework 2022-2031**

### **1. The Institute**

#### **NARI Vision, Goal, Purpose and Values**

In its Vision for PNG, NARI sees “Prosperous PNG Agricultural Communities” supported by the NARI Mission of promoting innovative agricultural development in PNG through scientific research, knowledge creation and information exchange. This is intended to be accomplished through the Institute’s purpose (strategic objective) of enhanced productivity, efficiency, stability and sustainability of the smallholder agriculture sector in the country so as to contribute to the improved welfare of rural families and communities who depend wholly or partly on agriculture for their livelihoods.

Our Core Values:

- Leadership
- Innovativeness
- Integrity
- Communication
- Organisational Excellence and Relevance

### **2. PNG Development Challenges**

Papua New Guinea (PNG) is by far the largest country in the Pacific in terms of the size of the economy, land mass as well as population size. However, while the nominal it has the largest gross GDP among the 22 Pacific Island Countries and Territories, the country ranks last in the region in the Human Development Index (HDI) and other social and demographic indicators. This is against a backdrop of abundance of natural resources including minerals, oil, gas and timber, fish and agricultural produce for export and domestic consumption. A burgeoning population will put increasingly pressure on natural resources, an already fragile agro-food system and necessitating creative strategies in using the growing population with innovative ways to increase income earning and employment opportunities.

### **3. Agriculture Research for Development**

#### **3.1 Contribution of Agricultural Research for Development to PNG Development Targets**

NARI as the premier agricultural research institute in the country is well positioned to make significant contributions in applying science and strategic research to address major challenges and realise opportunities in agricultural development. The Institute has realised that it needs to go beyond its traditional role of research and supplier of technology and information, to be a more active change agent in driving innovation, with people at the centre of the innovation rather than a focus on technology. In order to do so, NARI adopted the Agricultural Research for Development (AR4D) paradigm in 2010. AR4D is embedded within the agricultural innovations system (AIS) framework. This approach is now widely

accepted and principles applied across agricultural research organisations in the world, donor funding programs and in emerging approaches to enhance development outcomes with an expanded role of research to integrate different types of research and learning approaches, active participation in scaling pathways, responsiveness to peoples needs and a strong emphasis on research and innovations around the social, institutional and policy dimensions in impact pathways.

Agriculture, Forestry and Fisheries have been identified in the country's medium to long-term strategies as the key drivers in economic and social development with more than 85% of the population living in rural areas and relying on those sectors for their livelihoods. While Agriculture is often referred to as the back-bone of the country, it is yet to reach its full potential to support a rapidly growing population towards an improved welfare and living standards. Agricultural Research for Development interventions can make a significant contribution to the achievement of targets in social and economic development set out in the medium-and long-term strategies and policies of the PNG Government addressing major impact areas of reducing poverty, increasing food and nutritional security and health and sustainable natural resource base. The major policy directions and initiatives from the Government of PNG guiding social and economic development over the next 10-years and necessary contribution coming from agricultural development include the following:

*Reduction of poverty:*

The DSP 2030 is giving a target of an additional two million jobs by 2030. The SME policy 2016 is a key instrument in the Government's long-term strategies to achieve this aim. The bulk of the anticipated creation of SMEs and associated jobs will have to be in agriculture, forestry and fisheries with 85% of population living in rural areas and engaged depending on those sectors for their livelihood. Opportunities need to broaden to cover on- as well as off-farm employment to slow down the urban drift from rural areas and make it attractive for young people to seek employment and build their livelihoods in rural areas. This approach is calling for the strengthening of research for development and innovation along priority value and supply chains with a strong focus on inclusiveness to lift the country's performance in relation to gender equality.

*Food and nutritional security and health*

All facets of food and nutritional security i.e. food availability, food access, utilisation of food and stability of food availability and access need to significantly increase to meet the demands of the growing population and meet the targets set out by the Government in DSP 2030 and MTDP III 2017 – 2022 and other key policies including the National Nutrition Policy 2016 – 2025 and Draft National Food Security Policy 2018-2027.

*Sustainable resource management and use of agro-ecosystem services*

PNG's rich natural resources including it's unique biodiversity are under threat from over-exploitation, use of unsustainable agricultural production practices and global Climate Change unless a major shift using a whole system approach is instituted. The ongoing reliance of the national economy on mineral resource development and logging for revenue generation will continue to damage the environment, degrade of the landscape and accelerate loss of biodiversity requiring effective responses in policy, monitoring and rehabilitation efforts to sustain agro-ecosystems. Innovation system approaches are needed to ensure that agricultural development is holistic, inclusive and to ensure that agro-ecosystem services are extracted in a sustainable manner.

### **3.2 Major threats, constraints and opportunities in agricultural development**

Among the major constraints and threats that can impact the agriculture and food systems are:

- Overall low productivity, efficiency and insufficient volumes of food crops and livestock production considering population growth rates;
- Climate change and its effects on agricultural productivity and the inadequate ability of communities to manage the adverse and unpredictable impacts of global climate change;
- Degradation of the environment through uncontrolled waste disposal and poor cropping practices that depletes soil of nutrients,
- Increased risks to erosion because of sloping land and deforestation;
- Ongoing reliance on extractive industries and logging for revenue generation is causing damages to the environment, degradation of the landscape and loss of biodiversity
- Long-term effects of malnutrition and under-nutrition on cognitive development and health impacting on labour availability and productivity
- Lack or inadequate implementation of supporting policies, strategies, agenda and priorities in the agricultural sector
- Poor hygiene and sanitary conditions and access to water supplies impacting on food safety and overall health of rural communities
- Prevailing inequalities in opportunities for social and economic empowerment between genders, accessing benefits and participation in decision-making processes
- High degree of drudgery in agricultural production and poor access to markets, low income prospects and general lack of opportunities in rural areas increase urban drift;
- Weak, uncoordinated and fragmented agricultural innovation systems are attributed to lack of exploitation where synergies and networking among Government, research and training institutions, industry, financial sector and professional groups;
- Inadequate funding for agricultural research;
- Absence of skills inventory and inadequate alignment of the planning of human resource to development needs;

On the other hand, there are considerable opportunities to be realised from the development of the Sector including:

- Increase biological productivity of crops and livestock, enhance efficiency and profitability of production and marketing of crops and livestock products;
- Enhancing supply of agricultural commodities to rural, urban and export markets;
- Exploring value-addition and product diversification of crops and livestock
- Agriculture sector as the primary source for expansion of future productive employment for the large number of youths entering the workforce



## 4. Agricultural Research for Development – A Strategy and Results Framework

### 4.1 Development of the Strategy and Result Framework

The new Strategy and Results Framework (SRF) 2022 - 2031 builds on the first SRF 2011 – 2020 which is grounded in the Agriculture Research for Development (AR4D) paradigm. AR4D is embedded within the agricultural innovations system framework and a widely accepted framework guiding framework across the world for agricultural research, donors and development practitioners. As part of the development of the new SRF, the Institute commissioned a review of the implementation progress of the previous SRF that included stakeholder assessments, sought further comments from Senior Managers and Scientists and based on the insights and lessons learnt developed the new SRF.

The NARI Goal and Strategic Objectives as stated in the NARI Act 1996 have been reaffirmed during the strategic planning process:

***Goal: Improved welfare of rural families and communities who depend wholly or partly on agriculture for their livelihoods***

***Strategic Objective: Enhanced productivity, efficiency, stability and sustainability of the smallholder agriculture sector***

While the NARI Goal is aspirational and linking into the country's long-term vision as articulated in Vision 2050, the NARI Strategic objective expresses the Institute commitment to actively contribute in all aspects of the agricultural development process with relevant research outputs and outcomes.

The Institute links up well with the GoPNG priorities arising from the targeted development impacts of reduction of poverty, assurance of food and nutritional security and health and sustainable resources management as guided by the countries long-and medium-term development strategies (Figure 1).

The priorities of the Institute for the next 10 years that the Institute will endeavour to contribute to are as follows:

**Priority 1:** Contribution to economic resilience and development by enhancing agricultural markets, value chains and trade;

**Priority 2:** Contribution to enhanced resilience of rural communities and systems in light of climate, economic and demographic changes and associated threats to livelihoods and the environment;

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

Contributions will be made to the following **Development Outcomes:**

- Increased incomes and employment in rural areas arising from increased economic activities and business development
- Enhanced stability and resilience of livelihood systems of rural households and communities

- Production, productivity and efficiency of crop and livestock products increased and producers better linked through efficient value chains to profitable markets at scale
- Rural and urban households consuming healthy balanced and nutritious diets
- Improved standards in Food and Feed safety in agricultural production and food/feed use are applied
- Enhanced and equitable benefits from agro-ecosystem goods and services
- Agricultural production systems are sustainably managed under changing climates and macroeconomic drivers
- Enhanced equity and inclusion achieved

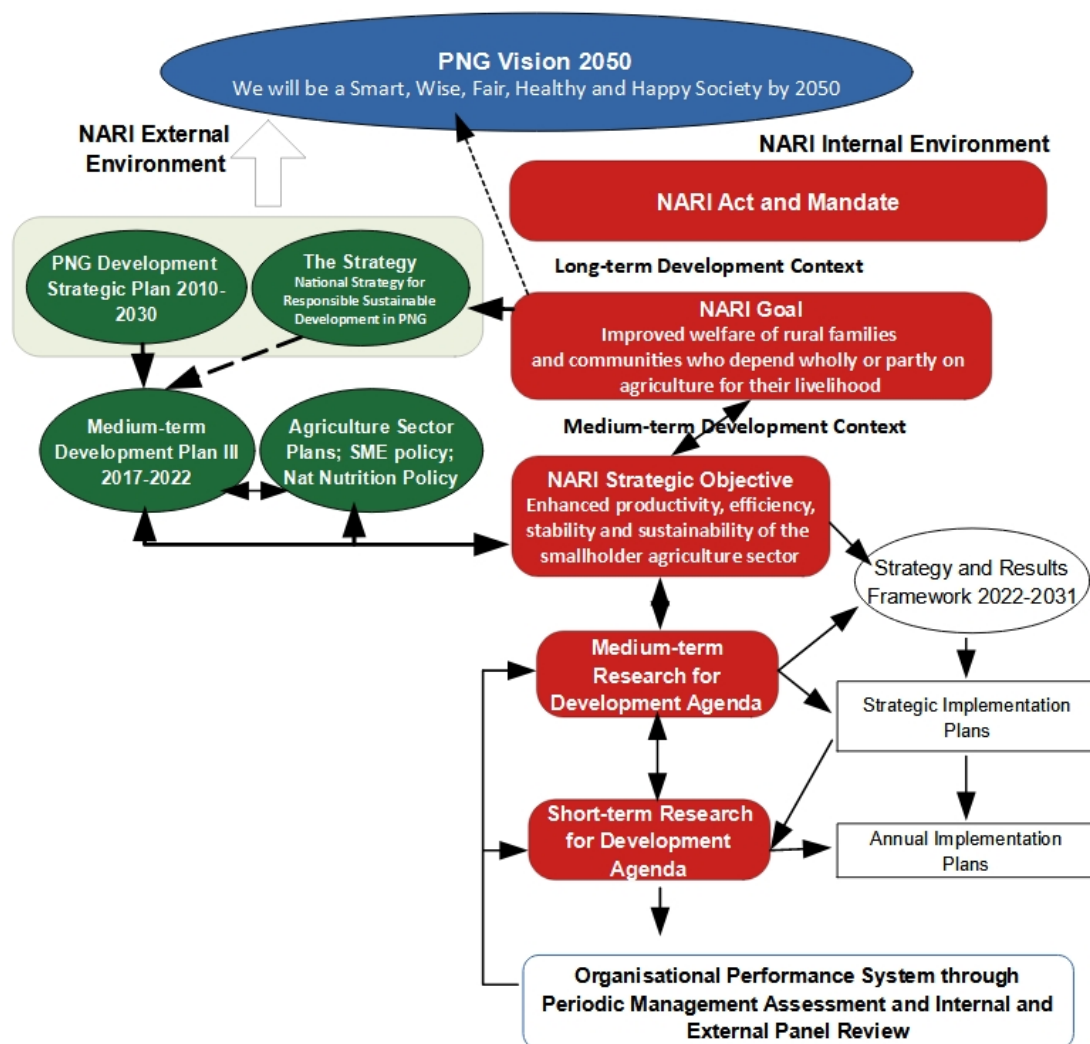


Figure 1: NARI contribution to agriculture sector and national development

#### 4.2 Targeting for Impact and Major beneficiaries

NARI used geographic information system (GIS) methods to classify the country into Agricultural Development Domain (ADD) Clusters (Annex 1). ADD clusters will help

guide the Institute in targeting AR4D activities and ensure that they are responsive to the needs of the beneficiaries and at the same time provide a guide on further scaling of successful interventions for achieving wider outcomes and impacts. The primary beneficiaries of NARI's Agricultural Research for Development agenda are the more than 80% of men and women smallholder farmers that live in rural areas in PNG and rely on agriculture, forestry and fisheries for their livelihoods. Other beneficiaries include consumers in general as well as Off-farm actors such as traders, processors, transporters and other service providers.

### **4.3 Agriculture Research for Development Priorities and Strategies**

For each of the three priorities (see above), a number of results referred to as system outcomes<sup>1</sup> have been identified with relevant strategies to achieve them. The identified system outcomes will guide the development of programs and project portfolios that will deliver the necessary results for the achievement of the system outcomes. Delivery pathway of research innovations into the AR4D system towards development outcomes at scale is summarised in Figure 2.

**Priority 1:** Contribution to economic resilience and development by enhancing agricultural markets, value chains and trade:

Markets, value chains and trade are not well developed in PNG and much of the agricultural produce for local consumption is traded in informal markets. But there is a strong drive by the PNG Government for a transition from the traditional subsistence and semi-commercial production system to an agri-business oriented Micro-Small to Medium Enterprises (MSMEs) and Small to Medium Enterprise (SME) model of agriculture farming. NARI and partners will use a whole value-chain approach to address the constraints in selected priority value-chains. Other AR4D strategies will explore opportunities in enhancing value-addition or advancing other forms of down-stream processing of crop and livestock products and research interventions.

#### **Targeted Results:**

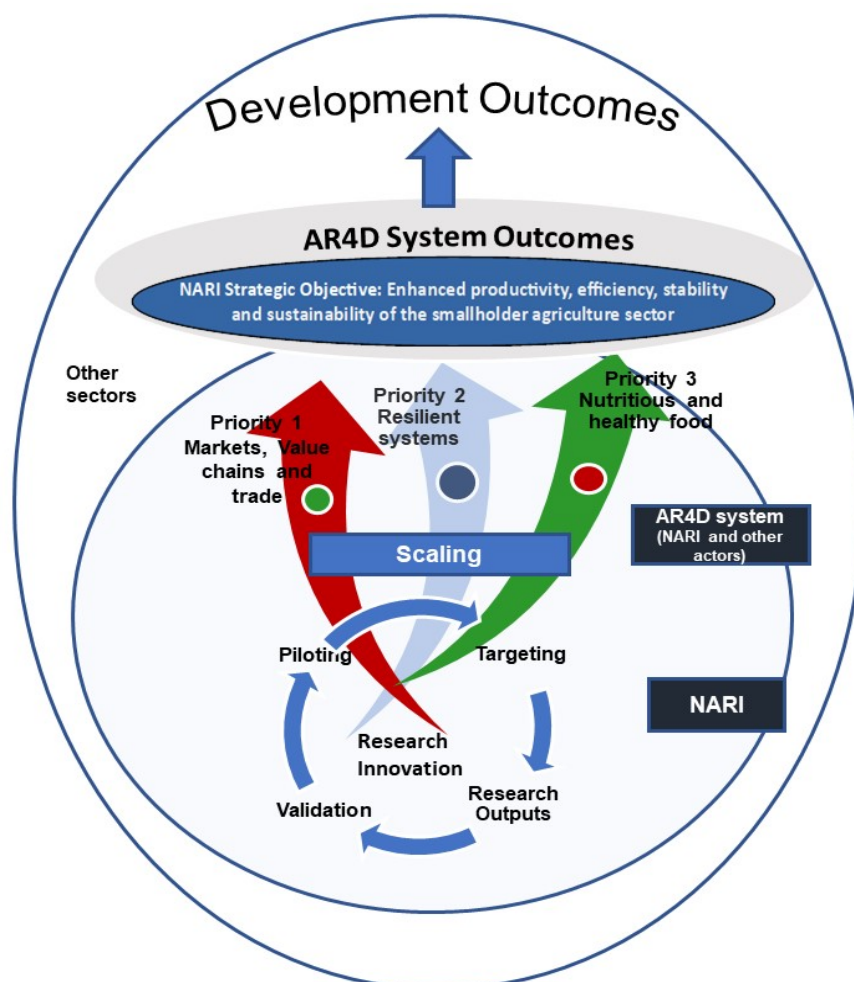
The following results at the AR4D system level will be targeted in Priority 1 by NARI with its contribution in AR4D:

- Increased economic returns to value chain actors from production, sale and added value of crop and livestock products;
- Increased equity, inclusion and participation of women, youth and other socially vulnerable groups in priority value chains;
- 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;
- Market accessions for export of PNG's agricultural products that promote local content of market share;
- An efficient institutional and policy environment that promotes productivity, food safety standards, and maintains an efficient value chain in all market levels;

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<sup>1</sup> Changes in the conditions of value chains, markets, household and system resilience, consumption patterns etc. as well as changes in the attitudes, aspirations, skills and knowledge of the targeted beneficiaries

- Increased localisation and import-substitution of target crops and livestock by locally based industries;
- Alternative agricultural export opportunities from crop, livestock, aquaculture and non-food products realised and reflected in the national agricultural development agenda;



**Figure 2: Delivery pathway of AR4D system and development outcomes at scale**

**Key strategies:**

Addressing bottlenecks in priority value and supply chains with technology and innovation in production, post-harvest management, marketing and communication using a whole value chain approach; Use of innovative and inclusive tools and approaches in facilitation of value chain actors; Development of business and enterprise models for smallholders and off-farm value chain actors for priority value chains; Feasibility assessment of domestic, regional, and international market access, opportunities and trends; and market & policy intelligence; Market diversification for crop and livestock products (fresh, dried, processed);

**Priority 2:** Contribution to enhanced resilience of rural communities and systems in light of climate, economic and demographic changes and associated threats to livelihoods and the environment;

Rural communities and households have a high vulnerability to food insecurity and disruption of income generating activities due to their low adaptive capacity to manage those threats and risks to their livelihood. Other economic pressures, high population growth and demographic changes with migration of people closer to roads and markets is putting increasing pressure on natural resources including soils, water and biodiversity. With an aim to increase resilience of communities and agriculture systems changes need to target technology, social and institutional changes. NARI's strategies will focus on three areas, viz. management and use of PNG's rich agro-biodiversity, adaptation strategies to global Climate Change and the broader application of technological, social and policy innovations in a system wide approach to strengthen agricultural production systems in a sustainable manner.

**Targeted Results:**

The following results at the AR4D system level will be targeted in Priority 2 by NARI with its contribution in AR4D:

- 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

**Selected key strategies:**

Inclusive management and conservation approaches for genetic resources; discovery of non-food products from agro-biodiversity; Increasing access to quality foundation material (crop varieties/breeding stock of poultry, goats, pigs, fish) to stakeholders; Genetic improvement of crops and livestock breeds resilient to biotic and abiotic stresses in PNG diverse environment; Portfolios of sustainable intensification practices and strategies to balance risks to production and livelihoods; risk assessments of critical pest and diseases under changing climates and management of new and emerging weeds, pest and diseases of crops and livestock in priority production and agro-ecosystems; integration of CSA products and approaches into diverse climate resilient and productive livelihood systems; facilitate application of information resources and platforms that enable engagement in the policy development process.

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

PNG is facing a severe nutritional crisis with a triple burden of malnutrition, i.e. under nutrition, micro-nutrient deficiencies and overweight/obesity. The threat of a lost generation that is impaired in contributing gainfully to economic and social development and to sustain their own livelihoods is a major threat to the nations future. Changes are required in all aspects of food and nutritional security, i.e. availability, access and use of

nutrient dense food at all times including food safety considering the prevalence and impact of food borne diseases, malnutrition and mortality of children. There are important linkages between agriculture and nutrition, and AR4D has a major role to play in with nutrition-specific interventions to the multi-sector approach of the Government. The major areas of intervention include enhancing the availability of nutrient dense crops and crop varieties by strengthening seed systems and diversifying production systems, increase of livestock production and consumption in both rural as well as urban setting, and increasing the awareness, education and changing attitudes, habits and perceptions of rural and urban dwellers towards food, diets, preparation and consumption of food.

### **Targeted Results:**

The following results at the AR4D system level will be targeted in Priority 3 by NARI with its contribution in AR4D:

- 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

### **Selected key strategies:**

Nutrient dense variety development; improving access to planting material for nutrient dense vegetables and staple crops and breeding stock especially to areas and regions most affected by poor nutritional outcomes; nutritious food product development from local staple crops, vegetable, fruits and nuts; development of husbandry and feeding systems for small livestock and aquaculture appropriate and potential for scaling for peri-urban and rural communities; Testing agri-food value chain innovations and interventions for improved diet quality and diversity; assessments on underlying root causes of malnutrition in different social and socio-economic settings across ADD clusters;

## **4.4 Delivery at scale**

NARI's strategy in delivery is directed towards outcomes and impacts at scale. While technical research outputs provide technology and management solutions, achieving downstream impacts with sustainable development outcomes from these is still a challenge. While some farmers will simply adopt an introduced technology as it is, targeting sustainable development outcomes requires innovative processes in which NARI will actively pursue the formation of strategic partnerships and networking with other actors in the sector and related sectors. This will promote effective learning, adoption, and integration required to scale the outcomes of research into socially inclusive, climate resilient, and economically conducive livelihood benefits for the wider and environmentally, agriculturally, and socially diverse communities throughout PNG.

## **PART II Extract from Strategic Implementation Plan 2022-2026**

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). 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).

As part of the development of the SIP, NARI undertook 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. This process involved NARI staff from all areas of operations as well as inputs from external stakeholders. 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. 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**

In the following sections a brief overview is presented of the different sub-strategies in each of the seven Result Areas this includes anticipated outputs and immediate outcomes to be achieved. The full SIP document should be consulted for more information and details. An assessment framework for the achievement of sub-strategies is shown in Annex 4.

### **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 following two Result Areas will guide NARI to design relevant programs and project portfolios to generate AR4D results.

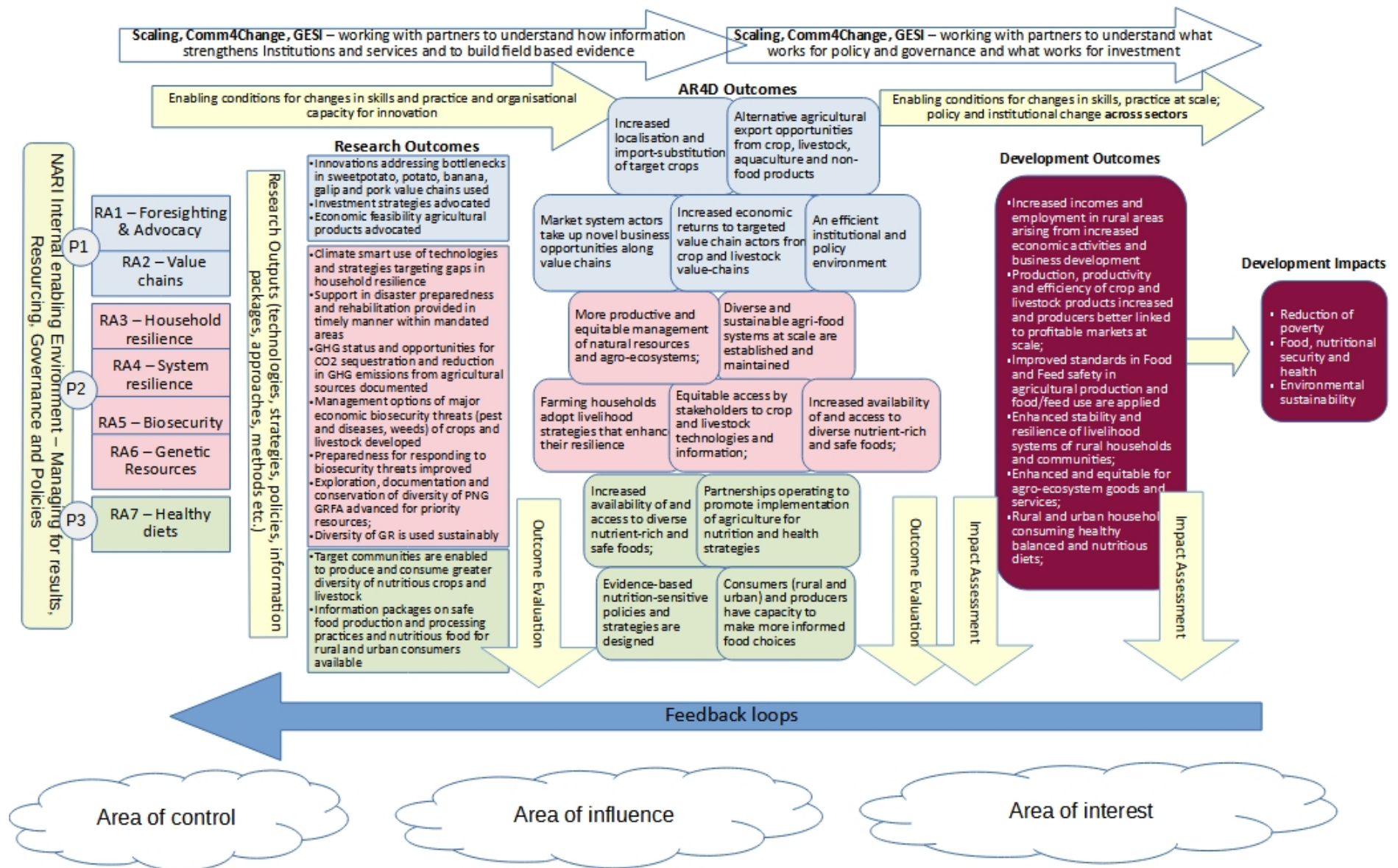


Figure 3: Theory of Change for of the contribution of AR4D in the achievement of System outcomes and Development Outcomes and Impacts



### 2.1.1 Result Area - Foresighting and Advocacy

This RA has two sub-objectives viz. Investment Strategies and Market and Production Opportunities. 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.

<b>Strategic objective:</b> <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>	
<b>1. Investment Strategies Strategic objective:</b> Investment strategies for agricultural transformation assessed and advocated	<b>2. Economic opportunities Strategic Objective:</b> Economic feasibility of fresh, processed and non-food agricultural production at different scales assessed and advocated
<b>Outputs</b>	
<ul style="list-style-type: none"> <li>• Information on costs and benefits of key agri-food system and investment options that are inclusive, pro-poor and targeted to promote economic growth;</li> <li>• Increased capacity and networking in the design of agricultural transformation strategies;</li> <li>• Information on future research needs and partnerships in policy analysis and data-driven investment opportunities;</li> <li>• Policy and strategy papers on future economic investment options and research investment;</li> <li>• Relevant databases on research investment, Agriculture Science and Technology Indicators (ASTI) and other information developed and maintained;</li> <li>• Communications tools used and stakeholder interactions facilitated to share information and advocate identified strategies;</li> </ul>	<ul style="list-style-type: none"> <li>• 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.)</li> <li>• Information on economically feasible agricultural production sites mapped.</li> <li>• Information on prospective investment opportunities in the agriculture sector accessed by government agencies, PNG owned companies and small holder farmers.</li> <li>• Information on opportunities and feasibility for organic certification for selected crop and livestock products;</li> <li>• Policy and strategy papers on future economic investment options and research investment;</li> </ul>
<b>Immediate Outcomes</b>	
<ul style="list-style-type: none"> <li>• Investment in agriculture and AR4D increased by GoPNG, donor agencies, private enterprises;</li> <li>• Increased rates of return on investment in AR4D from better targeting and decision making</li> </ul>	<ul style="list-style-type: none"> <li>• Investment in agriculture and AR4D increased by GoPNG, donor agencies, private companies;</li> <li>• Policy and institutional reforms draw on information from policy briefs and databases to revise strategies and policies in agriculture</li> </ul>

### 2.1.2 Result Area - Value Chain Support

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.

<b>Strategic Objective:</b> <i>Improved technological, practical and economical approaches and adaptations for agricultural systems through facilitated innovation, foreign direct investments,</i>
--

<i>and adoption processes along specific and related value chains</i>		
<b>1. Value chain innovations Strategic Objective:</b> Innovations addressing key bottlenecks in sweetpotato, potato and banana are used along the value chain	<b>2. Galip Nut Value Chain Strategic Objective:</b> Improved knowledge on current key bottlenecks in production, processing and marketing in the Galip value chain	<b>3. Pork Product Value Chain Strategic objective:</b> Availability of lower cost locally produced pigs and pork products in selected retail outlets or open market increased in target provinces
<b>Outputs</b>		
<ul style="list-style-type: none"> <li>• In-depth value chain mapping and research needs assessment for sweetpotato, potato and banana</li> <li>• Information and technology package on small scale commercial banana production;</li> <li>• Potato and sweetpotato varieties meeting end-user requirements;</li> <li>• Soil management package for sweetpotato production systems</li> <li>• Appropriate business models for micro-enterprises developed supporting target value chains;</li> <li>• Investment portfolios available for interested private sector operators;</li> <li>• Suitable mechanisation options available for different scales of operation in production and processing;</li> <li>• Production and Quality standards and Standard operating procedures available for downstream processing;</li> <li>• Gaps in availability of guidelines, protocols and systems for production of certified planting material of sweetpotato, potato and banana addressed;</li> </ul>	<ul style="list-style-type: none"> <li>• Commercial viability of business models for galip nut processing improved;</li> <li>• Appropriate business models for micro-enterprises developed and capacity of operators increased;</li> <li>• Improved production technologies developed (harvesting practices, on-farm processing;</li> <li>• Information on management options and strategies for the Galip weevil</li> <li>• Investment portfolios available for interested private sector operators;</li> <li>• Suitable mechanisation options available for different scales of operation;</li> <li>• Production and Quality standards and Standard operating procedures available;</li> </ul>	<ul style="list-style-type: none"> <li>• Effective research collaboration and networks between NARI and NAQIA on animal health &amp; diseases.</li> <li>• Capacity of selected smallholder farmers on improved production practices and animal Health &amp; welfare management tailored increased productivity and production increased.</li> <li>• Value chain mapping and key determinants influencing output across the value chain documented;</li> <li>• Safe &amp; economically sustainable models for multiplication, supply &amp; easy access for quality replacement stocks developed.</li> <li>• Demand &amp; key requirements in production, processing and marketing to support niche markets for pork meat determined;</li> <li>• Awareness on biosecurity standards and practices conducted.</li> <li>• NARI staff and partner capacity on para-veterinary skills and knowledge increased.</li> </ul>
<b>Immediate Outcomes</b>		
<ul style="list-style-type: none"> <li>• Knowledge on improved practices in production and postharvest management in sweetpotato, potato, banana value chains used by value chain actors in target areas;</li> <li>• Increased farm productivity and consistency in the supply of targeted produce;</li> <li>• Establishment of appropriate farm business/enterprise models in targeted value chains emerging;</li> <li>• Increased use of market information by participating commercial farmers and aggregators</li> </ul>	<ul style="list-style-type: none"> <li>• Increased volumes for Galip nut processed by current processors and sold in retail outlets in PNG</li> <li>• Increased establishment of Galip plantations or inter-cropping;</li> <li>• Increased investment by GoPNG and private sector in Galip AR4D, production, processing and marketing;</li> </ul>	<ul style="list-style-type: none"> <li>• Production of pig and pork products in target provinces showing incremental increases over time;</li> <li>• Improved access to productive breeding stock;</li> <li>• Health of pig herds and hygiene of production environment in target piggeries improved;</li> <li>• Improved knowledge on value chain actors on cost effective production, processing and marketing of pigs and pork products</li> </ul>

## 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. 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 while building capacity in the fourth area of Agro-eco system resilience.

### 2.2.1 Result Area - Household Resilience

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.

<p><b>Strategic Objective:</b>  <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><b>1. Climate Smart Solution - Strategic objective</b>  Climate smart technologies and strategies targeting gaps in household resilience to climate change induced stresses and other shocks in diverse agro-ecologies and food systems made available and used by target communities</p>	<p><b>2. Disaster response - Strategic objective:</b>  Support in disaster preparedness and rehabilitation provided in timely manner within mandated areas</p>
<p><b>Outputs</b></p>	
<ul style="list-style-type: none"> <li>• Vulnerability assessment information and maps</li> <li>• Baseline on traditional cropping calendars for representative areas and regions documented</li> <li>• Diversified climate resilient portfolios of crop varieties and species as well as livestock strategies and technologies adapted to climate risks available to stakeholders;</li> <li>• 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;</li> <li>• 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</li> </ul>	<ul style="list-style-type: none"> <li>• Sufficient quality planting material and breeding stock available as foundation material for rehabilitation after disaster events;</li> <li>• Increased capacity in production of quality planting material and breeding stock at NARI Centres</li> <li>• Information packages available on management of severe El Nino events (before, during and after the drought)</li> <li>• Weather data available from all NARI Centres to stakeholder</li> </ul>
<p><b>Immediate Outcomes</b></p>	
<ul style="list-style-type: none"> <li>• CSA products and approaches integrated into ADD production systems at scale</li> <li>• responsive networks and partnership models for community support operating</li> </ul>	<ul style="list-style-type: none"> <li>• Timely response and contribution to agricultural disaster rehabilitation;</li> <li>• improved forecasting and preparation for severe El Nino and La Nina events;</li> <li>• responsive networks and partnership models for community support operating</li> </ul>

### 2.2.2 Result Area – Agro-eco system resilience

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.

<p><b>Strategic Objective:</b>  <i>Sustainability of managing agro-systems and catchment areas in ADD clusters with high population density and intensified agricultural systems improved</i></p>
<p><b>GHG agricultural mitigation opportunities - Strategic Objective:</b>  GHG status and opportunities for CO2 sequestration and reduction in GHG emissions from agricultural sources documented</p>

<b>Outputs</b>
<ul style="list-style-type: none"> <li>• Assessment of GHG emissions from agricultural sources in PNG</li> <li>• Assessment of opportunities for CO2 sequestration and building of soil carbon levels.</li> </ul> <p>Guidelines for climate safe agricultural practice.</p>
<b>Immediate Outcomes</b>
<ul style="list-style-type: none"> <li>• improved knowledge on risks and mitigation of climate threats from agricultural production in PNG</li> </ul>

### 2.2.3 Result Area – Biosecurity

Biosecurity involves preventing the introduction of exotic as well as the management of endemic pests, diseases and weeds. 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 aquacultural production systems, as well as natural eco-systems.

<b>Strategic Objective:</b> <i>Biotic agro-ecosystem threats are sustainably managed by smallholder farmers at different scales of operation</i>	
<b>1. 1. Biosecurity Management - Strategic objective</b> Management options of major economic biosecurity threats (pest and diseases, weeds) of crops and livestock developed	<b>2. Biosecurity preparedness – Strategic objective</b> Preparedness for responding to biosecurity threats improved
<b>Outputs</b>	
<ul style="list-style-type: none"> <li>• Fall Army Worm Management Package and associated information available and capacity built for use by different stakeholders;</li> <li>• Additional environmentally safe options available to vegetable producers for effective management of Diamond-back moth;</li> <li>• Integrated management approaches for African Swine Fever control operating in small-scale piggeries in PNG Highlands as part of improved value chain management;</li> <li>• Improved understanding of the biology, population dynamics and management options of the Galip Weevil;</li> <li>• Effective management strategies of Banana-associated phytoplasma in affected areas in Morobe and Madang;</li> <li>• Information on presence of BWAP related disease in other banana growing regions</li> <li>• Information on agricultural pests in PNG available online;</li> <li>• 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>.</li> <li>• Standard operating manuals and procedures applied for production of quality, and pest- and disease-free planting material and breeding stock;</li> </ul>	<ul style="list-style-type: none"> <li>• Contributions to incursion Management Plans and risk assessments;</li> <li>• Contribution to data bases developed for pest alert and incursion threats by NAQIA for stakeholder advise and planning.</li> <li>• Pest &amp; Disease diagnostic capacity increased in supporting the sector;</li> </ul>
<b>Immediate Outcomes for both sub-objectives</b>	

- 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

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 in the country. NARI is the custodian of this diversity. There is a need to conserve but also utilise indigenous and local genetic resources to adapt to climatic and commercial changes. This Result Area has two sub-objectives capturing the scope of the NARI activities.

<b>Strategic Objective:</b> <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>	
<b>1. GR Management - Strategic objective</b> Exploration, documentation and conservation of diversity of PNG GRFA advanced for priority resources;	<b>2. Genetic Resources Use and Access - Strategic objective:</b> Diversity of GR is used sustainably enhancing diversity and adaptation of crops and livestock to social, economic and ecological conditions
<b>Outputs</b>	
<ul style="list-style-type: none"> <li>• A pilot <i>in-situ</i> conservation approach to sweetpotato genetic resources is tested in four districts;</li> <li>• Sweetpotato cultivars characterised, phenotyped, evaluated, documented, pre-bred for traits of importance to adaptation and resilience;</li> <li>• Information on GRFA is available to stakeholders in PNG and international community;</li> <li>• 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;</li> <li>• Breeding stock of village chicken, cross-breeds, ducks, goats and pigs maintained at NARI centres;</li> <li>• Breadfruit collection established and collections of taro, yam and aibika expanded;</li> <li>• Core collection of sweetpotato identified and conserved <i>in-vitro</i></li> <li>• Fact sheets on poultry and pig breeds in PNG</li> <li>• Compliance with ITPGRFA obligations to contracting parties</li> <li>• Genetic resources for FA management strategy updated;</li> </ul>	<ul style="list-style-type: none"> <li>• Locally adapted sweetpotato varieties (early maturing, drought tolerant, purple and orange fleshed) bred with farmers' participation;</li> <li>• Tissue Culture protocols for yam mass-multiplication</li> <li>• Seed systems enhanced to promote adapted sweetpotato varieties and other crops;</li> <li>• Seeded crops such as vegetables, legumes and pulses assessed for improvement and utilisation;</li> <li>• Improved rice and corn varieties released;</li> <li>• New spice and essential oil varieties introduced and basic information generated;</li> <li>• New Crop varieties and livestock breeds available with traits that are meeting end-user demand;</li> <li>• Standard operating procedures operating in all NARI centres for production of foundation crop planting materials and breeding stock;</li> <li>• Facilities, equipment and infrastructure in place for production and post harvest processing and safe storage of seed and planting material at NARI centres;</li> <li>• Facilities, equipment and infrastructure in place for improved supply of poultry breeding stock at NARI Centres;</li> <li>• Stakeholders access to and supply with quality breeding stock and planting material of priority crops and varieties improved;</li> </ul>
<b>Immediate Outcomes</b>	
<ul style="list-style-type: none"> <li>• Extensible <i>in-situ</i> biodiversity conservation approach developed for sweetpotato;</li> <li>• Research and development in plant genetic resources is strengthened in PNG;</li> </ul>	<ul style="list-style-type: none"> <li>• 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;</li> </ul>

<ul style="list-style-type: none"> <li>• Diversity of GR maintained and safe-guarded for the future;</li> <li>• Kuk Research Centre is established as Centre for Sweetpotato GR Collection</li> </ul>	<ul style="list-style-type: none"> <li>• Supply of improved crop varieties and breeds based on end-user needs and consumer demand</li> </ul>
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### 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, viz. diversification and enrichment of food systems with nutritious foods, addressing protein deficiency and communicating nutrition messages. This priority has one Result Area with two sub-objectives that NARI will be contributing to with relevant interventions.

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

### 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 three cross-cutting areas are: Scaling of R4D interventions, Gender, Youth and Social inclusion and Communication for Change.

a) Scaling of research innovation outcomes and impacts - Strategic objective: <i>Improved understanding on key drivers and innovations that enhance desirable system changes in scaling of AR4D out put</i>	<b>b) Gender, Youth and Social Inclusion – Strategic objective</b> Agricultural innovations process is gender sensitive, inclusive and responsive of needs and aspira-	<b>c) Communication for Change – Strategic objective</b> Communication innovations effectively support delivery of research outcomes
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<i>and outcomes</i>	tions of youth and other disadvantaged social groups	
<b>Outputs</b>		
<ul style="list-style-type: none"> <li>• 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;</li> <li>• Research outcomes and impacts assessed and key drivers of success determined;</li> <li>• Technical feasibility and commercial viability of research outputs determined;</li> <li>• Systems and processes in place for upscaling of supply of planting material and breeding stock;</li> <li>• Innovative learning approaches and activities in knowledge transfer and information access to reach rural communities in ADDs developed and applied;</li> <li>• Policy and Strategy papers informing on policy interventions to strengthen and improve scaling of interventions across Result areas and;</li> <li>• Events organised enabling exchange and sharing of insights into lessons learnt from R4D interventions among stakeholders and policy makers;</li> <li>• Stakeholders supported with efficient and affordable analytical services;</li> </ul>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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</li> <li>• 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;</li> </ul>	<ul style="list-style-type: none"> <li>• Communication Strategy</li> <li>• GIS databases and applications</li> <li>• Scientific, technical and general information accessible from on-line platforms and other media platforms;</li> <li>• Internal Information system with on-line databases on research management, Finance, HT and Assets management</li> </ul>
<b>Immediate Outcomes for cross-cutting areas</b>		
<ul style="list-style-type: none"> <li>• Farming households adopt livelihood strategies that enhance their nutritional status and resilience to climate, physical, and biological shocks, stresses and risks</li> <li>• Youth and women influence individual and collective resource management and decision making process at community household and system levels</li> <li>• Stakeholder have increased access to crop and livestock technologies and socioeconomic, technical and scientific information</li> <li>• Farming and agricultural business decision making is based on reliable data, analytical results and proven scientifically sound information and advise;</li> <li>• 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</li> </ul>		

### 3. Strengthening Institutional 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.

*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.*

Key deliverables in the three main strategies addressing the Institute Internal operating environments are summarised in the following tables. More details on the rational and approaches can be found in the full SIP document.

#### 3.1 Managing for Results

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

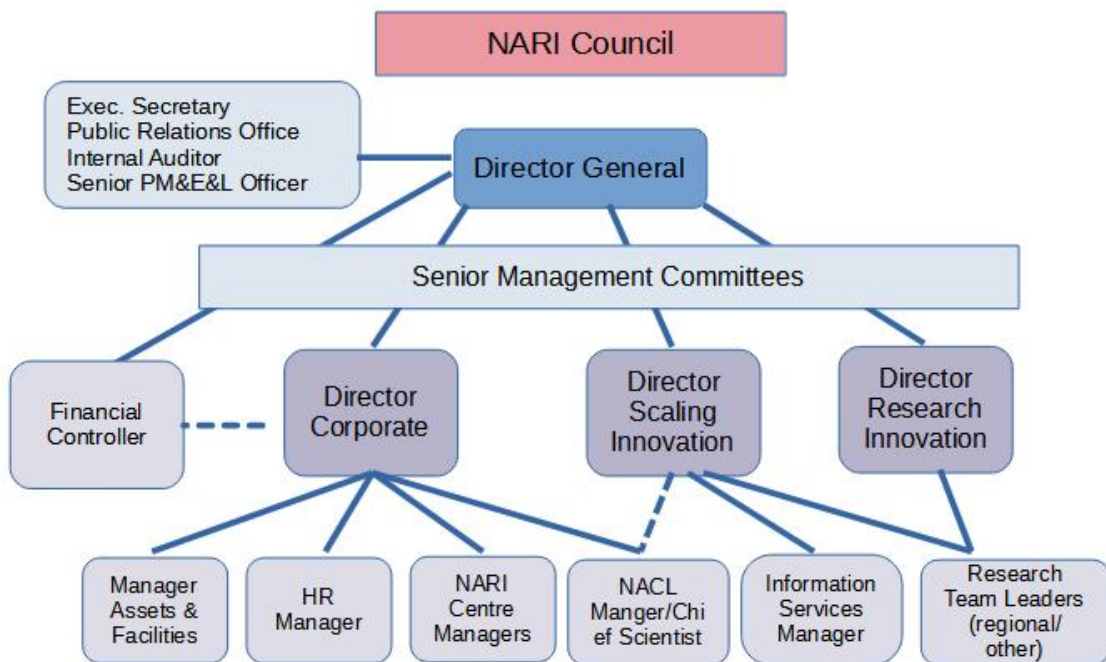
3.2.1 Advocacy and Visibility	3.2.2 Diversifying funding sources	3.2.3 Investing in Human Talents	3.2.4 Financial and material resource management
Avenues for increased level of advocacy and dialogue at policy level created	Business plans for key internal revenue activities completed and implemented	Human Talent Management and Development Strategy (HTMDS) developed	Integrated finance management system in NARI established with online access to reporting and project management information
NARI achievements presented in diverse media and its profile raised	Chemistry laboratory Business plan developed	Performance based Appraisal system operating	Medium-term assets and facility management and development plan developed and annual targets met
	Legal and operational framework for establishment of a NARI Business arm developed	On-line HT Management system operating	Housing estate management policy and strategy developed for NARI establishments
	NARI centre management structure and systems adjusted for improved delivery on assigned functions including revenue generation	Annual targets in HTMDS achieved	Security risk mitigation strategy developed and implemented
	Analysis of national and international practice to support development of a policy for industry funding support to research through levies or other mechanisms.		Infrastructure Development Strategy and Implementation Plan for NARI Centres developed and implemented
	Active engagement with GoPNG and donors result in annual award of diverse research for development grants and funding support		NARI land resources secured with title and ownership ascertained

### 3.3 Governance, Policies, Processes

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.

#### 3.3.1 Organisational Structure

Successful delivery of the SRF II and SIP will require a revision of the organisational management structure taking into account the lesson’s learnt and new requirements to take NARI into the future. A proposed structure at corporate level is shown in Figure 4. 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.



**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 as follows:

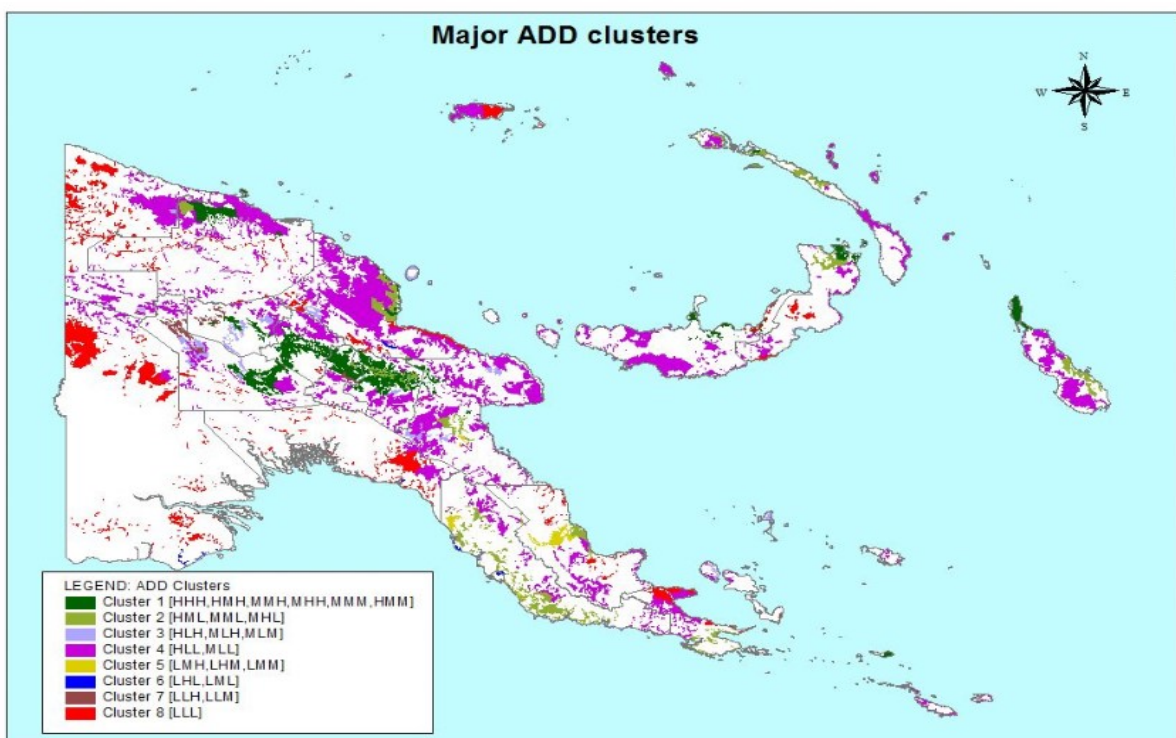
<b>Outputs</b>
Revised Organisational Structure at corporate level and regional centres in place
HT Management policies updated and/or revised
Financial Management and procurement policies and processes updated
ICT management policy developed
Review of the NARI Act

## Annex 1. 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 Table A1 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 1: Summary of major Agricultural Development Domain (ADD) clusters**

ADD Clusters <sup>1</sup>	ADD contained in Clusters	% of total rural population	% of total cultivated land area	Major provinces represented in the ADD <sup>2</sup>
<b>Cluster 1: HHH</b>	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%)
	<b>Sub-total</b>	<b>38.9</b>	<b>9.5</b>	
<b>Cluster 2: HHL</b>	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%)
	<b>Sub-total</b>	<b>6.9</b>	<b>7.1</b>	
<b>Cluster 3: HLH</b>	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%)
	<b>Sub-total</b>	<b>10.3</b>	<b>3.2</b>	
<b>Cluster 4: HLL</b>	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%)
	<b>Sub-total</b>	<b>29.8</b>	<b>43.5</b>	
<b>Cluster 5: LHH</b>	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%)
	<b>Sub-total</b>	<b>2.1</b>	<b>1.0</b>	
<b>Cluster 6: LHL</b>	LHL	0.04	0.05	Central (100%)
	LML	0.3	0.3	Western (43%), Central (38%)
	<b>Sub-total</b>	<b>0.34</b>	<b>0.35</b>	
<b>Cluster 7: LLH</b>	LLH	1.3	0.3	SHP (58%), Simbu (31%)
	LLM	1.8	0.9	SHP (43%), Enga (39%)
	<b>Sub-total</b>	<b>3.1</b>	<b>1.2</b>	
<b>Cluster 8: LLL</b>	LLL	8.5	34.3	Gulf (22%), Western (21%)
	<b>Sub-total</b>	<b>8.5</b>	<b>34.3</b>	
	Total	100	100	

<sup>1</sup> 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/km<sup>2</sup>; moderate: 61 – 100 persons/km<sup>2</sup>; high: 101 – 713 persons/km<sup>2</sup>

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

## Annex 2. Outcome Matrix

Outcome statements	Indicators of Success	Means of Verification	Assumptions
<b>Demonstrated Contribution to Development Outcomes</b>			
Increased incomes and employment in rural areas especially for women and youth	<ul style="list-style-type: none"> <li>• Median per capita rural income increased</li> <li>• Increase in farm income</li> <li>• Increase in on and off-farm employment esp for youth and women</li> </ul>	National statistics, BPNG reports, international databases and information, Income and expenditure surveys, sample survey reports and studies; nutritional surveys; impact assessment reports	Partners, stakeholders, key Government agencies contribute effectively;  Partner agencies and stakeholders appreciate and contribute to the improvement of the smallholder sector;
Enhanced stability and resilience in food production and supply for rural households and communities;	<ul style="list-style-type: none"> <li>• Disaster-related damages and losses in food and agriculture sectors reduced.</li> <li>• Diversification of crops grown on farms increased</li> </ul>		
Production, productivity and efficiency of crop and livestock products increased and producers better linked through efficient value chains to profitable markets at scale	<ul style="list-style-type: none"> <li>• Increase in agricultural GDP attributed to smallholder food production</li> <li>• Increase in factor productivity and resource use efficiency</li> <li>• Increased resource productivity at aggregate level</li> <li>• Composite staple food production index increased</li> <li>• Increased volumes of produce traded in formal markets</li> <li>• CPI Annual Average Food Inflation</li> </ul>		
Rural and urban households consuming healthy balanced and nutritious diets	<ul style="list-style-type: none"> <li>• Ave. food protein consumption (g/kg body weight/day) increased</li> <li>• Amount of protein in diet supplied from domestic animal (including fish) sources increased</li> <li>• Household dietary diversity score improved</li> </ul>		
Improved standards in Food and Feed safety in agricultural production and food/feed use are applied	<ul style="list-style-type: none"> <li>• Improved adherence to food safety standards</li> <li>• Food related health issues reduced</li> <li>• Increased number of producers supply formal markets</li> <li>• Number of food/feed processors supplying formal markets increased</li> </ul>		
Enhanced and equitable benefits from agri-ecosystem goods and services	<ul style="list-style-type: none"> <li>• Increased benefits including non-monetary returns from use of natural resources</li> </ul>		

<b>Outcome statements</b>	<b>Indicators of Success</b>	<b>Means of Verification</b>	<b>Assumptions</b>
Agricultural production systems are sustainably managed under changing climates	<ul style="list-style-type: none"> <li>Improved agricultural environment parameters</li> </ul>		
<b>Priority 1 Value chains, Markets and Trade</b>			
Increased economic returns to value chain actors from production, sale and added value of crop and livestock products;	<ul style="list-style-type: none"> <li>Net returns increased for value chain actors</li> <li>Increased shares of profits directly going to women and youth</li> </ul>	Income and Expenditure surveys, Health and Nutrition Surveys, other surveys and Impact Assessment reports; GoPNG statistics and information; other M&E reports	AR4D capacity available in the wider NARS and appreciation of the role of NARI and roles of other partners  positive response by farmers/stakeholders in up-taking technologies  Community support and participation in technology development, piloting and scaling  Appropriate funding support by donors, GoPNG, private sector  Other external factors are congenial for adoption
Increased equity, inclusion and participation of women and youth in priority value chains	<ul style="list-style-type: none"> <li>Increased shares of women and youth in on and off-farm activities</li> </ul>		
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;	<ul style="list-style-type: none"> <li>Number of newly established micro-and small businesses established and operating</li> </ul>		
Market accessions for export of PNG's agricultural products that promote local content of market share;	<ul style="list-style-type: none"> <li>Increased volumes of exports of agricultural raw and processed products produced in PNG</li> </ul>		
An efficient institutional and policy environment that promotes productivity, food safety standards, and maintains an efficient value chain in all market levels;	<ul style="list-style-type: none"> <li>Availability of relevant policies responsive to sector needs;</li> <li>Food safety standards available and applied;</li> <li>Improved market options and standards of facilities</li> </ul>		
Increased localisation and import-substitution of target crops and livestock by locally based industries;	<ul style="list-style-type: none"> <li>Reduced import volumes of target crops and livestock</li> </ul>		
Alternative agricultural export opportunities from crop, livestock, aquaculture and non-food products realised and reflected in the national agricultural development agenda;	<ul style="list-style-type: none"> <li>Increased number and type of agricultural export products realised</li> </ul>		
<b>Priority 2 Resilient Systems</b>			

Outcome statements	Indicators of Success	Means of Verification	Assumptions
Diverse and sustainable agri-food systems at scale are established and maintained and reflected in the national agricultural development agenda.	<ul style="list-style-type: none"> <li>● Increased productivity of targeted production systems per unit of limiting resource</li> <li>● Increased quality of crop and livestock products</li> <li>● GoPNG responds with development and improvement of GR policies</li> </ul>	Income and Expenditure surveys, Health and Nutrition Surveys, other surveys and Impact Assessment reports; GoPNG statistics and information; other M&E reports	AR4D capacity available in the wider NARS and appreciation of the role of NARI and roles of other partners
Farming households adopt livelihood strategies that enhance their nutritional status and resilience to climate, physical, and biological shocks, stresses and risks	<ul style="list-style-type: none"> <li>● Consistent supply of food at household level throughout the year</li> <li>● Share of rural population vulnerable to climate change associated risks reduced</li> <li>● Increased number of farmers with consistent income sources</li> </ul>		positive response by farmers/stakeholders in up-taking technologies
Equitable access by stakeholders to gender-sensitive crop and livestock technologies and up-to-date socioeconomic, technical and scientific information	<ul style="list-style-type: none"> <li>● Relevant technologies and information matching needs of different stakeholders generated</li> <li>● Diverse access mechanisms operating across the country</li> </ul>		Community support and participation in technology development, piloting and scaling
More productive and equitable management of natural resources and agri-ecosystems	<ul style="list-style-type: none"> <li>● Increased gender equality in access to resources and decision making;</li> <li>● improved environmental health parameters for agri-ecosystems</li> </ul>		Appropriate funding support by donors, GoPNG, private sector
<b>Priority 3: Healthy and nutritious diets</b>			
Increased availability of and access to diverse nutrient-rich foods	<ul style="list-style-type: none"> <li>● Increased volumes of nutrient dense food traded in markets;</li> <li>● release of nutrient dense crop varieties and food products to producers and consumers;</li> <li>● households maintain diversity in food crops and livestock holdings</li> <li>●</li> </ul>	Income and Expenditure surveys, Health and Nutrition Surveys, other surveys and Impact Assessment reports; GoPNG statistics and information; other M&E reports	AR4D capacity available in the wider NARS and appreciation of the role of NARI and roles of other partners
Partnerships operating to promote implementation of agriculture for nutrition and health strategies for agri-food value chain/food system innovations and interventions at scale.	<ul style="list-style-type: none"> <li>● Increased number of multi-partner nutrition-specific programs</li> </ul>		positive response by farmers/stakeholders in up-taking technologies
			Community support and participation in technology development, piloting and



Outcome statements	Indicators of Success	Means of Verification	Assumptions
Evidence-based nutrition-sensitive policies are designed accompanied by effective implementation strategies;	<ul style="list-style-type: none"> <li>• Information on outcomes of nutrition specific interventions generated;</li> <li>• increased policy dialogue across sectors and stakeholders;</li> <li>• increased funding for nutrition specific interventions in the agriculture sector</li> </ul>		scaling  Appropriate funding support by donors, GoPNG, private sector  Other external factors are congenial for adoption
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	<ul style="list-style-type: none"> <li>• Composition of diets and daily intake of major food groups and micro-nutrients in households</li> </ul>		
<b>Setting the Institute up for delivery</b>			
High visibility of the Institute's progress and achievements	<ul style="list-style-type: none"> <li>• Annual reports furnished in timely manner</li> <li>• Diverse visibility actions (press-releases, media article, shows and exhibitions, presentations etc) implemented</li> <li>• NARI represented in diverse fora</li> </ul>	Annual and M&E reports; Reports to donors and GoPNG; publicity materials and media articles;	GoPNG and donors are responsive to the resourcing needs in NARI and the sector  Required staff competencies are available in the open marketed
Improved institutional arrangements, policies and increased investment in the agriculture sector	<ul style="list-style-type: none"> <li>• Agricultural development policies informed by facts and figures</li> <li>• Increased scale of adoption of improved agr. Technologies</li> <li>• Increased formation of formal and ad hoc partnerships and networks between AR4D system actors</li> </ul>		
AR4D agenda is resourced with adequate resources (expertise, financial and material resources);	<ul style="list-style-type: none"> <li>• Efficient use of HT across NARI locations implemented;</li> <li>• Diversity in sourcing of expertise for delivery of AR4D agenda</li> <li>• Diversity in revenue sources</li> <li>• Improved use of NARI assets and resources</li> </ul>		

Outcome statements	Indicators of Success	Means of Verification	Assumptions
An enabling internal value-based institutional policy environment created and maintained.	<ul style="list-style-type: none"> <li>improved decision using inclusive and equitable management mechanisms</li> <li>Institute policies are up-to-date and comply with public service and common law</li> </ul>		

#### 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
<b>Priority 1 Economic Development and Value Chains</b>			
<b>Result Area 2. Foresighting and Advocacy</b>			
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>Output 1: Investment Strategies</i> Investment strategies for agricultural transformation assessed and advocated	<ul style="list-style-type: none"> <li>Investment in agriculture and AR4D increased by GoPNG, donor agencies, private companies;</li> <li>Increased rates of return on investment in AR4D from better targeting and decision making</li> </ul>	Budget allocations to AR4D institutions from GoPNG and Donors; ASTI reports	Interest and commitment by AR4D organisations to enhance collaboration;
<i>Output 2: Economic opportunities</i> Economic feasibility of fresh, processed and non-food agricultural production at different scales assessed and advocated	<ul style="list-style-type: none"> <li>Investment in agriculture and AR4D increased by GoPNG, donor agencies, private companies;</li> <li>Policy and institutional reforms draw on information from policy briefs and databases to revise strategies and policies in agriculture based economic development</li> </ul>	Budget papers by GoPNG and donor strategies for agriculture sector; National policies and strategies	supporting national policy environment
<b>Result Area 2. Value Chain Support</b>			
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>Output 1: Value chain innovations</i> Innovations addressing key bottlenecks in sweetpotato, potato and banana are used along the value chain	<ul style="list-style-type: none"> <li>Knowledge on improved practices in production and post harvest management in sweetpotato, potato, banana value chains used by value chain actors in target areas;</li> <li>Increased farm productivity and consistency in the supply of targeted produce;</li> </ul>	Stakeholder survey reports; Annual Reports, M&E reports;	Adequately resources partners available and committed to support jointly agreed work programs

	<ul style="list-style-type: none"> <li>• Establishment of appropriate farm business/enterprise models in targeted value chains emerging;</li> <li>• Increased use of market information by participating commercial farmers and aggregators</li> </ul>		
<p><i>Output 2: Galip value chain</i> Improved knowledge on current key bottlenecks in production, processing and marketing in the Galip value chain</p>	<ul style="list-style-type: none"> <li>• Increased volumes for Galip nut processed by current processors and sold in retail outlets in PNG;</li> <li>• Increased establishment of Galip plantations or inter-cropping;</li> <li>• Increased confidence and investment by GoPNG and private sector in Galip AR4D, production, processing and marketing;</li> </ul>	Stakeholder survey reports; Records from the NARI factory; Annual Reports; Budget allocations	On-going commitment of current partnerships in implementation of work programs
<p><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)</p>	<ul style="list-style-type: none"> <li>• Production of pig and pork products in target provinces showing incremental increases over time;</li> <li>• Improved access to productive breeding stock;</li> <li>• Health of pig herds and hygiene of production environment in target piggeries improved;</li> <li>• Improved knowledge on value chain actors on cost effective production, processing and marketing of pigs and pork products</li> </ul>	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
<b>Priority 2. Resilient Systems</b>			
<b>Result Area 3. Household resilience</b>			
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			
<p>Output 1: Climate smart solutions Climate smart technologies and strategies targeting gaps in household resilience to climate change induced stresses and other shocks in diverse agro-ecologies and food systems made available and used by target communities</p>	<ul style="list-style-type: none"> <li>• CSA products and approaches promoted are integrated into ADD production systems at scale;</li> <li>• Responsive networks and partnership models for community support operating</li> </ul>	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
<p>Output 2: Disaster response Support in disaster preparedness and rehabilitation provided in timely manner within mandated areas</p>	<ul style="list-style-type: none"> <li>• Timely response and contribution to agricultural disaster rehabilitation;</li> <li>• Improved forecasting and preparation for severe</li> </ul>	Stakeholder surveys; Project and Annual M&E reports;	Relevant GoPNG bodies at national and provincial level provide required leadership

	<ul style="list-style-type: none"> <li>El Nino and La Nina events;</li> <li>Responsive networks and partnership models for community support operating</li> </ul>		
<b>Result Area 4. Agro-ecosystem resilience</b> 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"> <li>Research and technical publications on GHG status available to stakeholders from NARI</li> </ul>	Annual M&E reports	Relevant expertise can be sourced in-country
<b>Result Area 5. Biosecurity</b> 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 livestock developed	<ul style="list-style-type: none"> <li>Increased use of pest and disease management strategies in targeted crops and production systems;</li> <li>Increase in production and quality of agricultural (fresh and processed) products</li> </ul>	Survey of targeted agricultural production systems, markets;	Relevant expertise available
<i>Output 2: Biosecurity preparedness</i> Preparedness for responding to biosecurity threats improved	<ul style="list-style-type: none"> <li>P&amp;D threats diagnosed in-country in timely manner to initiate response strategies</li> <li>All stakeholders respond to incursion of biosecurity threats as per incursion management plans</li> </ul>	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
<b>Result Area 6 Genetic Resources</b> 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"> <li>Communities in four districts (Menyama, Teptep, Usurufa, Rigo) apply strategies to maintain and conserve sweetpotato biodiversity</li> <li>Research and development in plant genetic resources is strengthened in PNG;</li> <li>Diversity of GR in ex situ, in vitro and in situ collections maintained and safe-guarded for the future</li> </ul>	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 so-	<ul style="list-style-type: none"> <li>New and improved crop varieties and livestock breeds released to stakeholders;</li> <li>Quality Foundation material supplied to stake-</li> </ul>	Annual M&E reports;	

cial, economic and ecological conditions	holders in adequate numbers; • Access to NARI crop varieties and breeding stock in all provinces in PNG;		
<b>Priority 3. Nutritious Food and Healthy Diets</b>			
<b>Result Area 7. Safe and nutritious Food</b> 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 livestock	<ul style="list-style-type: none"> <li>Increased small livestock production and consumption in selected communities in Momase region compared to baseline;</li> <li>increased diversity in diets in target communities from production of greater diversity of food crops;</li> </ul>	Stakeholder surveys; Project and Annual M&E reports;	Other sector agencies contribute and collaborate in interventions and activities;  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"> <li>Information packages produced</li> <li>Information packages disseminated to diverse group of stakeholders</li> </ul>	Annual M&E reports	
<b>Cross-cutting - Scaling:</b> 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"> <li>Recommendations made on successful approaches in scaling of research outputs;</li> <li>NARI information, technologies and services reach greater number of stakeholders compared to baseline</li> </ul>	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
<b>Cross-cutting – Gender, Youth and Social Inclusion:</b> 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"> <li>High level of participation of women, youth (male and female) and/or other socially disadvantaged groups</li> <li>interventions targeting socially disadvantaged groups incorporated in the portfolio of projects and activities</li> </ul>	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
<b>Cross-cutting – Communication for Change:</b> Communication innovations effectively support delivery of research outcomes	<ul style="list-style-type: none"> <li>Diverse portfolio of communication tools used to reach stakeholders;</li> <li>Stakeholders have knowledge of and use of NARI communication tools;</li> </ul>	Annual M&E reports; period M&E evaluation reports	



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

1. any branch of biological, physical and natural sciences related to agriculture;
2. cultural and socio-economic aspects of the agricultural sector, especially of the smallholder agriculture; and
3. 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

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### **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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