NATIONAL AGRICULTURAL RESEARCH INSTITUTE

# Development of Strategic Priorities in Agricultural Research for Development

**Corporate Technical Report**

**November 2012**

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

i) any branch of biological, physical and natural sciences related to agriculture;
ii) cultural and socioeconomic aspects of the agricultural sector, especially of the smallhold er agriculture; and
iii) matters relating to rural development and of relevance to Papua New Guinea.

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

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

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

NARI Logo

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

# Development of Strategic Priorities in Agricultural Research for Development

**Komolong, B., Maro, J., Ryan, J. and Ghodake, R**

**Corporate Technical Report**

**November 2012**

**Correct Citation:** Komolong, B., Maro, J., Ryan, J., and Ghodake, R. 2012. Development of Strategic Prioritites in Agricultural Research for Development. NARI Corporate Technical Report. National Agricultural Research Institute, Lae, Papua New Guinea.

ISBN: 9980-932-77-5


For any further information, please contact the Planning, Monitoring and Evaluation Unit at the Head Office, Sir Alkan Tololo Research Centre, P.O. Box 4415, LAE 411, Morobe Province, Papua New Guinea.

Phone: 675-475 1444
Fax: 675-475 1450
Email: naripng@nari.org.pg

Website: http://www.nari.org.pg

# Table of Contents

## List of Figures



## List of Tables

# Foreword

Agriculture is the main source of livelihood for the vast majority of people in Papua New Guinea but its potential is yet to be fully harnessed and used to improve the overall welfare of its people. The PNG National Agricultural Research Institute (NARI) has recognized the need to improve on the Institute's effectiveness in better serving its major clients, the smallholder farming and rural communities, given the current stagnant and often backward trends of development among rural communities.

NARI adopted Agriculture Research for Development (AR4D) as its guiding paradigm to help improve on the effectiveness of agricultural research in contributing to development. This required a refocussing of its planning and implementation approaches and strategies in research for development to be able to accommodate the often complex interactions of a range of different actors/stakeholders along development pathways within and outside the agriculture sector to achieve desired impacts.

An important requirement was the development of approaches to derive strategic priorities that are linked to addressing constraints and opportunities to agricultural development among different smallholder farming communities in their diverse natural, socio-economic and cultural environment. This report is a summary of work that was conducted within NARI from June 2008 to March 2011 as part of a comprehensive Strategic Planning Process. Most of the managerial and scientific staff of NARI as well as other collaborators and partners were involved in the process one way or the other and their contributions are gratefully acknowledged.

This work was pioneered by the NARI Strategic Planning Taskforce under the leadership of Dr Birte Komolong with the core team comprising of Drs A. Ramakrishna, K. Kshirsagar, S. Bang, P. Kohun and N. Omot and Messrs E. Dowa, J. Ryan and J. Maro. The taskforce did the groundwork in the conceptualization of the Agricultural Development Domains and application of this approach in the PNG context.

The NARI Strategic Planning Process was supported through funding from the AusAID Agricultural Research and Development Support Facility (ARDSF), Component 1. We thank Dr Adiel Mbabu of ARDSF for his invaluable strategic guidance and support to this work and the changes happening in NARI and to his colleagues from the ARDSF secretariat for their support and contributions in the strategic planning process. This support also enabled NARI to engage international experts in Agricultural Research for Development Planning, Drs Z. Franca and S. Sibanda to build capacity and facilitate results-based Strategic and Programme Planning in NARI.

# Executive Summary

In order to improve the service delivery to its clients, the PNG National Agricultural Research Institute (NARI) embarked on a major exercise to re-focus and transform the organisation under the Agricultural Research for Development paradigm (AR4D) to develop and implement more effective research portfolios that will result in greater impacts at the farm household level as envisioned in its institutional goal and objective.

A key prerequisite for greater effectiveness is the need in the Institute to identify strategic priorities of investment in AR4D. The results of this strategic planning process are documented in the NARI Strategy and Results Framework (SRF): 2011-2020. This paper is intended to accompany the NARI SRF as a background paper. It provides background information on the current status of the smallholder sector, information on key concepts used in the strategic planning process and describes the approaches used to define the smallholder environment and how NARI used this information to derive AR4D strategies that are deemed responsive to smallholder farming communities.

## AR4D as conceptual basis for developing strategies

NARI adopted the AR4D paradigm as the over-arching approach for guiding its research planning and implementation processes. AR4D is an emerging paradigm embedded within the agricultural innovations system that is gaining momentum globally such as its application in the CGIAR reform process. In contrast to the linear model of 'generation, transfer and adoption of technology', AR4D recognizing the fact that development challenges in rural areas are increasingly complex, and cannot be resolved by individuals, or institutions acting alone. It requires integrated and collective actions of all stakeholders to improve institutions, policies and technologies involved in production, processing and marketing.

## Understanding the overall development context

PNG is an agriculture-based country as defined by the relatively high share of agriculture in the GDP of >30%. The majority of its population (>80%) earn their livelihoods in rural areas and depend on agriculture supported by fisheries and forestry for their food, income and monetary and non-monetary employment. Agricultural systems are highly diverse and closely adapted to the wide range of agro-ecological environments.

Despite its rich resources, the current economic and social situation of the country is in dire need of improvement. The country's development status ranks low in most MDG indicators. In terms of the Human Development Index PNG is placed 153 in the world and last among the Pacific Island countries. An assessment of the status of welfare of rural communities using the indicators of food security, income generation, employment and environmental sustainability showed that there are ongoing threats to food and nutritional security given the increasing population and the declining trend in the per capita agricultural production as exacerbated through the increasing occurrence of natural disasters and threats from adverse and unpredictable impacts of global Climate Change. In terms of income generation through agriculture, poverty remains overwhelmingly rural with more than 40% of the population live under the international poverty line of US$1/day. Rural employment is characterized by low productivity, underemployment and low wages and there are predictions that due to the LNG project, the rural skilled and unskilled employment levels in the short run will decline by 12 and 24%, respectively. The high increase of the population over the past 40 years is putting increasing pressure on existing agricultural systems and natural resources with increasing evidence that soil productivity is declining.

Overall, economic activity in the rural sector over the past 30 years has shown little improvement.

Contribution of agriculture to the GDP has not changed much in this period with low levels of technical efficiency and low total factor productivity in agricultural production.

The current situation of rural communities is clearly linked to the poor performance of the agriculture sector over the decades. Current and past national development plans and agricultural development objectives do recognize the importance of increasing agricultural productivity and production in addressing food and nutritional security, income generation, rural employment and environmental sustainability. While the relevance of these broad agricultural development objectives is undisputed, the poor performance in the past highlights the need for reforms in how to approach agricultural development.

## Deriving strategic AR4D priorities for NARI

The major challenge for NARI as part of the strategic planning process was to identify AR4D strategies that are linked to addressing constraints and opportunities in agricultural development of different smallholder farming communities in their diverse natural, socio-economic and cultural environment. This would then allow development of programme and project portfolios along the research to development impact pathway taking into account NARI's complex national mandate of serving the smallholder agriculture sector.

## Defining the smallholder farming environment

In order to specify the smallholder environment NARI used a methodology based on spatial analysis using GIS methods. The methodology disaggregates the country into geographical units or Agricultural Development Domains (ADD) that are based on a single set of domain criteria applied consistently across a region. The criteria uses three major considerations, viz. agricultural potential (indication of absolute advantage in agricultural production) of an area, market access and population density as socioeconomic factors representing the comparative advantage specific to a certain geographic location (i.e. the extent to what the agricultural potential is realized) of communities in such domains. The methodology and process in constructing those domains ADDs represent areas where similar agricultural development problems or opportunities are likely to occur. Application of the ADD approach for PNG using available GIS databases (PNGRIS and MASP) resulted in a total of 23 domains that were further collapsed into eight clusters and described on the basis of major constraints and opportunities in relation to agricultural and related socioeconomic development.

## NARI AR4D strategies

Using the strategic objectives of the four NARI programmes (Agricultural Systems, Enabling Environment, Information and Knowledge, Institutional Management and Development) as a basis for the detailed constraints and opportunity analysis for each of the ADD clusters, information derived was used to develop a list of prioritized strategies or 'Project Areas' (PA) for each of the programmes. A prioritization process was then to be applied to identify the priority PAs that the Institute should focus on in the medium-term future. Major criteria for prioritization included direct or indirect linkages to the impact pathway to the Institutes Goal and Strategic objective, consideration of the human and physical environment and contribution to issues of national importance, impact (potential benefits, adoption likelihood) and feasibility (scientific potential, research capacity).

## Conclusion

The work reported in this paper describes an innovative approach to derive AR4D strategies that are clearly linked to current needs of farming communities in Papua New Guinea and are recognizing the diversity of their biophysical and socio-economic environment. Application of the ADD approach enabled NARI to incorporate smallholder needs and aspirations at a strategic level, linking them to the Institute goal and strategic objective and making them the purpose to where discipline and commodity based research would contribute to.

# 1. Introduction

Agricultural research and development organizations play a pivotal role in generating new knowledge and providing improved technologies and services that support innovations in farming communities. The PNG National Agricultural Research Institute (NARI), together with other PNG agricultural R&D organisations has been participating in the Agricultural Research and Development Support Facility (ARDSF), an initiative by the PNG and Australian Governments, funded by the Australian Aid for International Development (AusAID) to build capacity in the PNG agricultural R&D sector for better service delivery to its clients. This initiative was taken to address some of the major constraints contributing to the poor performance of agricultural R&D in the country:

- Research agendas that are not responding to farmer's needs (technology driven focus only)
- Obstructive intra- and inter-organizational boundaries (or inadequate linkages, partnerships and coordination within and between organizations, private sector, NGOs, farming communities and others)
- Lack of inter-, or multi-disciplinarity in R&D (especially neglect of socio-economic and socio-cultural aspects)
- Weak monitoring, evaluation and performance cultures (including lack of institutionalized organizational learning)
- Insufficient resourcing in terms of finances and quality human capacity of agricultural R&D

In order to address those issues NARI embarked on a major exercise to re-focus and transform the organisation under the Agricultural Research for Development paradigm (AR4D) (Mbabu and Ochieng 2006, Hawkins et al. 2009, ICRA 2010) to develop and implement more effective research portfolios that will result in greater impacts at the farm household level as envisioned in its institutional goal and objective.

A key prerequisite for greater effectiveness is the need to identify strategic priorities of investment in AR4D for the Institute that are applicable nationwide but still take into consideration the diverse nature of smallholder communities in the country. This requires a holistic consideration and understanding of the overall development context including the biophysical as well as the socio-economic environment in order to address the constraints and opportunities as experienced by smallholder communities in relation to agricultural productivity and development.

NARI invested considerable resources into this strategic planning process making use of or adapting relevant concepts and methodologies available in the global pool of knowledge on AR4D and agricultural development planning. The results of this strategic planning process were used to set the AR4D agenda of NARI for the coming 10 years which is documented in the NARI Strategy and Results Framework (SRF): 2011-2020.

This paper is intended to accompany the NARI SRF as a background paper. It introduces the AR4D as the conceptual basis for the strategic planning and provides a more detailed analysis of the macro-economic situation in relation to important indicators of welfare including food and nutritional security, rural income and employment and environmental sustainability and trends of agricultural productivity and production over the past 20-30 years. Emerging development challenges are then linked to the current national agricultural development objectives that guide NARI's AR4D agenda. The last part of this report describes the approaches used to define the smallholder environment and how NARI used this information to derive AR4D strategies that are deemed responsive to smallholder farming communities in their diverse environment and effectively contribute to the achievement of the institutional and national agricultural development objectives.

## 2. AR4D as conceptual basis for developing strategies

NARI adopted the Agriculture Research for Development (AR4D) paradigm as the overarching approach for guiding its research planning and implementation processes. AR4D is an emerging paradigm embedded within the agricultural innovations system framework (Mbabu and Ochieng 2006, Rajalahti et al. 2008, Anandajayasekeram and Gebremedhin 2009) that is gaining momentum globally such as its application in the CGIAR reform process. Agriculture has been rediscovered as a multidimensional instrument for development especially in the context of globalization of food systems and emerging integrated food value chains, increasing resource scarcity and climate change and the need for environmental services (de Janvry 2010). While the importance of agricultural research based on science and technology, knowledge creation and dissemination for development is undisputed, there is a growing sense that 'business as usual' in agricultural R&D, i.e. the linear model of 'generation, transfer and adoption of technology' is not achieving the desirable results in catalysing agricultural change to impact on the lives of smallholder farming households. In AR4D agricultural research is only one of the components of the development process (Figure 1) recognizing the fact that development challenges in rural areas are increasingly complex, and cannot be resolved by individuals, or institutions acting alone. It requires integrated and collective actions of all stakeholders to improve institutions, policies and technologies involved in production and marketing. Figure 1 depicts AR4D as part of a wider system where a variety of outcomes from different sectors need to be generated in order to improve people's livelihoods.

AR4D involves a set of participatory processes that result in collective action at different levels to achieve rural development. To achieve the desired outcomes, practical application of AR4D will also require changes of personal skills, mindsets and attitudes, organizational practices and culture and the way in which organizations interact. In short, it requires a paradigm shift, a change of mentality, a different way of looking at the world (Mbabu and Ochieng 2006, Hawkins et al. 2009, ICRA 2010).

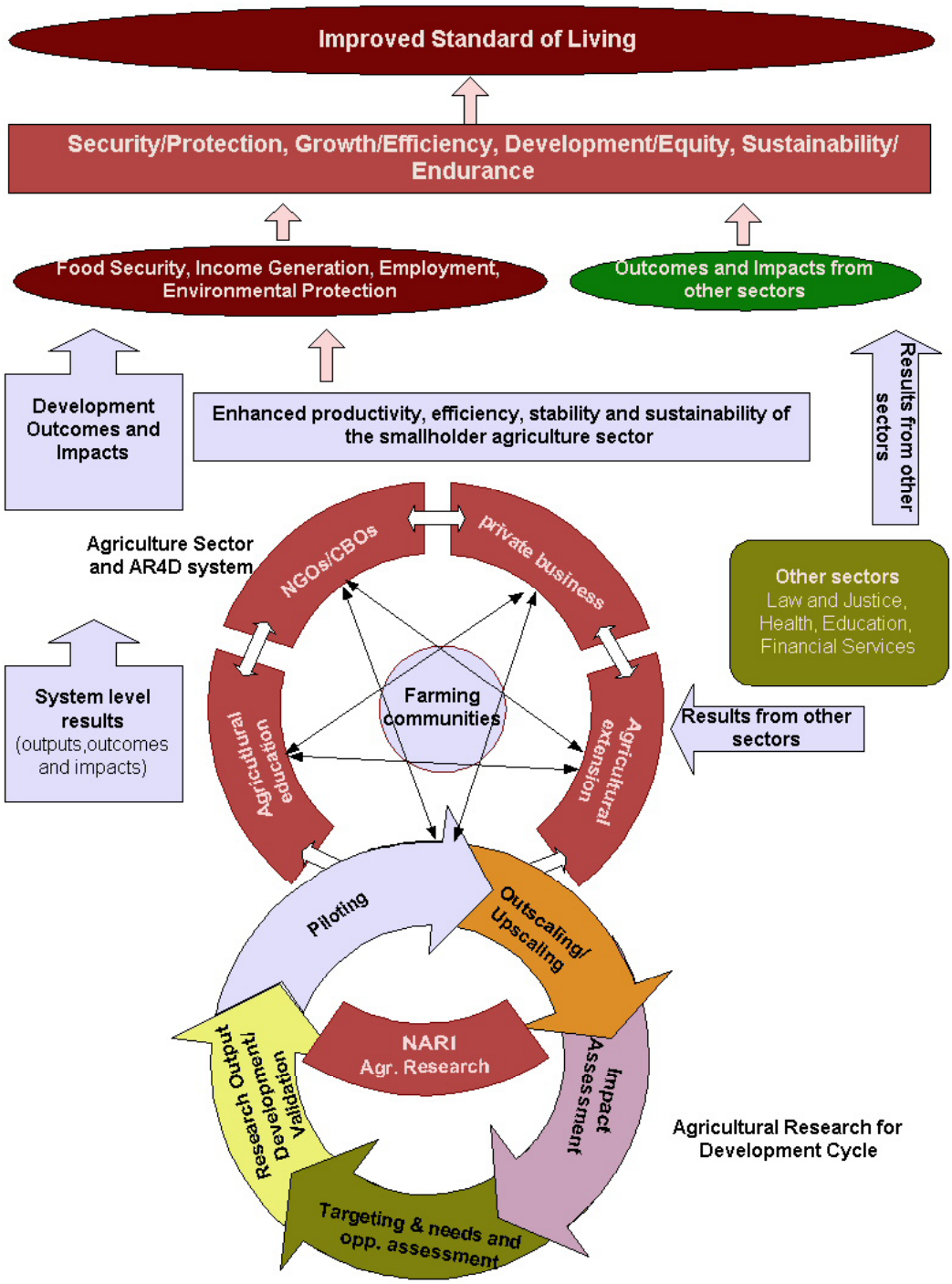



**Figure 1. AR4D linkages and development pathways**

## 3. Understanding the overall development context

In the first part of this section we examine the current situation in the country with a focus on the agriculture sector given the importance of agriculture in the lives of people. This will include a brief macroeconomic overview and the status of welfare of rural communities using indicators such as food security, income, employment and environmental sustainability as well as trends in agricultural productivity and production in the country in the past 20-30 years. The second part of this section shows how national agricultural development objectives respond to those agricultural development challenges.

### 3.1 Macro-economic overview with focus on agriculture

PNG is a country rich in resources such as minerals, oil, gas, timber, marine life and a great diversity in fauna and flora. It is an agriculture-based country as categorized by the World Bank (2007) based on the relatively high share of agriculture (of >30% ) in the GDP (Figure 2).

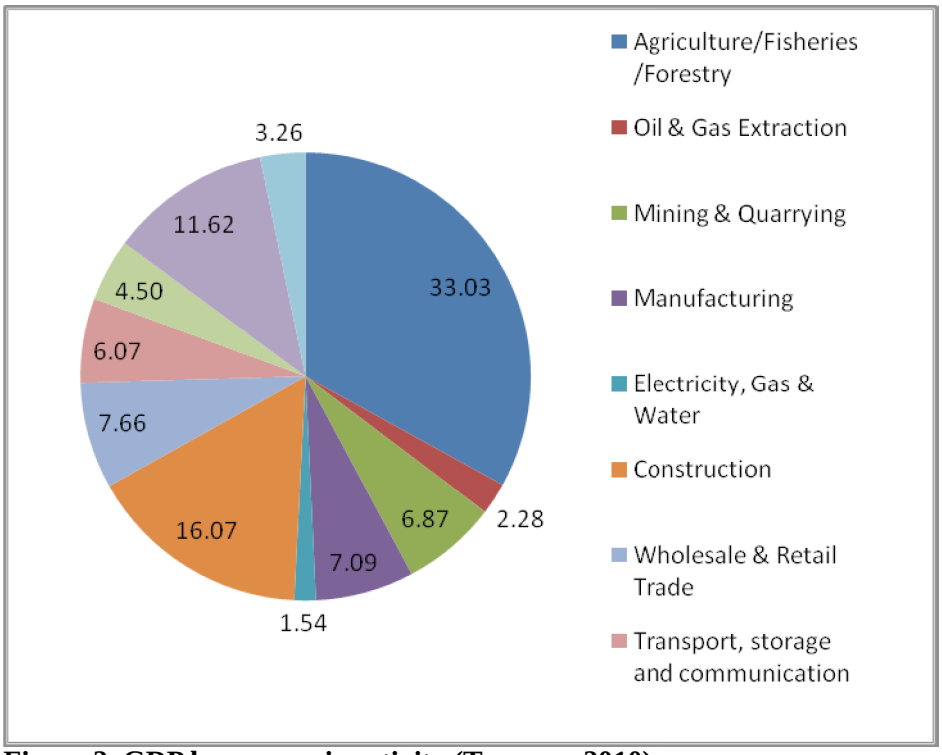



**Figure 2. GDP by economic activity (Treasury 2010)**

The majority of its population (>80%) earn their livelihoods in rural areas and depend on agriculture supported by fisheries and forestry for their food, income and monetary and non-monetary employment and will do so many more years to come. More than 90% of rural people are semi-subsistence smallholder farmers who produce food and cash crops for their own consumption and barter (subsistence) or sell their produce. A small percentage engages in fully commercial activities. On the other end of the spectrum are considered true subsistence farmers, mostly in isolated areas in the country. Agricultural systems are highly diverse and closely adapted to the wide range of agro-ecological zones. Despite the countries rich resources, the current economic and social situation of the country is in dire need of improvement. The countries development status ranks low in most MDG indicators (Table 1) and in terms of the Human Development Index, the country is still lagging much behind other countries in the region. PNG is placed 153 in the world (UNDP 2011) and last among the Pacific Island countries (Table 2).

**Table 1. Selected Demographic and MDG indicators**

| | |
|---|---|
| Total population [1] | 6.9 Million |
| Rural population | 6.0 Mil (87%) |
| Urban population | 0.9 Mil (13%) |
| Average Population density per km$^2$ | 15 |
| Average population growth rate | 2.7% |
| Share of population below 15 years | 37.6% |
| Poverty rate[2] | >40% |
| Live expectancy at birth[3] | 61.6 |
| Infant mortality rate (per 1,000 live births)[3] | 58 |
| Under 5 mortality rate (per 1,000 live births)[3] | 74 |
| Maternal mortality ratio (per 100,000 live births)[3] | 733 |
| Adult HIV/AIDS prevalence rate | 1.28% |
| Average adult literacy rate (male, female)[4] | 59.1% (63.6%, 55.6%) |
| Mean years of schooling[4] | 4.3 years |

*[1]projected number mid 2011 based on 2000 national census (SPC 2011); [2]Based on the international poverty line of US$1/day, World Bank (2004) [3]NSO (2009); [4]UNDP (2011)*

**Table 2. Pacific Island Countries Human Development Indicators**

| | 1998 | | 2011 | |
|---|---|---|---|---|
| **Country** | **Index** | **Rank** | **Index** | **Rank** |
| Cook Islands | 0.822 | 2 | 0.837 | 1 |
| Palau | 0.861 | 1 | 0.816 | 2 |
| Niue | 0.774 | 3 | 0.823 | 3 |
| Samoa | 0.590 | 7 | 0.770 | 4 |
| Tonga | 0.647 | 6 | 0.745 | 5 |
| Fiji Islands | 0.667 | 4 | 0.726 | 6 |
| FSM | 0.569 | 9 | 0.724 | 7 |
| Marshal Islands | 0.563 | 10 | 0.716 | 8 |
| Tuvalu | 0.583 | 8 | 0.700 | 9 |
| Nauru | 0.663 | 5 | 0.647 | 10 |
| Vanuatu | 0.425 | 12 | 0.648 | 11 |
| Kiribati | 0.515 | 11 | 0.606 | 12 |
| Solomon Islands | 0.371 | 13 | 0.587 | 13 |
| Papua New Guinea | 0.314 | 14 | 0.444 | 14 |

*Source: SPC/UNDP Regional Human Development Indicators Database*

More detailed information on the macro-economic situation of the country can be found in various publications, reports and articles (ADB 2004, NZIER 2006, AusAID 2007, UNDP 2008, Batten et al. 2009, NSPTF 2009, Treasury 2010, UNDP 2011)

### 3.1.1 Food and nutritional security

Food (and nutritional) security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life (FAO 1996). This concept includes food availability, food access, utilization of food and stability (of food availability and access) (FAO 2006). In PNG, domestic subsistence food production is the most important source of food.

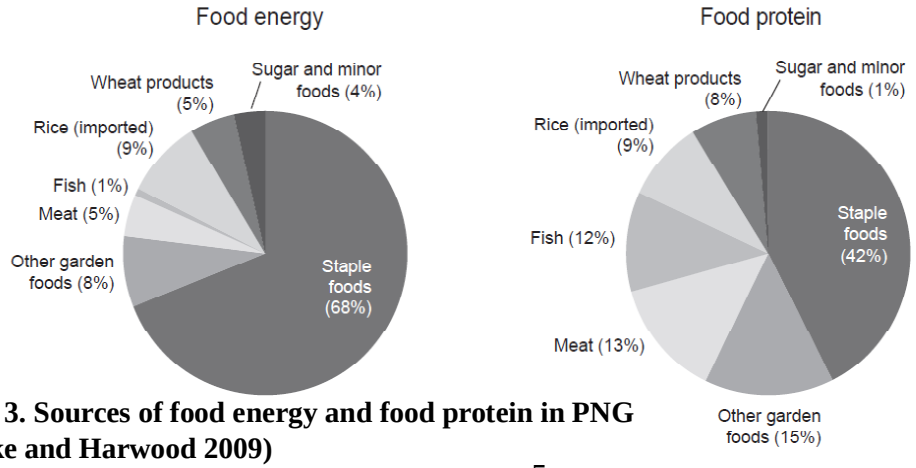



**Figure 3. Sources of food energy and food protein in PNG (Bourke and Harwood 2009)**

In terms of self-sufficiency, at a national level the country is considered to be among the group of least vulnerable countries in the Pacific since only 17% of food energy (mostly rice and wheat-based foods) and 24% of food protein are imported and the country has a very low Food Import Capability Index[1] as an indicator for its ability to pay for the food imports (McGregor et al. 2009).

However, at the household level food security is not assured. A study based on FAO statistics showed that while crop and livestock production outputs increased steadily, the per capita agricultural production index showed a declining trend (Figure 4), indicating potential risks to overall food security in the country (FAO 2003, Reddy 2007). Already, 27% of the population is undernourished and an even larger percentage is malnourished (in particular protein and micronutrient deficiencies such as Iodine, Vitamin A and Anemia/Iron) especially among children and women (FAO 2003, PNG Department of Health et al. 2006). Also, there are large differences between regions, within provinces and even districts.

Periodic food shortages regularly occur towards the end of the dry season and the situation is exacerbated through the increasing occurrence of natural disasters such as prolonged drought, floods, cyclones and threats from adverse and unpredictable impacts of global climate change.

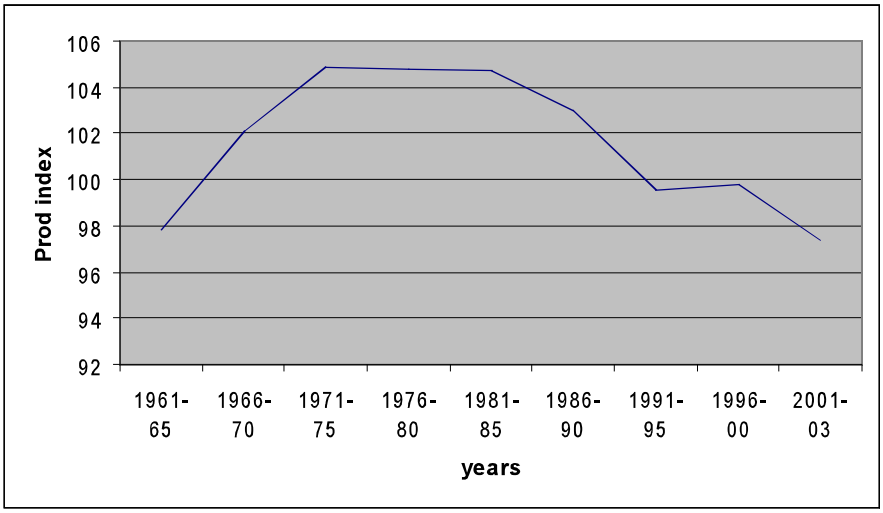



**Figure 4. Agricultural Production index in PNG, 1961-65 to 2001-03 (1999-2001=100) based on FAO Statistics (Reddy 2007)**

### 3.1.2 Income generation through agriculture

Availability of cash income in farming households is closely linked to food security since it enables access to purchase food especially in times when home grown supplies are sparse. However, there are also increasing demands on rural households to generate cash income to access health, education and other services.

National statistics show that there is a wide disparity in income distribution with very low incomes generated from agricultural activities, which are variable over time and extremely diverse across provinces and agro-ecological regions. Within households, gender inequities exist in access and distribution of income. According to a World Bank assessment in 2004 (World Bank 2004), more than 40% of the population live below the international poverty line of US$1/day[2]. Poverty is overwhelmingly rural but again there are great differences between regions and within provinces. Studies by Allen et al. (2005) suggest that patterns of poverty in PNG have not changed much since before the advent of colonialism and are directly linked to severe environmental constraints in climate and landforms (very high altitude, high rainfall, steep slopes, flooding and poor soils) preventing communities to effectively participate in cash economies. The major cash income earning enterprises in the country include oilpalm, coffee and cocoa. However, there are a wide

[1] *Food Import Capability Index measures the proportion of food imports to total exports*

[2] *Using a poverty line that allows for 2200 calories per adult equivalent per day and an allowance for basic non-food expenditure, poverty has increased from 37.5% in 1996 to about 54% by 2003*

range of non-export income earning activities involving cash crops, livestock and fisheries and wildlife happening in the country. Among them sales of fresh food is the most important activity contributing more than 20% to the incomes of more than 90% of the total rural population (Allen et al. 2001, Bourke and Harwood 2009).

### 3.1.3 Rural employment

Labour force participation and employment rates for females and males in the rural sector are high, but only a small proportion of those employed are wage earners or have money income from another (non-agricultural) source (only 3.1%). Most of the economically active persons (approximately 75%) are engaged in subsistence activities (for household consumption) (NSO 2003). At key times of the year when additional labour is required, households traditionally draw on their extended family and clan for assistance. This labour is provided in expectation of reciprocal assistance. Labour is an important factor of production in the rural areas. However, rural employment is characterized by low productivity, underemployment and low wages. Due to low levels of mechanization there is a high degree of drudgery in performing daily tasks in agriculture especially for women. There are predictions that the LNG project will have a major impact on rural employment, indicating that in the short run rural skilled and unskilled employment levels will decline by 12 and 24%, respectively (ACIL Tasman 2009).

### 3.1.4 Natural Resources

The rich natural resource base is a major asset for PNG, supplying all inputs into the traditional subsistence systems and forming the basis for the livelihoods of its rural communities. Traditional shifting cultivation systems are low-intensity and self sustaining. However, the population has more than doubled over the past 40 years, putting increasing pressure on existing systems and natural resources. Although cultivated land area has increased by about 11% from 1975 to 1996 (McAlpine et al. 2001), there are limitations to further expansion since according to PNGRIS more that 50% of the country are mountains and hills and 79% of soils have major limitations (salinity, inundation, extreme stoniness, anion fixation). Consequently, farming communities have resorted to intensifying land use to increase food production on land already used and this trend will continue in future. Those environments are already historically most preferred areas of settlement and agricultural production and include littoral, alluvial fans, volcanic and alluvial plains found in the highlands, lowlands and some atolls and islands of PNG (McAlpine and Freyne 2001, Allen et al. 2005). There is now increasing evidence that soil productivity is declining in those areas due to shortening of fallow periods and low rate of replenishment under existing systems (Kurika et al. 2007, Bailey et al. 2008, Bailey et al. 2009).

### 3.1.5 Trends in Agricultural Productivity and Growth in PNG

Economic activity in the rural sector over the past 30 years has shown little improvement. Contribution of agriculture to the GDP has not changed much during n this period (Figure 5) growing only at an average rate of 0.1% per annum and remained at around 31%.

Most agricultural statistics available on PNG report on the performance of export tree crops. However, it is estimated that at least 17% of the total agricultural GDP comes from non-export agricultural commodities and activities. Since more than 90% of the produce do not pass through formal markets, this figure is likely to be a gross underestimation, also due to problems with accuracy of measures of subsistence production. Bourke and Vlassak (2004) and Gibson (2001) estimated the production of staple foods in PNG at 4.5 million tonnes (approximately 1t/year for each rural person) with an assigned value of K2.8 billion and constitutes around 50% of total food production (including staples, vegetables, fruits and nuts and livestock). This suggests a total value of about K5.5 billion in 2004, highlighting the importance of the contribution of household food production to the national economy.

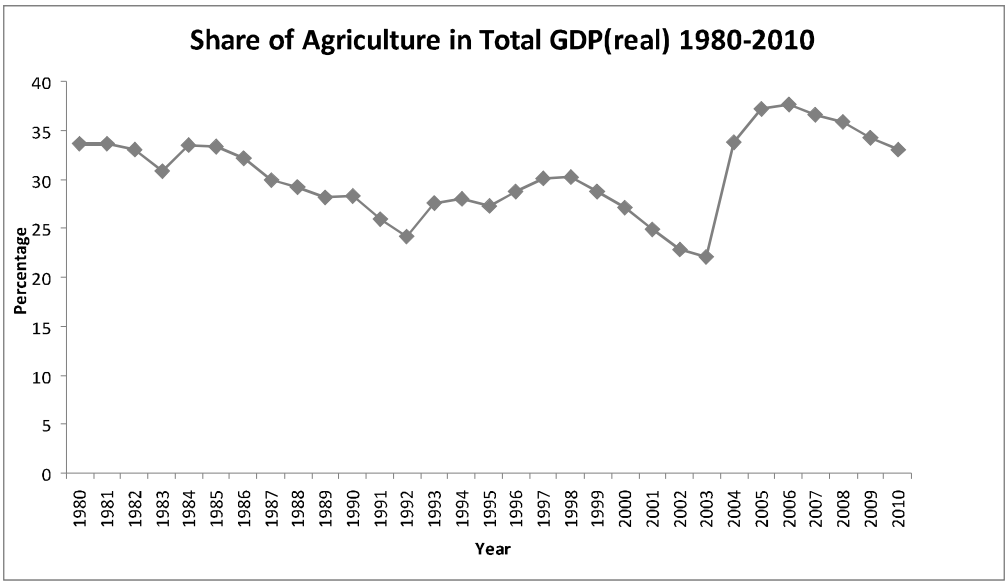



**Figure 5. Share of agriculture as % of real GDP from 1980-2010 (includes forestry and fisheries) (Treasury 2010)**

Studies also showed that the level of technical efficiency in agricultural production is low and has not changed over the past four decades. Total factor productivity (TFP) only showed a slightly upwards trend in the past 20 years and this is mostly credited to advances made in the oil palm industry (Figure 6). The conclusion is that public investment in agriculture has mostly led to agricultural expansion rather than an increase in efficiency and productivity (Fleming 2007, Reddy 2007).

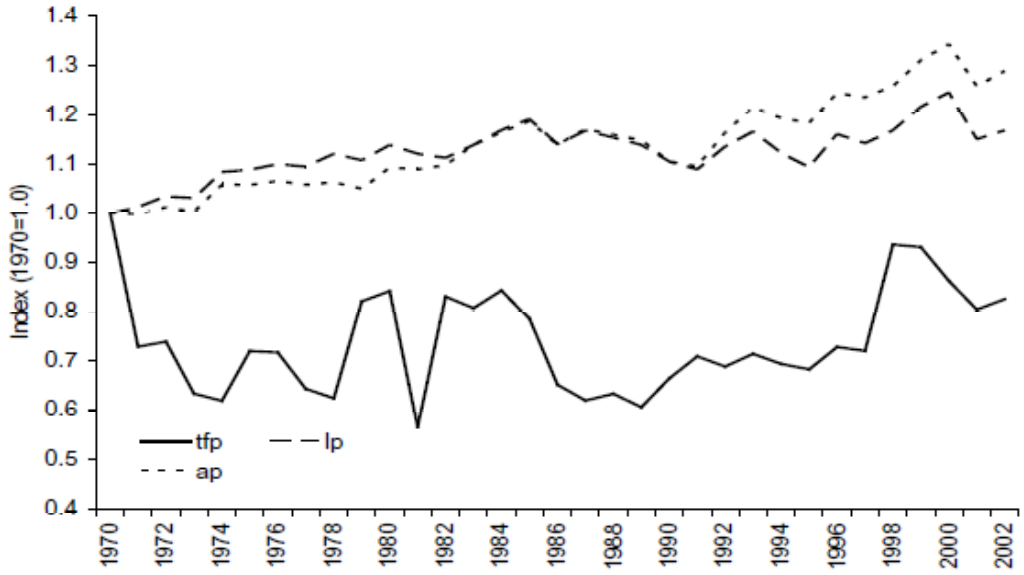



**Figure 6. Agricultural Total Factor productivity (tfp) and partial productivity (labour - lp, land - ap) trends in PNG, 1970-2002 (Fleming 2007)**

## 3.2 National Agricultural Development Objectives

In 2009, the Government of Papua New Guinea developed the country's long-term development strategy 'PNG Vision 2050' (NSPTF 2009) that envisions "We will be a Smart, Wise, Fair, Healthy and Happy Society by 2050". Fulfilment of this vision will entail a substantial transformation of the country's economy and society in the coming 40 years. With the majority of its population (>80%) earning their livelihoods in rural areas and depending on agriculture supported by fisheries and forestry for their food, income and monetary and non-monetary employment, rural areas have to be the major targets for this transformation with agriculture as an important driver for development. Vision 2050 recognizes this and views the shift from the current reliance of the economy on the

mining and energy sectors to broad-based economic growth dominated by agriculture, forestry, fisheries, eco-tourism and manufacturing as an important strategy to drive the development agenda for the country (NSPTF 2009).

Vision 2050 is supported by medium-term government and sector implementation plans such as the Development Strategic Plan (DSP) 2010-2030 (DNPM 2010a), Medium-Term Development Plan (MTDP) 2011-2015 (DNPM 2010b) and the National Agricultural Development Plan (NADP) 2007-2016 (MAL 2006). Objectives outlined in those plans aim at significant increases in agricultural productivity and production and a transition of smallholder subsistence farmers into market-oriented enterprises that can take advantage of domestic and global markets (Figure 7).

In summary, based on four indicators of welfare viz. food and nutritional security, income, rural employment and environmental sustainability, rural communities have not seen much improvement in their situation over the past 20-30 years and are facing significant challenges in the future. This situation is clearly linked to the poor performance of the agriculture sector in that period given its importance in the lives of the majority of people in the country. Current national development plans and agricultural development objectives do recognize the potential of agriculture as the driver for development and the importance of increasing agricultural productivity and production in addressing food and nutritional security, income generation, rural employment and environmental sustainability. However, similar objectives have been included in previous national development plans over the past 2-3 decades, without making much headway in achieving those objectives (Bourke and Harwood 2009). Nevertheless, the relevance of these broad agricultural development objectives is undisputed and they have to continue to form the national agricultural development agenda for the future. It does though highlight the need for reforms in how to approach agricultural development.

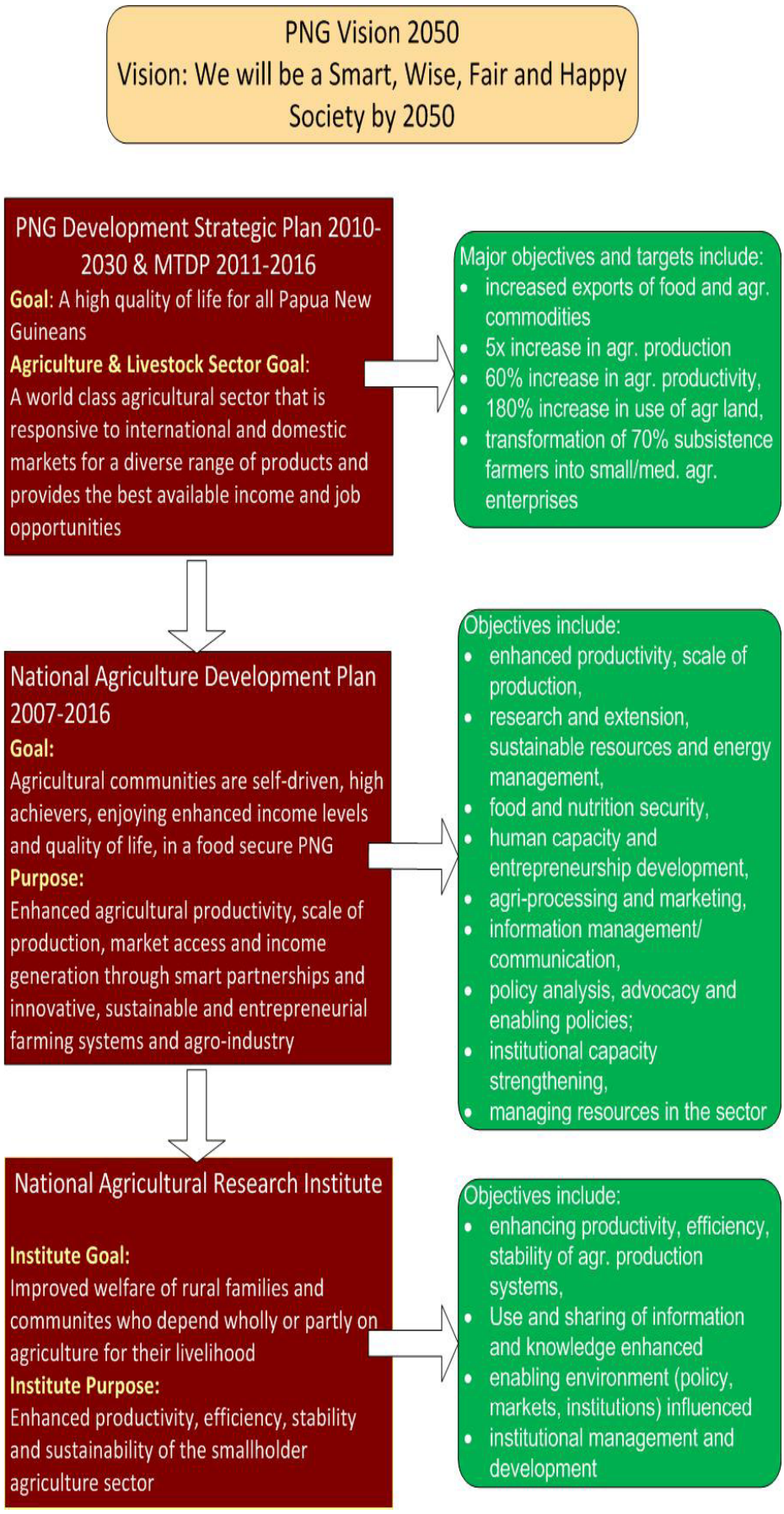



**Figure 7. National agricultural development objectives (NSPTF 2009; DNPM 2010; DAL 2011)**

# 4. Deriving strategic AR4D priorities for NARI

The NARI Goal and Strategic Objective are focussing on the contribution of the Institute to the welfare of rural communities through enhancing productivity, efficiency, stability and sustainability of the smallholder agriculture sector. These were originally outlined during the establishment of NARI in 1997 and manifested in the NARI Act 1996, governing the Institute. As highlighted in the previous section both (goal and objective) are still of high relevance and thus reconfirmed as part of the strategic planning process to continue to drive the Institute's AR4D agenda.

The major challenge for NARI as part of the strategic planning process was to identify AR4D strategies that are linked to addressing constraints and opportunities in agricultural development of different smallholder farming communities in their diverse natural, d socio-economic and cultural environment. These would allow development of programme and project portfolios along the research to development impact pathway, taking into account NARI's complex national mandate of serving the smallholder agriculture sector in relation to all aspects of development-oriented applied and adaptive research. The research is being focussed on staple food crops, emerging cash and food crops, village livestock, natural resource management issues and the relevant socioeconomic and policy environment. NARI approached this challenge by defining, characterizing and analysing the smallholder farming environment in order to derive and prioritize AR4D strategies that will be responsive to identified smallholder farmer needs, as a basis for supporting the AR4D agenda in NARI for the 10 years (2011-20).

## 4.1 Defining the smallholder farming environment

The challenge for NARI in defining the smallholder farming environment was to apply a methodology that takes the diversity of this environment into account and at the same time simplifies the landscape in order to see patterns of agriculture and agricultural development challenges so strategies can be formulated that are applicable across the country and that are both coherent and transparent. NARI used a methodology based on spatial analysis using GIS methods previously developed to derive strategic priorities for Agricultural Development in Eastern and Central Africa (Omamo et al. 2006). The methodology disaggregates the country into geographical units or Agricultural Development Domains (ADD) that are based on a single set of domain criteria applied consistently across the country. The criteria uses three major considerations, viz. agricultural potential (indication of absolute advantage in agricultural production) of an area, market access and population density as socioeconomic factors representing the comparative advantage specific to a certain geographic location (i.e. the extent to which the agricultural potential is realized). ADDs represent areas where similar agricultural development problems or opportunities are likely to occur and therefore represent areas of broadly similar strategic and investment opportunities and help in the identification of viable sets of livelihood options for the farming communities in such domains. The methodology and process in constructing those domains is described in Appendix 1.

Application of the ADD approach for PNG using available GIS databases (PNGRIS and MASP) resulted in a total of 23 domains (Figure 8). ADDs are based on the agricultural system units in the MASP database which are located only within the 117 858 km$^2$ of land classified in PNGRIS as 'used and cultivated' (in current use and under fallow), i.e. 25% of the total land area of PNG. The remaining 75% of the total land area (marked as 'unsuitable' in Figure 8) covers uncultivated land (5%, grasslands, sago stands and savanna woodland) and unused land (70% forests). Bourke and Harwood (2009) state that most of the unused land is also not suitable for agricultural production because it is too steep, too high in altitude (too cold), rainfall is very high, or the land is flooded every year. Table 3 shows an overview of the relative distribution of the total cultivated land area and population for individual domain layers (agricultural potential, market access, and population).

**Table 3. Relative distribution of total cultivated land area and total population for individual domain layers (agricultural potential, market access, population density)**

| | % Total cultivated land Area km$^2$ | % of total estimated population in 2009 |
|---|---|---|
| **Agricultural potential** | | |
| high | 4.6 | 12.5 |
| moderate | 59.0 | 73.5 |
| low | 36.4 | 14.0 |
| **Market access** | | |
| high | 1.5 | 7.7 |
| moderate | 16.4 | 40.6 |
| low | 82.1 | 51.7 |
| **Population density** | | |
| high | 8.6 | 41.0 |
| moderate | 6.1 | 13.5 |
| low | 85.3 | 45.5 |

*Note: 2009 population estimated using 2.7 growth rate provided in 2000 population census*

## Agricultural potential

Only 4.6% of the total cultivated land area (117 858 km$^2$ or 25% of total land area) has a high agricultural potential. These are areas where the temperature, annual rainfall, slope and soils are highly desirable for the production of food crops. The remaining cultivated land area has a medium (59.0%) to low potential (36.4%) with at least one or more constraints (steep slopes, seasonal inundation, waterlogged, low soil productivity etc). The majority of the population lives in areas with moderate production potential.

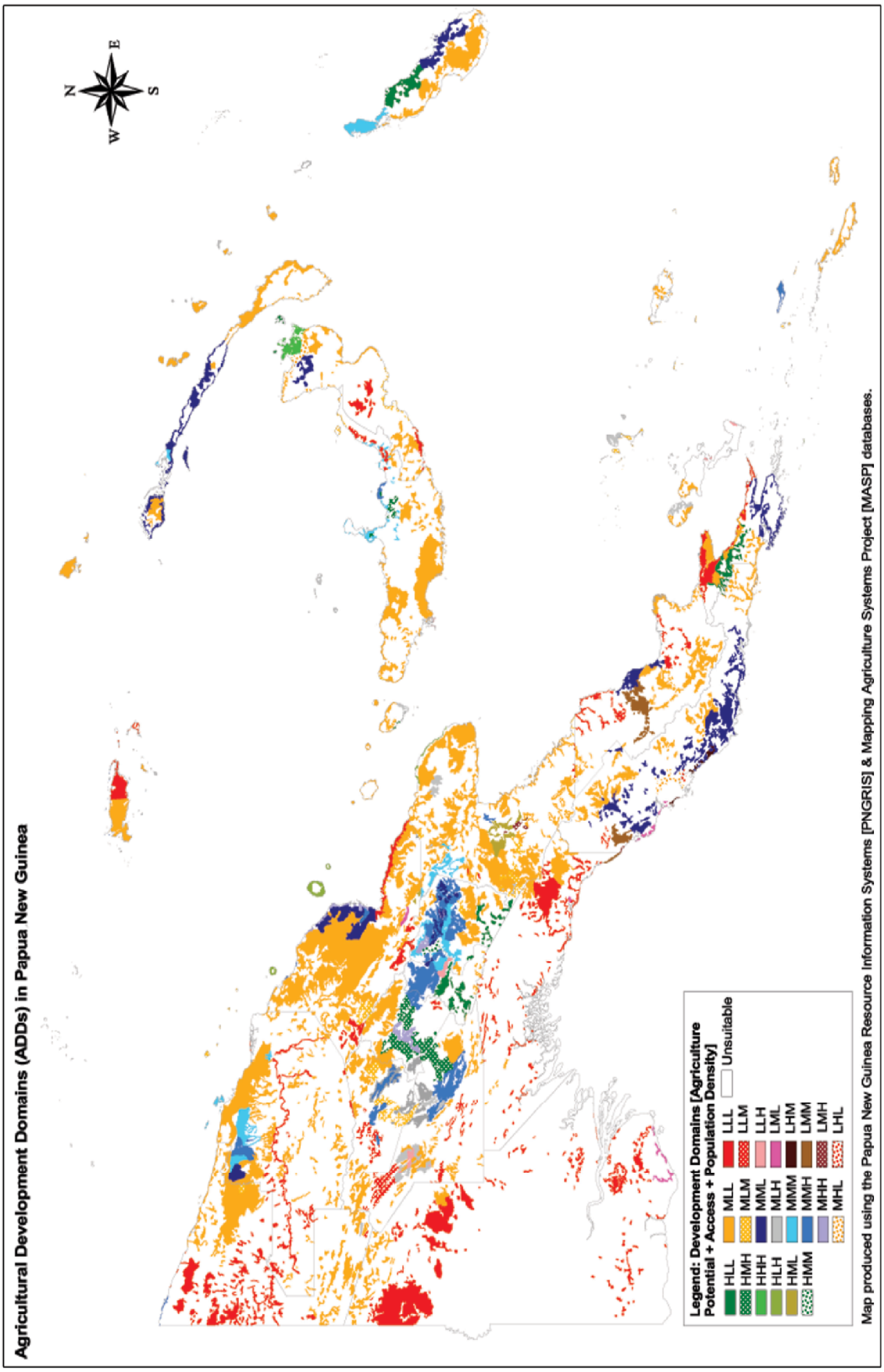



Figure 8. Agricultural Development Domains in PNG

**Market access**

More than half of the total population (51.7%) in PNG lives in 82.1% of total cultivated land area that is considered as 'low access to services/markets (travel more than 4 hrs by foot, vehicle or boat to a provincial capital or an urban centre with more than 1000 people or any level of service or administration centre). Another 40.6% live within 4 hrs travel to a major service centre. However, deteriorating road conditions and transport services (increase of fuel prices) over the past 10-15 years have not been taken into account here. Therefore the real situation may actually be worse especially in the context of access to markets for the majority of people in PNG.

**Population density**

With regards to population density, more than 40% of the total population lives on only 8.6% of the cultivated land, mostly in the Highlands Provinces and a number of islands and atolls. However, in most parts of the country the population density is low (<60 person/km$^2$), especially in Western, Gulf, Sandaun and Madang Provinces. These demographic trends over the past 30 years are likely to continue over the coming decade where people from ADDs with low agricultural potential and access to services will migrate into ADDs with high/medium agricultural potential and high/medium access to services (Allen et al. 2005, Bourke and Harwood 2009).

NARI wanted to further describe ADDs but due to lack of information and data for many ADDs it was difficult to discern them for their specific characteristics relevant to agricultural development. Therefore, the ADDs were further collapsed into eight clusters by considering all the factors with moderate-high rating as "High", while the low rated factors were left as such (Figure 9). Table 4 shows a summary of the ADD clusters, ADDs contained in clusters, percentage of total rural population, percentages of total cultivated area per domain and provinces with the highest share of population in a particular domain. Based on the summary, the largest ADD cluster by population is the HHH cluster with almost 40% of the population living on only 9.5% of the total cultivated land area. Most of the population is located in the Highlands Provinces with other high density population pockets in Gazelle Peninsula (ENB) and some islands and atolls. The second largest cluster by population and by area is the HLL cluster that is dominated by the MLL domain. The MLL domain is found in all provinces of PNG, however more than 50% of the population and 52.9% total land area are located in the Momase Region (Table 4, Appendix 2a and 2b).

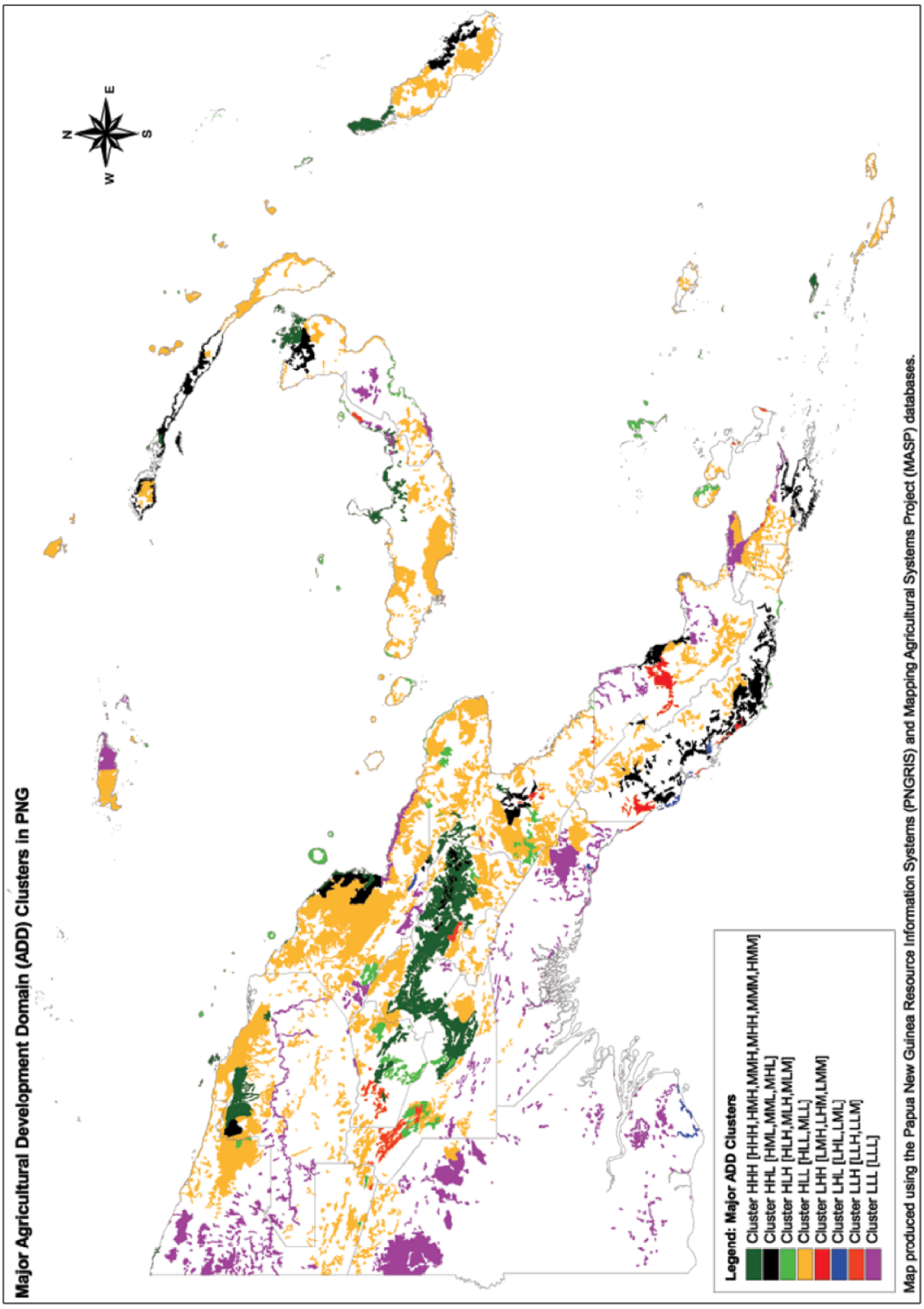



**Figure 9. Agricultural Development Domain Clusters**

**Table 4. Summary of major Agricultural Development Domain (ADD) clusters, ADDs, percentage of total rural population, percentage of total cultivated area per domain and major provinces represented in each ADD**

| ADD Clusters | ADD contained in Clusters | % of total rural population | % of total cultivated land area | Major provinces represented in the ADD[2] (per cent covered) |
|---|---|---|---|---|
| **Cluster 1: HHH[1]** | HHH | 2.92 | 0.38 | ENB (100%) |
| | MHH | 4.1 | 0.61 | WHP (58%), EHP (27%), Madang (15%) |
| | MMH | 19.3 | 4.2 | EHP (25.4%), Simbu (24.0%), SHP (15.5) |
| | HMH | 6.3 | 1.6 | WHP (63%), SHP (24%) |
| | MMM | 6.1 | 2.6 | ESP (30%), EHP (23%) |
| | HMM | 0.2 | 0.12 | EHP (100%) |
| | **Sub-total** | **38.9** | **9.5** | |
| **Cluster 2: HHL** | HML | 0.4 | 0.4 | Morobe (90%) |
| | MML | 6.0 | 6.3 | Central (30%), NI (17%) |
| | MHL | 0.5 | 0.4 | ENB (65%), Central (35%) |
| | **Sub-total** | **6.9** | **7.1** | |
| **Cluster 3: HLH** | HLH | 1.3 | 0.3 | Madang (83%), Morobe (15%) |
| | MLH | 5.5 | 1.3 | SHP (47.0%) |
| | MLM | 3.5 | 1.6 | Enga (36%), Morobe (23%) |
| | **Sub-total** | **10.3** | **3.2** | |
| **Cluster 4: HLL** | HLL | 1.4 | 1.8 | ARB (40%), Simbu (35%), Milne Bay (16%) |
| | MLL | 28.4 | 41.7 | (Morobe – 21%; Madang – 13%, ESP – 10%, WSP – 9%) |
| | **Sub-total** | **29.8** | **43.5** | |
| **Cluster 5: LHH** | LMH | 0.3 | 0.1 | Morobe (65%), Central (35%) |
| | LHM | 0.2 | 0.1 | Central (100%) |
| | LMM | 1.6 | 0.8 | Oro (68%), Central (25%) |
| | **Sub-total** | **2.1** | **1.0** | |
| **Cluster 6: LHL** | LHL | 0.04 | 0.05 | Central (100%) |
| | LML | 0.3 | 0.3 | Western (43%), Central (38%) |
| | **Sub-total** | **0.34** | **0.35** | |
| **Cluster 7: LLH** | LLH | 1.3 | 0.3 | SHP (58%), Simbu (31%) |
| | LLM | 1.8 | 0.9 | SHP (43%), Enga (39%) |
| | **Sub-total** | **3.1** | **1.2** | |
| **Cluster 8: LLL** | LLL | 8.5 | 34.3 | Gulf (22%), Western (21%) |
| | **Sub-total** | **8.5** | **34.3** | |
| | Total | 100 | 100 | |

*[1]Agricultural potential, Access to markets/services, Population density; [2]15%> of total population in particular domain.*

## 4.2 Constraints and opportunities of the smallholder farming communities in ADD clusters

ADDs represent areas with similar broad agricultural development problems and opportunities. During the strategic planning exercise, ADD clusters were described in as much details as possible using available information sources including the Rural Development Handbook (Hanson et al. 2001), the Text summaries for the 'Agricultural Systems of PNG' (Bourke et al. 1998) supplemented by data and information available from the 2001/2002 NARI priority setting exercise (NARI 2004) and other sources.

The following section provides a brief situation analysis for each of the eight clusters. An overview of broad constraints and opportunities in the eight clusters can be found in Appendix 3. A full account of all the information gathered on ADDs in each cluster and the methodology and results of the detailed analysis of constraints and opportunities for each cluster can be found in the NARI Strategic Planning, Strategy and Result Framework Workshop Report (NARI 2010).

### 4.2.1 Brief situation analysis of ADD clusters

Refer to the map in Figures 8 and 9 for the location and distribution of clusters and ADDs in the country.

**Cluster 1: HHH (HHH, HHM, HMH, MMH, MHH, MMM, HMM)**

This HHH cluster (Figure 9) includes ADDs that by definition have the highest absolute and comparative advantage in terms of agricultural production and potential. Historically, due to its high agricultural potential, plantation cash crops (coffee in the highlands and cocoa/coconut plantations in the lowlands) were established in those domains, together with the necessary infrastructure to ensure that plantation crops can reach overseas markets. Population densities in the Highlands were already high but elsewhere plantation crops attracted labour from other parts of the country so that those domains generally show the highest population densities in the country. To date much of the food and cash crop production in the country is undertaken in the HHH cluster of domains and the transition from subsistence to commercial farming has progressed here most among smallholder farmers. Among the major constraints are impediments for efficient marketing systems, (e.g. deteriorating infrastructure, high transport cost, high postharvest losses), effects of pest and diseases and declining soil fertility, lack of capacity to promote farmer learning and impeding socio-cultural practices and values.

**Cluster 2: HHL (HML, MML, MHL)**

The HHL cluster of domains is a smaller cluster than cluster HHH. The biggest ADD in this cluster is the MML domain. Similar to Cluster HHH domains communities here have reasonable opportunities to participate in economic activities as they have access to the road network connecting them to provincial centres. Plantation crops such as coffee, cocoa/coconut and increasingly oilpalm as well as fresh food production supplying provincial centres are important for income generation. However, with low population densities land resources are still underutilized, offering opportunities for increased agricultural production. Similar to Cluster 1 inefficient marketing systems are a major constraint but poor integration of livestock into farming systems and lack of soil and water management, ineffective extension, lack of awareness on agricultural opportunities are other important issues in this cluster. These prevent communities to take advantage of opportunities offered through access to markets.

**Cluster 3: HLH (HLH, MLH, MLM)**

**T**he HLH cluster of domains is another smaller cluster with farming communities mostly located in the Highlands (Southern Highlands and Enga Provinces) of PNG as well as other small areas in other provinces, especially Morobe and Madang. While opportunities in production of cash crops such as coffee, cocoa, pyrethrum and fresh food (e.g potatoes) for marketing are explored, the distance to services and markets and lack of marketing opportunities are major constraints. There is also increasing pressure on land and declining soil fertility due to high population densities as well as social insecurity especially in the Highlands. Lack of access to social and extension services also prevent communities from improving agricultural production and productivity in this cluster.

**Cluster 4: HLL (HLL, MLL)**

The HLL cluster is the largest cluster by land area and also represents almost a third of the country's population. These communities have a predominantly subsistence lifestyle and have retained much of their traditional agricultural systems, making them vulnerable to irregular seasonal weather patterns and global climate change. Plantation crops such as coffee, cocoa/coconut and some oilpalm have been established in some areas. However, due to the distance to markets these crops only contribute marginally to income generation, thus cash incomes in this cluster of domains remaining very low. Historically, investment into infrastructure has been low partly as a result of difficult terrains and low population densities. The major opportunity in this cluster is the availability of underutilized natural resources especially land. Therefore in order to increase agricultural production and productivity, efforts need to be made to improve access to socio-economic and agricultural extension services and help communities to mobilize their land for sustainable agricultural production. This needs to be accompanied by improving marketing opportunities and services (including infrastructure) and a range of strategies to address production constraints.

**Clusters 5 and 6: LHH (LMH, LHM, LMM) and LHL (LHL, LML)**

The LHH and LHL clusters are very small clusters representing pockets of communities mainly located in Central and Oro Provinces. Cluster LHL also includes communities living in peri-urban areas of the National Capital District. Local opportunities exist due to the proximity and access to district and provincial centres. Agricultural potential is low in those domains. The more productive land areas in relevant domains in Oro Province have been taken up by oilpalm development. Natural resource management constraints such as soil fertility decline, poor water and pest and disease management need to be addressed as well as improving integration of livestock into cropping systems. Other constraints include the lack of access to information and markets, inefficient marketing systems as well as limited access to land in densely populated peri-urban areas of Port Moresby.

**Cluster 7: LLH (LLH, LLM)**

**The** LLH cluster of domains is a small cluster primarily located in Southern Highlands, Enga and Simbu provinces. The lifestyle of farming communities is mostly subsistence. Cash incomes are very low and other social indicators such as levels of education and malnutrition are poor. Communities are vulnerable to irregular seasonal weather patterns or events and Climate Change. High population densities are contributing to social conflicts due to land disputes. This cluster of domains is also home to major mineral resource development that on one hand create opportunities for agricultural production as niche markets but on the other hand also divert the interest of communities away from agriculture. Therefore, besides addressing the major constraints in the natural environment (e.g soil fertility decline, losses to pest and diseases, access to planting materials and breeding stock), emphasis needs to be placed no improving the socio-economic environment in terms of farmer learning capacity and appropriate market systems to exploit such niche markets based on a sound understanding of the socio-cultural environment.

**Cluster 8: LLL**

This cluster with only one domain represents farming communities scattered across more than a third of the total used and cultivated land area in the country. This domain occurs in a number of provinces but is mostly represented in Gulf, Western and Sandaun Provinces. Social indicators in this domain are very poor especially in terms of life expectancy, infant and maternal mortalities, education status and levels of nutrition. Communities still maintain a very traditional often nomadic lifestyle that is not based on agriculture but barter systems (e.g. fish bartered for sago or other staples). Also in this cluster (domain), mineral resource development is taking place creating similar opportunities for communities as in Cluster LLH. Due to the overall very poor absolute and comparative advantage, livelihood options based on agriculture here may be limited. Major constraints include the lack of social service infrastructure and a lack of understanding of appropriate alternative livelihood options (based on agriculture or non-agriculture), and also serious biophysical constraints due to unfavourable land forms and climatic conditions.

## 4.3 NARI AR4D strategies

Early in the strategic planning process NARI determined the four major thematic strategic thrusts (referred to later as Programmes) that guide the further development of project areas and project portfolios (Figure 10). They represent major outputs based on a holistic approach of what is necessary and sufficient to achieve the Institute Strategic objective to enhance agricultural productivity, efficiency, stability and sustainability of the smallholder agriculture sector. Those outputs are in line with major issues affecting the smallholder agriculture sector emerging from a broad analysis of constraints and opportunities. In Programme – Agricultural System instead of focussing on individual issues affecting particular commodities or the natural environment, emphasis is placed on improving agricultural production systems encompassing aspects of the biophysical and socio-economic environment. Using the ADD approach of planning where the same ADDs are located in different parts of the country, aspects of outscaling and upscaling also need to be given sufficient

consideration to achieve the desired impact. Other major constraints that emerged are in relation to markets, trade and the policy environment (Programme- Enabling Environment) and to the utilization of information by stakeholders in the sector (Programme – Information and Knowledge). Programme – Institute Management and Development is concerned with the internal institutional environment that needs to support the delivery of the other 3 programmes.

Using the strategic objectives of the four NARI programmes as a basis for further analysis, the detailed constraint and opportunity analysis for each of the ADD clusters mentioned in the previous section was used to develop a list of prioritized strategies for each of the programmes for those clusters. Similar strategies within a programme were then consolidated across clusters to formulate overarching objectives (referred to as project area [PA] objectives) of national importance that represent major outputs to be achieved in each programme. Each of the consolidated PA objectives has one or more PAs addressing particular issues in one or more ADD clusters. A full list of identified consolidated PA objectives, PAs and their relative priority in specific clusters can be found in Appendix 4.

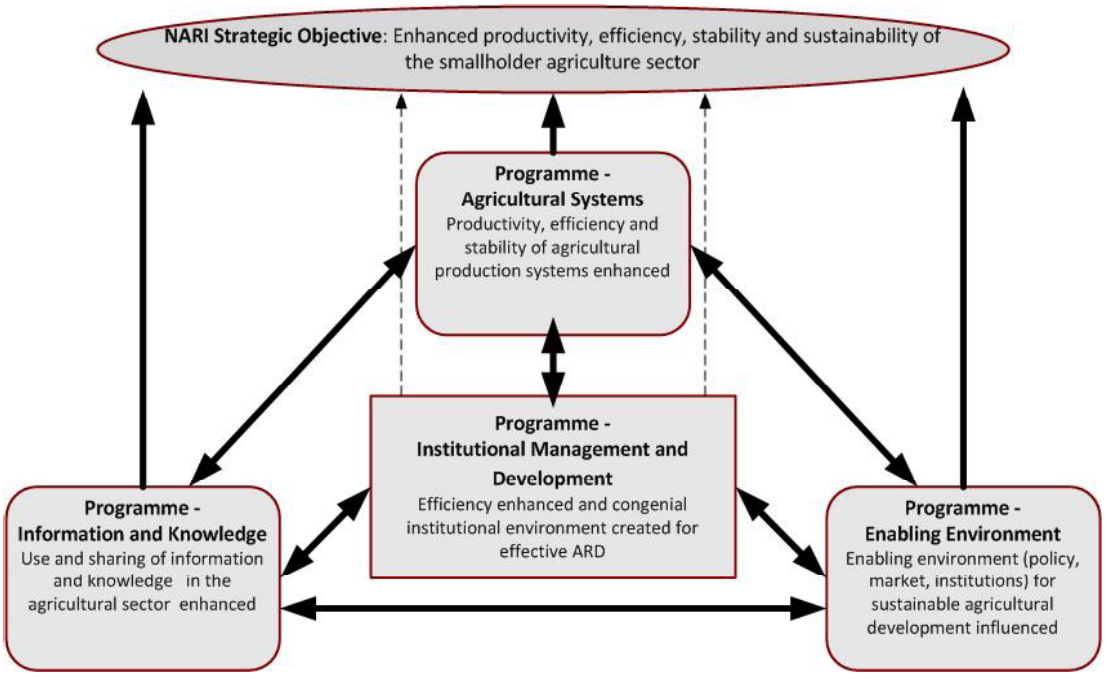



**Figure 10. NARI thematic programmes representing major strategic thrust for delivery of the Institute Strategic Objective**

While consolidated PAs act as anchor points for NARI's AR4D efforts provide the link between higher level institutional objectives and the actual needs of smallholder communities. Identified PAs would serve as the major guide for the development of project portfolios as they are linked to specific clusters and specific needs of farming communities. However, each of the identified PAs still involves a complex set of issues to be addressed and with limited resources available to NARI, a prioritization process was to be applied in Programmes 1-3 to identify the priority PAs that the Institute should focus on in the medium-term. Major criteria for prioritization included direct or indirect linkages to the impact pathway to the Institutes Goal and Strategic objective, consideration of the human and physical environment and contribution to issues of national importance, impact (potential benefits, adoption likelihood) and feasibility (scientific potential, research capacity). Prioritization was done in independent scoring steps. At the end, an aggregate score was produced for the PAs in each of the programmes that was used to rank the Pas, where highest scores are considered highest priority. The prioritization methodology and process is described in detail in Appendix 5. Table 5(a), (b) and (c) shows the results of high priority PAs that can be considered by the Institute in the medium-term. The full list of prioritized PAs can be found in Appendix 5 Tables A5.1-3.

**Table 5(a). High priority Project Areas for Programme – Agricultural Systems**

| Consolidated Project Area Objective | Project Area Objectives | Prioritization: Final weighted aggregate score | Agricultural Development Domain Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Increased use of suitable quality planting materials, breeding stock and other farm inputs by smallholder farmers | 1. Access to suitable quality planting materials and breeding livestock by men and women smallholder farmers improved. | 4.2 | X (4/11)[1] | | X (2/6) | X (3/7) | | X (3/6) | X (3/9) | |
| 2. Marketing systems for crop and livestock products improved | 2. Marketing of and value addition opportunities for crop and livestock products improved | 4.2 | X (1/11) | X (1/6 & 4/6) | X (1/6) | X (1/7) | X (3/6) | X (2/6) | X (5/9) | |
| 3. Smallholder farming communities are better prepared to cope with abiotic stresses due to seasonal weather patterns or climate change and natural disasters | 3. Improved capability of men and women smallholder farmers to manage periods of water shortage and water excess (incl. high rainfall, sea water inundation) | 4.2 | X (9/11) X (8/11 & 10/11) | X (3/6) | X (6/6) | x (2/7)] | x 2/6) | X (4/7) | X (6/9) | |
| 4. Smallholder farmers use improved and sustainable land and soil fertility management practices | 4. Men and women smallholder farmers use improved and sustainable land and soil fertility management practices | 4.0 | X (5/11) | | X (3/6) | X (2/7) | X (1/6) | [x (4/7)] | X (1/9) | X (1/3) |
| 5. Biotic agro ecosystem threats are sustainably managed by smallholder farmers | 5. Men and women smallholder farmers use effective and sustainable crop pest, disease and weed management practices | 3.9 | X (2/11) | X (6/6) | X (4/6) | X (5/7) | | X (5/6) | X (2/9) | |
| | 6. Men and women smallholder farmers have increased capability to manage livestock health threats | 3.7 | X (2/11) | X (6/6) | X (4/6) | X (5/7) | | X (5/6) | X (2/9) | |

**Table 5(b). High priority Project Areas for Programme – Enabling Environment and Programme – Information and Knowledge**

| Consolidated Project Area Objective | Project Area Objectives | Prioritization: | Agricultural Development Domain Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Programme – Enabling Environment** | | | | | | | | | | |
| 1. Conducive socio-cultural environment influenced | 1. Conducive Socio-cultural environment | 3.5 | X (2/3) | X (3/4) | | X (5/5) | X (5/6) | X (3/4) | X (2/2) | |
| 2. Improved marketing opportunities for agricultural commodities available to smallholder farmers | 2. Improved market infrastructure (access) | 3.4 | X (1/3) | | | | X (1/6) | | X (1/2) | |
| | 3. Access to developed and new markets improved (creating knowledge on markets) | 3.3 | X (3/3) | | | | | | | |
| 3. Institutional arrangements improved | 4. Increased investment in agricultural research and wealth creation. | 3.2 | | | | X (1/5) | | | | |
| | 5. Adequate access to agricultural and allied inputs (mostly credits) | 3.1 | | | X (3/5) | | X (2/6) | X (1/4) | | |
| | 6. Relevant and user friendly seed policy established | 2.9 | | | | | X (4/6) | | | |
| **Programme – Information and Knowledge** | | | | | | | | | | |
| 1. Information is effectively packaged and disseminated to NARI clients and stakeholders | 1. Information appropriately packaged | Ns | X (2/4) | | | X (3/5) | X (2/2) | X (1/2) | | |
| | 2. Improved access to information | Ns | X (4/4) | X (1/2) | X (1/2) | X (1/5) | X (1/2) | X (2/2) | X (1/3) | X (2/2) |
| | 3. Improved responses of farming communities | Ns | | | X (2/2) | | | | | |
| | 4. Improved access to information on livelihood options | Ns | | | | | | | | X (2/2) |
| 2. Information is effectively managed by NARI | 5. Improved information management system established | 3.5 | X (3/4)[3] | | | X (5/5) | | | | |
| 3. Appropriate and effective Information facilities developed in NARI and assistance provided to partners | 6. Appropriate and effective Information facilities developed in NARI and assistance provided to partners | 3.4 | | | | | X (4/5) | | | |
| 4. Learning needs of smallholder farmers identified and appropriately addressed | 7. Appropriate extension models identified | 3.3 | | X (2/2) | | | | | X (2/3) | |
| | 8. Farmers learning facilitated | 3.3 | X (1/4) | | | | | | X (3/3) | |

**Table 5 (c). List of Project Areas for Programme – Institutional Development and Management[3]**

| Consolidated Project Area Objective | Project Area Objectives | Prioritization: Final weighted aggregate score | Agricultural Development Domain Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Research performance of the Institute and staff effectively improved in NARI | 1. Effective results-based performance management system | Ns | | | | X | | | | |
| | 2. Result-oriented plans | Ns | | X | | | | | | |
| 2. Human talents, financial and material resources adequately mobilized and managed in NARI | 3. Effective resource mobilization | Ns | X | | | | | | | |
| | 4. Appropriate capacity available (staff and facilities) | Ns | X | X | X | X | X | X | X | X |
| 3. A congenial working environment established, fostered and maintained within NARI | 5. Conducive working environment | Ns | | | X | | | | | |
| 4. Effective development and management of partnerships, collaborations with and provision of efficient technical services to stakeholders | 6. Conducive environment established for effective partnership & collaboration | Ns | X | | | | | | | |
| | 7. Effective networking | Ns | | | X | | X | | | |
| | 8. Effective collaboration and partnership | Ns | | X | | X | | X | | X |
| | 9. Efficient technical services provided to stakeholders and clients | Ns | | | | | | | | |
| 5. Appropriate conducive institutional policies and strategies developed and implemented in the Institute | 10. Workplace policy on gender developed | Ns | X | | | | | | | |
| | 11. Workplace policy on HIV/AIDS developed for NARI and partner institutions | Ns | | | | X | | | | X |
| 6. Effective and prudent leadership and stewardship incorporating the mechanisms, processes and structures developed and implemented | 12. Effective NARI and partner institution governance and leadership | Ns | X | | | | | | | |

[3] *Programme – Institute Management and Development4 was not included in the final prioritization exercise (Appendix 5); necessary prioritization will be done at a later stage of planning.*

## 5. Conclusion

The work reported in this paper describes an innovative approach to derive AR4D strategies that are clearly linked to needs that are current for farming communities in Papua New Guinea, by recognizing the diversity of their biophysical and socio-economic environment. NARI pioneered this approach in PNG based on work done with ADDs by ASARECA in East Africa (Omamo et al. 2006) and it has now been adopted with modifications by a number of other NARS institutions in the country for their own planning purposes.

Increasing agricultural productivity as a means for improving livelihoods of rural communities has been the major agenda of agricultural development policies in the country for decades. However social indicators of people's welfare especially in rural areas are not improving and the majority of the country's population continues to live in relative poverty measured by their cash incomes, nutrition and health. Given the importance of agriculture as a basis for sustainable livelihoods of people in the country, increasing agricultural productivity as the main objective for agricultural development is as current as ever. NARI has taken an innovative approach to catalyze agricultural development with the adoption of the AR4D paradigm. The foundations of this paradigm are the needs and aspirations of smallholder farming communities in the country. Those needs and aspirations form the foundation for defining a range of strategies and interventions support a change process enabling farming communities to move forward towards the long-term goals of the country envisioned in national policies. .

NARI used a results-based management approach (UNDP 2002) in its strategic planning exercise which first defines the objectives starting at the institutional level and then defines the necessary and sufficient results in the form of outputs at different levels to achieve the set objectives. A key question was how and where to incorporate identified needs of smallholder farmers and appropriate responses in the form of AR4D objectives. Smallholder needs have been considered before in NARI's planning processes but that was done at project development level in regards to specific issues concerning commodities. Application of the ADD approach enabled NARI to incorporate smallholder needs and aspirations at a strategic level linking them to the Institute goal and strategic objective and making them the purpose to where discipline and commodity based research would contribute to.

ADD clusters are a representation of smallholder communities and their overall environment in the country. Generation of ADD clusters and their visualization on maps in itself was an eye opener to realize that smallholder farmers are not a homogenous group but are very diverse in their livelihood strategies and opportunities in terms of agricultural development and hence the need for a diverse set of strategies to address respective needs. Further detailed analysis of constraints and opportunities then confirmed this diversity although some major constraints especially affecting their socio-economic and cultural environment such as deteriorating infrastructure, lack of social services and law and order problems appeared to be common across all ADD clusters. The ADD clusters are based on a broad set of assumptions and limitations to the databases (PNGRIS/MASP) used to generate the ADDs. Limitations to and availability of data sources used for the analysis of constraints and opportunities are outlined in Appendix 1(A1.2). Validity of the assumptions underlying ADDs will need to be confirmed through ground truthing and further data collection at a more disaggregate level. Overall the success of ADDs in AR4D planning will also depend on further development of project portfolios in identified Project Areas and to ensure that necessary and high priority projects are developed along the Research to Impact pathway.

## References

ACIL Tasman (2009). PNG LNG Economic Impact Study. Melbourne, ACIL Tasman: 65pp.

ADB (2004). Preparing the agriculture and rural development project - Papua New Guinea. Port Moresby, Asian Development Bank.

Allen, B., et al. (2005). "Poor rural places in Papua New Guinea." Asia Pacific Viewpoint 46(2): 201-217.

Allen, B. J., et al. (2001). Dimensions of PNG Village Agriculture. Food Security for Papua New Guinea. R. M. Bourke, B. J. Allen and J. Salisbury. Canberra, ACIAR: 529-553.

Anandajayasekeram, P. and B. Gebremedhin (2009). Integrating innovation systems perspective and value chain analysis in agricultural research for development: Implications and challenges. Nairobi, Kenya, International Livestock Research Institute: 67pp.

AusAID (2007). Papua New Guinea – Australia Development Corporation Strategy 2006-2010. Canberra, Australian Agency for International Development.

Bailey, J. S., et al. (2008). An evaluation of soil fertility constraints in the Highlands of PNG. Lae, National Agricultural Research Institute.

Bailey, J. S., et al. (2009). "An evaluation of nutritional constraints on sweet potato (Ipomoea batatas) production in the central highlands of Papua New Guinea." Plant and Soil 316(1-2): 97-105.

Batten, A., et al. (2009). "Papua New Guinea Economic Survey Economy: from boom to gloom?" Pacific Economic Bulletin 24(1): 1-26.

Bourke, R. M., et al. (1998). Papua New Guinea: Text Summaries. Canberra, Department of Human Geography, Research School of Pacific and Asian Studies, The Australian National University.

Bourke, R. M. and T. Harwood, Eds. (2009). Food and Agriculture in Papua New Guinea. Canberra, ANU epress, The Australian National University.

Bourke, R. M. and V. Vlassak (2004). Estimates of Food Crop Production in Papua New Guinea. Canberra, Land Management Group, The Australian National University.

DAL (2011). Aligning the agriculture sector to higher National Development Plans. Port Moresby, Department of Agriculture and Livestock.

de Janvry, A. (2010). "Agriculture research for development: new paradigm and options of success." Agricultural Economics 41(s1): 17-36.

DNPM (2010). Medium-Term Development Plan 2011-2015. Port Moresby, Department of National Planning and Monitoring.

DNPM (2010). Papua New Guinea Development Strategic Plan 2010-2030. Port Moresby, Government of Papua New Guinea, Department of National Planning and Monitoring.

FAO (1996). Declaration on world food security. World Food Summit. Rome, FAO.

FAO (2003). Nutrition country profiles - PNG. Rome, Food and Agriculture Organization.

FAO (2006). "Food Security." Policy Brief June, Issue 2.

Fleming, E. (2007). "Agricultural productivity change in Pacific island countries." Pacific Economic Bulletin 22(3): 32-47

Gibson, J. (2001). The economic and nutritional importance of household food production in PNG. Food Security for Papua New Guinea. Proceedings of the Papua New Guinea Food and Nutrition 2000 Conference. ACIAR Proceedings No. 99. R. M. Bourke, M. G. Allen and J. Salisbury. Canberra, ACIAR: 7-44.

Hanson, L. W., et al. (2001). Papua New Guinea: Rural Development Handbook. Canberra, The Australian National Universitys.

Hanson, L. W., et al. (2001). Mapping Land Resource Potential and Agricultural Pressure in Papua New Guinea. Canberra, ACIAR: 52pp.

Hawkins, R., et al. (2009). Integrated Agricultural Research for Development (IAR4D). A Concept Paper for the Forum for Agricultural Research in Africa (FARA) Sub-Saharan Africa Challenge Programme (SSA CP). Accra, Ghana, Forum for Agricultural Research Africa.

ICRA (2010). ARD - An Introduction, ICRA Learning Resources. November 2010.

Kurika, L., et al. (2007). "Agricultural research and development on small islands and atolls: the Papua New Guinea experience." Pacific Economic Bulletin 22(3): 126-136.

MAL (2006). National Agriculture Development Plan 2006-2016. Port Moresby, Independent State of Papua New Guinea, Ministry of Agriculture and Livestock.

Mbabu, A. N. and C. Ochieng (2006). Building an Agricultural Research for Development System in Africa. Washington, USA, International Food Policy Research Institute.

McAlpine, J. R. and D. F. Freyne (2001). "Land use change and intensification in Papua New Guinea 1975 - 1996." Asia Pacific Viewpoint 42(2/3): 209-218.

McAlpine, J. R., et al. (2001). Land use and rural population change in PNG, 1975-96. Food Security for Papua New Guinea. ACIAR Proceedings No. 99. R. M. Bourke, M. G. Allen and J. G. Salisbury. Canberra, ACIAR: 277-283.

McGregor, A., et al. (2009). "Pacific Island Food Security: Situation challenges and opportunities." Pacific Economic Bulletin 24(2): 24-42.

NARI (2004). Medium-Term-Research-Priorities of the National Agricultural Research Institute. Lae, Papua New Guinea, National Agricultural Research Institute.

NARI (2010). NARI Strategic Planning: Strategy and Result Framework Workshop. Lae, National Agricultural Research Institute.

NSO (2003). PNG 2000 Census of Population and Housing: National Report. Port Moresby, National Statistical Office.

NSO (2009). Demographic and Health Survey 2006: National Report. Port Moresby, National Statistics Office.

NSPTF (2009). Papua New Guinea Vision 2050. Port Moresby, Government of Papua New Guinea, National Strategic Plan Taskforce.

NZIER (2006). Papua New Guinea - Issues and Options. Port Moresby, INA: 89 pp.

Omamo, S. W., et al. (2006). Strategic Priorities for Agricultural Development in Eastern and Central Africa. Washington, IFPRI. Research Report No. 150: 140pp.

PNG Department of Health, et al. (2006). Micronutrient Survey PNG, 2005. Port Moresby, PNG Department of Health.

Rajalahti, R., et al. (2008). Agricultural Innovation Systems:From Diagnostics toward Operational Practices. Washington, DC, World Bank: 87pp.

Reddy, M. (2007). "Enhancing the agricultural sector in Pacific island economies." Pacific Economic Bulletin 22(3): 48-62.

SPC (2011). 2011 populations and demographic indicators, Secretariat of the Pacific Communities.

Treasury (2010). Economic and Development Policies. Volume 1. Port Moresby, Department of Treasury, Government of Papua New Guinea.

UNDP (2002). Results based Management: Concepts and Methodology. Technical Note: 2000.

UNDP (2008). United Nations Country Programme Papua New Guinea 2008-2012. Port Moresby, United Nations Development Programme.

UNDP (2011). Human Development Report 2011: Sustainability and equity - a better future for all. New York, United Nations Development Programme: 176pp.

World Bank (2004). Papua New Guinea: poverty assessment. Washington, World Bank: Error! Hyperlink reference not valid..

World Bank (2007). Agriculture for Development. World Development Report 2008. Washington DC, Worldbank.

# Appendix 1. Construction of Agricultural Development Domains

## A1.1 Methodology of constructing ADDs

ADDs are constructed by the intersection of the three spatial variables or layers (agricultural potential, access to services and population density each in 3 classes viz. high, medium, low) using GIS.

### A1.1.1 Construction of the Agricultural potential layer

The agricultural potential layer (Figure A1) is based on the PNG Resource Information System (PNGRIS) database using modified classification scales for Landscape context (slope), Rainfall (Annual rainfall, inundation) and soil quality (soil productivity index) (Hanson et al. 2001). Agricultural potential represents the absolute advantage for agricultural production while location-specific factors influence the crop and livestock species that will perform well under the risk of exposure to harmful pests, diseases, floods, droughts, erosion hazards etc.

### A1.1.2 Construction of the Market access layer

Access to markets and infrastructure is one of the variables used to help determine the comparative advantage (profitability) of a location or livelihood option and is a complex factor as well. As stated in Omamo et al. (2006) opportunities for gathering market information, obtaining credit, buying inputs, selling outputs depend on a wide range of socioeconomic, institutional, and cultural factors that are not necessarily associated with settlement size or the connectivity among locations.

In order to generate the market access layer, the SPTF initially developed a modified scheme based on the market access layer developed by Omamo et al. (2006) (Figure A2a). This composite scheme would take the various marketing options, modes of transport as well as distances to travel into consideration. However, due to lack of available databases, lack of data, slow response in relevant government agencies to provide available data on road networks, ports, airports, jetties but most importantly limitations of the current GIS software, the SPTF resolved to use data on 'Access to services' (Allen et al. 2001, Hanson et al. 2001), (Figure A2b) that are available in the MASP (Mapping Agricultural Systems Project) database. Since only three classes viz. low, moderate, good are used for the ADDs, there was a need to re-categorize the five available access classes (very low, low, moderate, good, very good) as shown in Figure 8b taking a conservative approach considering the deteriorating road and other transport infrastructure conditions, i.e. high access - < 1 hr travel to major regional centre, medium access – 1-4 hrs to a provincial capital or larger urban centre (>2000 people), low access - >4 hrs to provincial capital or urban centre or any administration centre at all. It would be desirable to utilize the market access option shown in Figure 8a as this will help to better establish constraints and opportunities for market access in the different domains. This will be important for identifying more specific development options within domains.

### A1.1.3 Construction of the Population Density layer

Population density or pressure is another variable used to determine the comparative advantage of a location or livelihood option. It is expected to influence the labor intensity of agricultural production, including the choice of commodities as well as production technologies and land management practices (Omamo et al. 2006).

The MASP database also contains population data based on the 2000 PNG census. The data were extrapolated using an average population growth rate of 2.7% to derive estimates for 2009. For the purpose of developing ADDs only rural population data were used. The classification of population density used in the Rural Development Handbook was applied to develop three population density classes:

Low: 0 - 60 persons/km$^2$

Moderate: 61 – 100 persons/km$^2$

High: 101 – 713 persons/km$^2$

### A.1.1.4 Data sources and preparation

*Primary data sources*

The application of the ADD approach requires the availability of spatial databases containing both biophysical and socio-economic information across the entire country. Two of the national GIS databases were used for this work, which are the Papua New Guinea Resource Information Systems [PNGRIS] and Mapping Agricultural System Project [MASP]. The PNGRIS database is a national inventory of all natural resource information such as topography, soil types, land use, land cover and population. The database was developed at 1:500,000 map scale. It is defined by mapping units (polygons) called Resource Mapping Units (RMUs). A RMU is a unique combination of altitude, landform, bedrock and rainfall. 4566 RMUs were delineated across the entire country.

MASP is a national database containing agricultural information of rural smallholders in the country. The mapping unit of the database is known as Agriculture Systems [Agsyst]. An Agsyst is an area with an unique combination of fallow type, fallow period, and period of cultivation before fallowing, staple crops, aspects of garden and crop segregation and soil fertility maintenance techniques. There are 247 discrete agriculture systems found across the country. Similar to the PNGRIS, this database was developed at a map scale of 1:500,000. MASP was recently updated with the 2000 population census data and service accessibility at the Australian National University (pers.comm. Bryant Allen)

*Secondary data sources*

2000 national population census data is available in GIS format. It was produced at a scale of 1:100,000 using census units. Census units represent location of villages, towns, health and education points. It provides demographic information at the provincial, district and local level government levels.

**Figure A1. Agricultural Potential Layer**

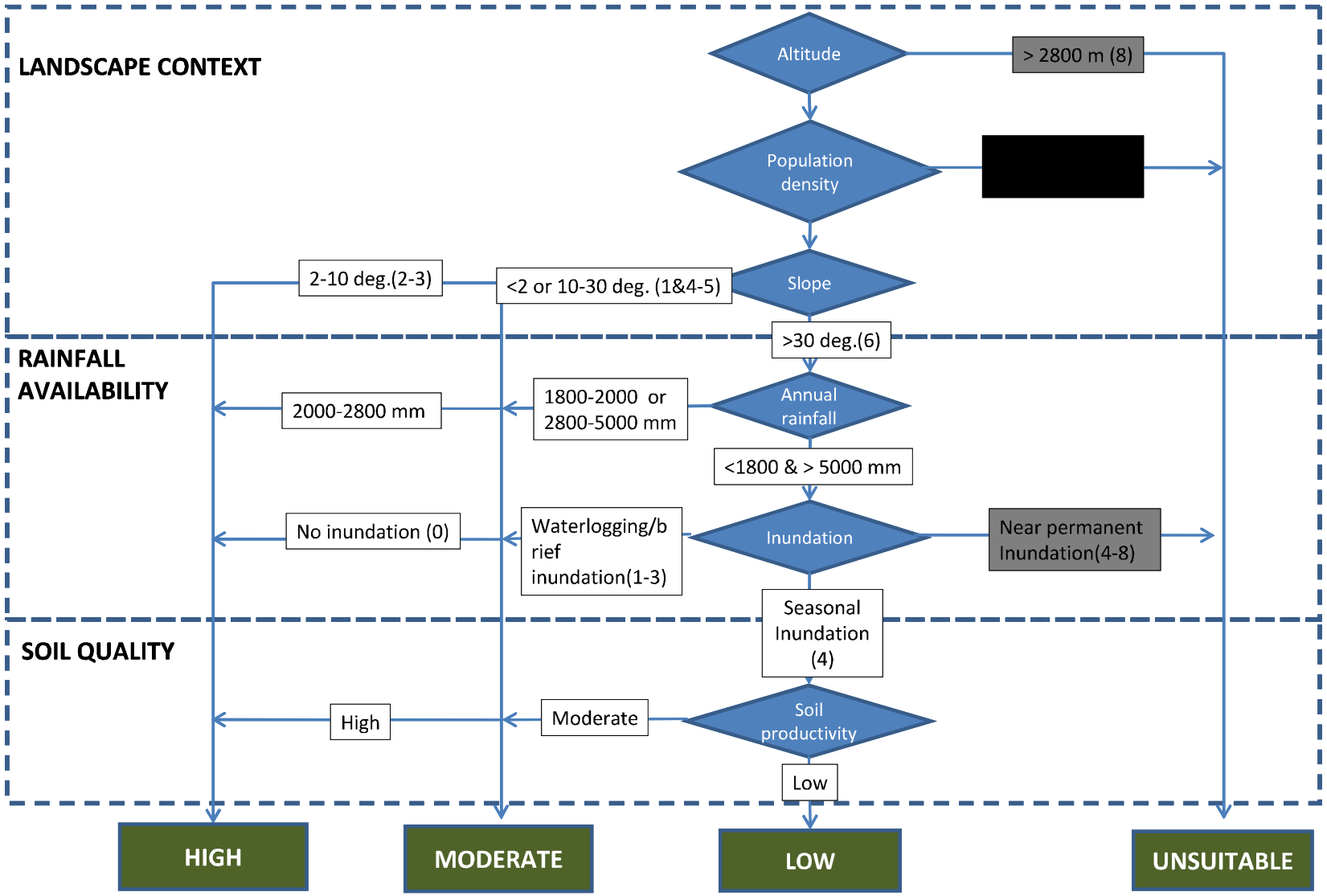


**Figure A2a. Market access layer proposed for developing Agricultural Development Domains**

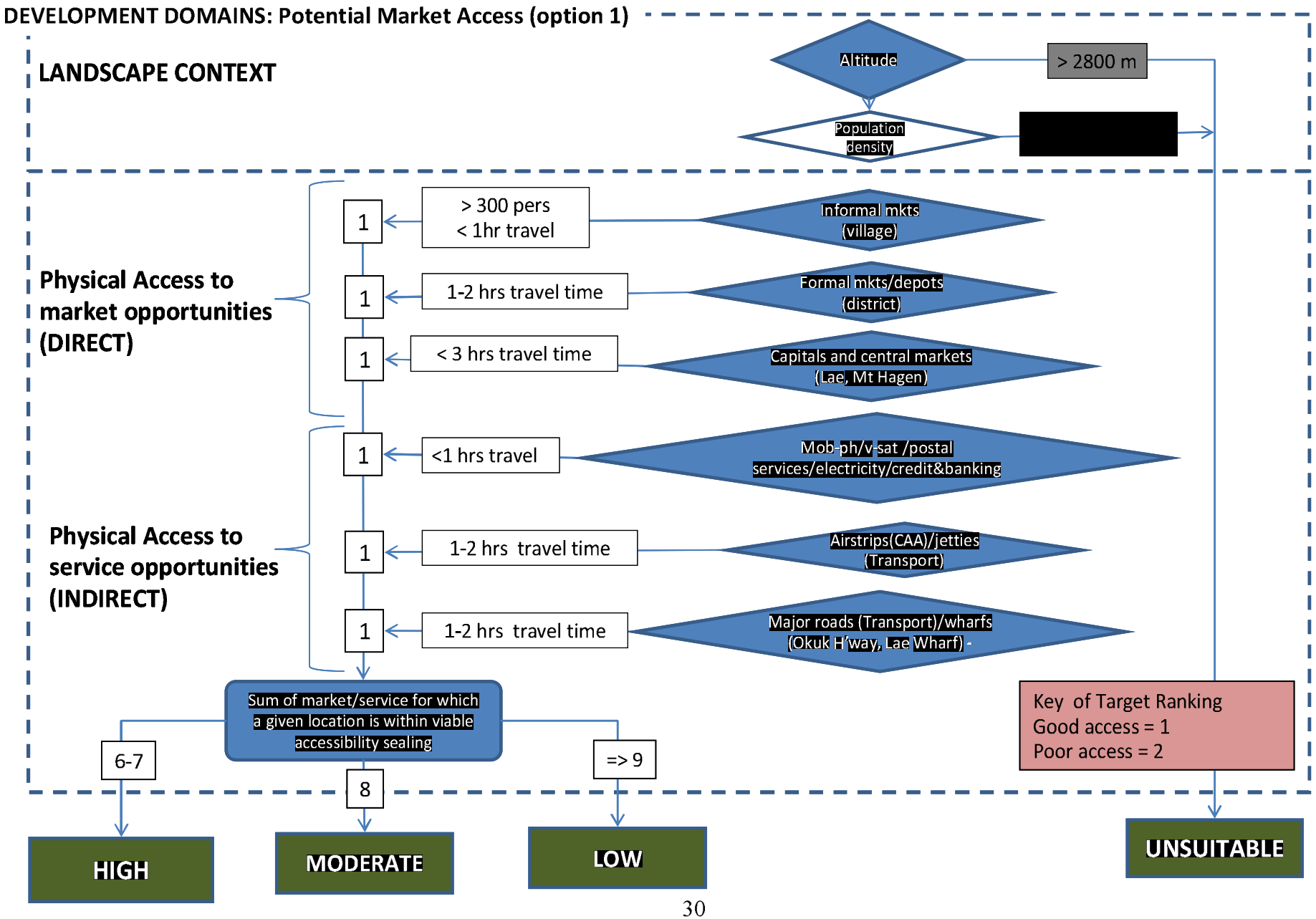
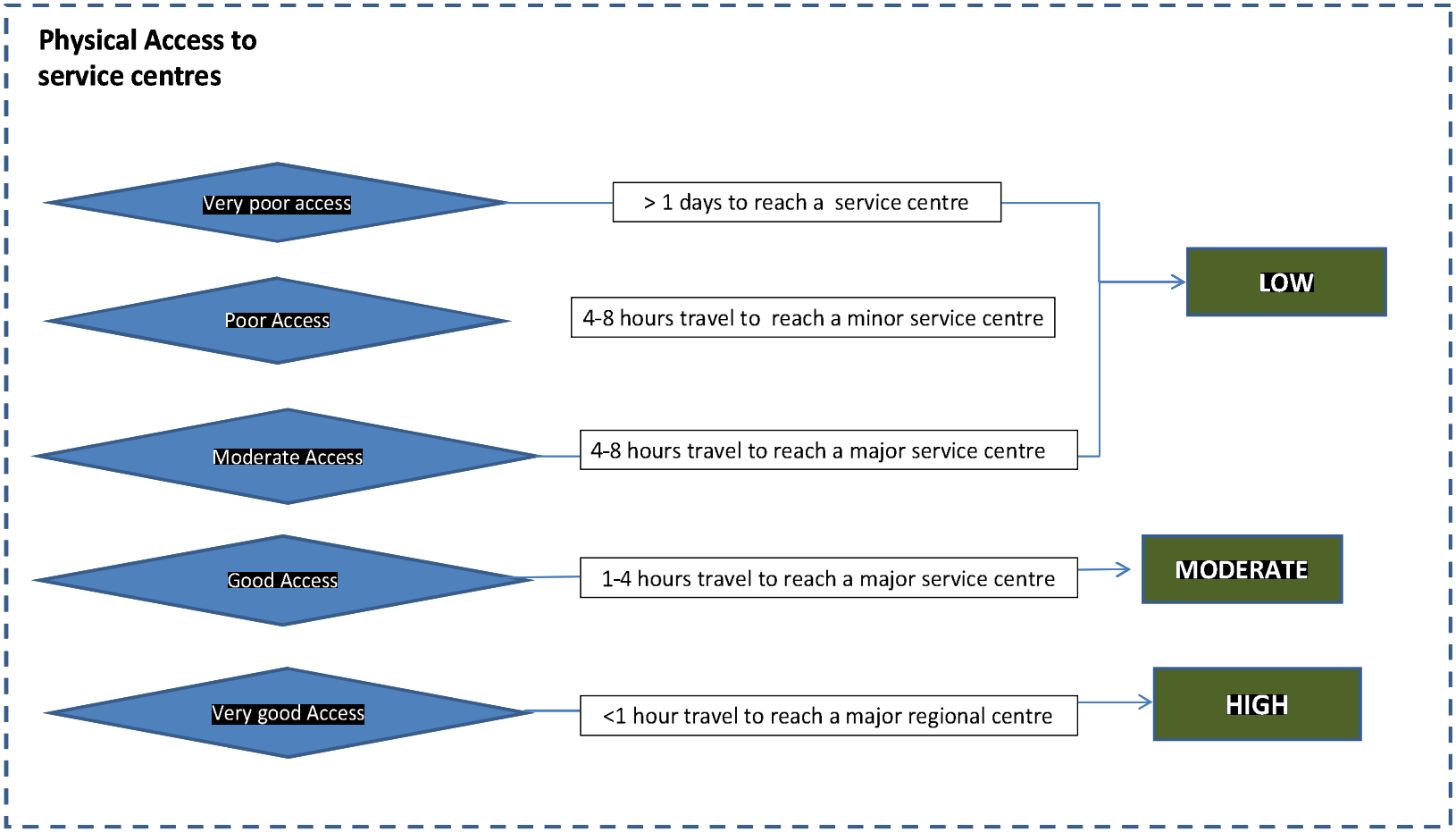


**Figure A2b. Market access layer used for developing Agricultural Development Domains**




Note: Access to services is defined as the time taken to travel by foot, vehicle, or boat from each MASP 'agsystem' to the nearest service centre; **very poor** – no road access, more than one day's travel to any level of service or administration centre; **poor** – 4-8 hrs surface travel to any level of service or administration centre; **moderate** – 4-8 hrs travel to a prov. capital or urban centre (>1000 people); **good** – 1-4 hrs travel to a provincial capital or larger urban centre (>2000 people); **very good** - < 1 hr to a major regional centre (Allen, Bourke et al. 2001; Hanson, Allen et al. 2001)

### A1.1.5 Data Preparation and Processing: Generation of composite PNGRIS and MASP dataset

In order to do the GIS analysis, a composite dataset containing the two databases, PNGRIS and MASP, was required to enable data in MASP to be used in conjunction with PNGRIS. A composite dataset, called "allagrmu" was generated during the implementation of the MASP database (Hobsbawn, P. et al. 1997). This work combined both natural resource and rural agriculture information in a single dataset, by incorporating MASP to PNGRIS. However, the dataset was not registered to any recognized map projection system making it impossible to overlay or examine the data with other sources of GIS data.

In the absence of a registered composite dataset a new dataset had to be generated. This was achieved by extracting the ANU "allagrmu" attribute table and using it as the 'link table' to join both PNGRIS and MASP databases. A composite dataset was generated by combining PNGRIS and MASP databases using Table link tool in ArcView, by firstly linking "allagrmu" table to PNGRIS then MASP. The composite dataset was processed, primarily to filter and cross check the data in MS Excel then subsequently exported to ArcView to perform the spatial analysis.

An initial raw composite dataset was generated with 3230 new map units or polygons. Many of which were duplicated data arising because the polygons in PNGRIS and MASP do not overlap exactly, creating slivers or overshoots when combined. To address this duplication in the composite dataset, it was filtered into unique agriculture systems attribute data (in MASP) representing only cultivated land units. The reason for using agriculture systems in MASP as a data-filter is that they are discrete areas (polygons) which proved to be effective approach for removing the duplicated data. The filtered composite dataset resulted in 339 new map units. Even though some data was lost while filtering, this product is considered suitable for the analysis as the number of map units (339) obtained is relatively close to the number of original agriculture systems of 342 in MASP. Further examination was done on the dataset to validate and finalise it, in preparation for the analysis.

## A1.2 Limitations of the datasets and databases

### A1.2.1 Databases used to generate ADDs

Due to the coarse map scale, attributes in PNGRIS that are accurate are similar over large areas. Examples of these are landform and topography. In contrast, the less reliable attributes the scale of environmental processes declines and interpretation or extrapolation increases. Examples of these attributes are soil types and slope gradient which are highly variable at local scale and within the PNGRIS RMUs and between adjacent RMUs.

A key limitation in the composite dataset that was generated by ANU is that some data/information may have been lost or repeated (duplicated) prior to and after the data preparation. There are three major contributing factors that are likely to have caused errors which are associated with the materials used, equipment/ technology and data processing. A problem associated with materials used is with the link-table used to join PNGRIS and MASP. The link file used to join the PNGRIS/MASP has not been validated or cross-checked for errors (status is unknown because there was no proper documentation done for it). Also this file contains repeated data because the RMU in PNGRIS and Agriculture Systems in MASP are unrelated and do not overlap exactly. This link file was used in this study as it can only be generated with the availability and utilization of advanced GIS features and techniques which is not possible with the software currently available in NARI. Processing errors arose through data filtration which was done by random selection of attributes both in MS Excel and ArcView in order to link between different datasets.

The issues raised here can be addressed with the availability of advanced software programs such as the ArcGIS software program or open source GIS products, with improved tools to improve data examination and management and conduct data processing and analysis more accurately and efficiently.

### A1.2.2 Datasets used for the constraint and opportunity analysis

A limitation to the data collection for the constraint and opportunity analysis was that only macro-economic data were available. Further, data used to generate the population density layer is based on the 2000 PNG census extrapolated with an average growth rate of 2.7%. However, it is possible that population densities in certain area are either over-, or underestimated. Similar to that the information on 'Access to services' is more than 10 years old and since then the condition of many infrastructures such as roads, airstrips and jetties has deteriorated significantly so that areas now listed as having moderate access have in fact moved into domains with low access. Another consideration in regards to 'Access to services' is that the reference points for access are administrative centres, which cannot always be equated with 'market access', for example Misima Island (Milne Bay Province) has been classified in the MMH domain, i.e being within 4 hrs of a major service centre. However, considering the distance to the PNG mainland (where major markets would be) and the cost of transport this island is still very remote in terms of marketing.

Therefore, it will be necessary as part of further planning along the AR4D cycle to factor in further disaggregation of respective domains, actual ground truthing to assist with a more detailed needs and opportunity analysis for target communities to derive more operational development options as part of AR4D that will be piloted in target areas.

# Appendix 2a: Domain data – Estimated land area (sq km)

| | Cluster 1 HHH | | | | | | Cluster 2 HHL | | | Cluster 3 HLH | | | Cluster 4 HLL | | Cluster 5 LHH | | | Cluster 6 LHL | | Cluster 7 LLH | | Cluster 8 LLL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Province** | **HHH** | **HMH** | **HMM** | **MMH** | **MMM** | **MHH** | **MHL** | **MML** | **HML** | **HLH** | **MLH** | **MLM** | **HLL** | **MLL** | **LHM** | **LMH** | **LMM** | **LHL** | **LML** | **LLH** | **LLM** | **LLL** |
| Western | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1211 | 0 | 0 | 0 | 0 | 167 | 0 | 0 | 14044 |
| Gulf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1809 | 0 | 0 | 53 | 0 | 20 | 0 | 0 | 11532 |
| Central | 0 | 0 | 0 | 0 | 0 | 0 | 297 | 3243 | 0 | 0 | 90 | 0 | 0 | 2416 | 132 | 17 | 323 | 68 | 108 | 0 | 68 | 0 |
| Milne bay | 0 | 0 | 0 | 158 | 0 | 0 | 0 | 723 | 0 | 3 | 342 | 144 | 677 | 2057 | 0 | 0 | 0 | 0 | 0 | 46 | 33 | 1058 |
| Oro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 558 | 0 | 0 | 0 | 0 | 0 | 2332 | 0 | 0 | 839 | 0 | 0 | 0 | 0 | 793 |
| Southern Highlands | 0 | 713 | 0 | 1277 | 0 | 0 | 0 | 0 | 0 | 0 | 921 | 0 | 0 | 2575 | 0 | 0 | 0 | 0 | 0 | 154 | 665 | 353 |
| Enga | 0 | 0 | 0 | 619 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 836 | 0 | 1153 | 0 | 0 | 0 | 0 | 0 | 0 | 414 | 0 |
| Western Highlands | 0 | 1441 | 0 | 284 | 0 | 508 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 1781 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 126 |
| Simbu | 0 | 0 | 0 | 1276 | 246 | 0 | 0 | 51 | 0 | 0 | 0 | 0 | 700 | 106 | 0 | 0 | 0 | 0 | 0 | 165 | 0 | 0 |
| Eastern Highlands | 0 | 0 | 186 | 1859 | 811 | 217 | 0 | 507 | 0 | 0 | 0 | 113 | 409 | 1627 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31 |
| Morobe | 0 | 0 | 0 | 60 | 480 | 0 | 0 | 0 | 611 | 68 | 322 | 542 | 11 | 9424 | 0 | 91 | 14 | 0 | 0 | 0 | 40 | 28 |
| Madang | 0 | 0 | 0 | 108 | 0 | 187 | 0 | 1362 | 46 | 323 | 0 | 318 | 0 | 12364 | 0 | 0 | 0 | 0 | 87 | 0 | 0 | 1326 |
| East Sepik | 0 | 0 | 0 | 479 | 1113 | 0 | 0 | 367 | 0 | 0 | 0 | 58 | 0 | 6224 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10682 |
| West Sepik | 0 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 45 | 111 | 0 | 4965 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 9886 |
| Manus | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 1027 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 659 |
| New Ireland | 0 | 0 | 0 | 0 | 70 | 0 | 0 | 1383 | 0 | 0 | 43 | 0 | 0 | 2667 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| East New Britain | 571 | 52 | 0 | 0 | 0 | 0 | 349 | 348 | 0 | 0 | 0 | 150 | 0 | 1339 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 581 |
| West New Britain | 0 | 178 | 0 | 95 | 452 | 0 | 0 | 0 | 0 | 0 | 73 | 85 | 0 | 4659 | 0 | 0 | 0 | 0 | 0 | 11 | 75 | 193 |
| Autonomous Bougainvile | 0 | 0 | 0 | 0 | 678 | 0 | 0 | 858 | 0 | 0 | 54 | 0 | 846 | 2602 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| total land area Domain by province | **571** | **2384** | **186** | **6256** | **3850** | **912** | **646** | **9400** | **657** | **394** | **1910** | **2387** | **2643** | **62338** | **132** | **108** | **1229** | **68** | **382** | **376** | **1319** | **51292** |
| % of land area Domain by province | **0.38** | **1.60** | **0.12** | **4.19** | **2.58** | **0.61** | **0.43** | **6.29** | **0.44** | **0.26** | **1.28** | **1.60** | **1.77** | **41.71** | **0.09** | **0.07** | **0.82** | **0.05** | **0.26** | **0.25** | **0.88** | **34.32** |

*Note: Land area is estimated using the agriculture systems in MASP database*

## Appendix 2b: Domain data – Estimated rural population for PNG in 2009

| | Cluster 1 HHH | | | | | | Cluster 2 HHL | | | Cluster 3 HLH | | | Cluster 4 HLL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Province** | **HHH** | **HMH** | **HMM** | **MHH** | **MMH** | **MMM** | **HML** | **MHL** | **MML** | **HLH** | **MLH** | **MLM** | **HLL** | **MLL** |
| Western | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12216 |
| Gulf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17101 |
| Central | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9118 | 92024 | 0 | 15954 | 0 | 0 | 46840 |
| Milne bay | 0 | 0 | 0 | 0 | 17784 | 0 | 0 | 0 | 29888 | 899 | 48027 | 10386 | 11488 | 42489 |
| Oro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25936 | 0 | 0 | 0 | 0 | 39879 |
| Southern highlands | 0 | 76861 | 0 | 0 | 154524 | 0 | 0 | 0 | 0 | 0 | 132085 | 0 | 0 | 88564 |
| Enga | 0 | 0 | 0 | 0 | 160015 | 0 | 0 | 0 | 0 | 0 | 0 | 65855 | 0 | 38997 |
| Western highlands | 0 | 205637 | 0 | 123612 | 52997 | 0 | 0 | 0 | 0 | 0 | 0 | 1931 | 0 | 71052 |
| Simbu | 0 | 0 | 0 | 0 | 238715 | 19900 | 0 | 0 | 2797 | 0 | 0 | 0 | 24902 | 1304 |
| Eastern highlands | 0 | 0 | 11425 | 57092 | 252561 | 73057 | 0 | 0 | 18128 | 0 | 0 | 7562 | 6332 | 71373 |
| Morobe | 0 | 0 | 0 | 0 | 6451 | 35513 | 19645 | 0 | 0 | 10509 | 41214 | 42371 | 483 | 301331 |
| Madang | 0 | 0 | 0 | 30680 | 13569 | 0 | 2187 | 0 | 36087 | 56272 | 0 | 21116 | 0 | 192654 |
| East sepik | 0 | 0 | 0 | 0 | 72501 | 92987 | 0 | 0 | 16896 | 0 | 0 | 4816 | 0 | 148265 |
| West sepik | 0 | 0 | 0 | 0 | 5320 | 0 | 0 | 0 | 0 | 0 | 5743 | 10796 | 0 | 131130 |
| Manus | 0 | 0 | 0 | 0 | 6420 | 0 | 0 | 0 | 0 | 0 | 3564 | 0 | 0 | 10718 |
| New Ireland | 0 | 0 | 0 | 0 | 0 | 5355 | 0 | 0 | 52261 | 0 | 8578 | 0 | 0 | 60983 |
| East New Britain | 150430 | 15349 | 0 | 0 | 0 | 0 | 0 | 16772 | 5440 | 0 | 0 | 11878 | 0 | 29205 |
| West New Britain | 0 | 27007 | 0 | 0 | 13414 | 39380 | 0 | 0 | 0 | 0 | 16599 | 6000 | 0 | 64564 |
| Autonomous Bougainvile | 0 | 0 | 0 | 0 | 0 | 48327 | 0 | 0 | 30315 | 0 | 9525 | 0 | 27702 | 94291 |
| total pop 2009 Domain by province | **150430** | **324854** | **11425** | **211384** | **994271** | **314519** | **21832** | **25890** | **309772** | **67680** | **281289** | **182711** | **70907** | **1462956** |
| % of pop 2009 Domain by province | **2.92** | **6.30** | **0.22** | **4.10** | **19.29** | **6.10** | **0.42** | **0.50** | **6.01** | **1.31** | **5.46** | **3.54** | **1.38** | **28.38** |

*Note: Rural PNG population is estimated using the agriculture systems in MASP database*

## Appendix 2b. continued

| | Cluster 5 LHH | | | Cluster 6 LHL | | Cluster 7 LLH | | Cluster 8 LLL |
|---|---|---|---|---|---|---|---|---|
| **Province** | **LHM** | **LMH** | **LMM** | **LHL** | **LML** | **LLH** | **LLM** | **LLL** |
| Western | 0 | 0 | 0 | 0 | 5498 | 0 | 0 | 90141 |
| Gulf | 0 | 0 | 4324 | 0 | 1144 | 0 | 0 | 95710 |
| Central | 11596 | 5979 | 21329 | 2173 | 4783 | 0 | 4991 | 0 |
| Milne Bay | 0 | 0 | 0 | 0 | 0 | 5248 | 3188 | 15918 |
| Oro | 0 | 0 | 57626 | 0 | 0 | 0 | 0 | 24475 |
| Southern Highlands | 0 | 0 | 0 | 0 | 0 | 37425 | 40409 | 15469 |
| Enga | 0 | 0 | 0 | 0 | 0 | 0 | 36817 | 0 |
| Western Highlands | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1994 |
| Simbu | 0 | 0 | 0 | 0 | 0 | 20292 | 0 | 0 |
| Eastern Highlands | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 336 |
| Morobe | 0 | 11251 | 1126 | 0 | 0 | 0 | 3137 | 881 |
| Madang | 0 | 0 | 0 | 0 | 1277 | 0 | 0 | 37747 |
| East Sepik | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 54617 |
| West Sepik | 0 | 0 | 0 | 0 | 0 | 0 | 1634 | 57759 |
| Manus | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21566 |
| New Ireland | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| East New Britain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15384 |
| West New Britain | 0 | 0 | 0 | 0 | 0 | 1928 | 4666 | 5244 |
| Autonomous Bougainvile | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| total pop 2009 Domain by province | **11596** | **17230** | **84405** | **2173** | **12702** | **64893** | **94842** | **437241** |
| % of pop 2009 Domain by | **0.22** | **0.33** | **1.64** | **0.04** | **0.25** | **1.26** | **1.84** | **8.48** |

## Appendix 3. Broad Constraints and Opportunities and other information for Agricultural Development Domain clusters

| ADD Clusters[1] (agr. potential, market access, pop. density) | % total pop | % total area | Important staples/cash crops | Socio-economic characteristics | Constraints | Opportunities |
|---|---|---|---|---|---|---|
| **Cluster 1: HHH (HHH, HMH, MMH, MHH, MMM, HMM)** | **38.9** | **9.5** | **Staple**: banana, sweet potato, cassava, Singapore taro, taro true<br><br>**Cash income**: cocoa, coconuts, fresh food, balsa, Coffee A, fresh food, oil palm, potato, pyrethrum | • People business minded,<br>• mostly semi-commercial farmers,<br>• increasing population,<br>• land shortage, | • Cocoa pod borer; volcanic eruptions;<br>• No potential for further agr. development (land shortages),<br>• financial management<br>• law & order<br>• high farm input costs<br>• lack of value chains for fresh & processed products,<br>• Lack of credit (banking facilities)<br>• Risk of environmental degradation;<br>• High prevalence of HIV/AIDs<br>• Deteriorating road access<br>• Limited technical knowledge and access to published information / extension services<br>• Non-availability of quality planting materials/seeds; lack of post harvest intervention<br>• Risk of drought and frost, high cloud cover (WHP);<br>• Frequent inundation, steep slopes, high rainfall,<br>• Varying levels of malnutrition | • Large potential for production of many crops;<br>• access to other domestic and export markets through port;<br>• alternative cash crops (e.g. galip, spices)<br>• Value addition, farm mechanisation,<br>• high food demand (urban expansion, mining),<br>• Cash incomes are high from coffee, fresh food, (sweet potato)<br>• Off-farm income earning opportunities/spin-off business |

| ADD Clusters[1] (agr. potential, market access, pop. density) | % total pop | % total area | Important staples/cash crops | Socio-economic characteristics | Constraints | Opportunities |
|---|---|---|---|---|---|---|
| **Cluster 2: HHL (HML, MML, MHL)** | **6.9** | **7.1** | **Staple**: Banana, Sweet potato, yam, taro, chinese taro<br><br>**Cash income:**<br><br>Coffee, A; sugar, oil palm, betelnut;<br><br>betelnut, aquaculture, aluvial mining, broiler chicken, logging, cattle, eagle wood, crafting, tapa cloth, rubber | • income is moderate to high from sale of fresh foods and royalties<br>• mining impact (in/out migration of different people),<br>• low access to education facilities and health centres<br>• poor management of royalties,<br>• loss of cultural values, | • steep slopes; low rainfall and long dry seasons, some inundation;<br>• poor road conditions; lack of storage facilities,<br>• limited land accessibility and land shortages, inefficient/underutilization of agriculture land<br>• declining soil productivity<br>• high cropping intensity (arable land locked in perennial crop),<br>• High transport and transaction cost<br>• Deforestation<br>• Loss of skills due to Rural-Urban drift<br>• cocoa pod borer;<br>• volcanic eruptions<br>• Limited information on improved agriculture practices | • high land potential;<br>• good access to services;<br>• potential for spin off business from mining;<br>• non-agricultural activities, increase income<br>• downstream processing in coconut<br>• Supply POM market,<br>• Access to timber for construction<br>• Sale of customary lands to potential buyers for other investment |

| ADD Clusters[1] (agr. potential, market access, pop. density) | % total pop | % total area | Important staples/cash crops | Socio-economic characteristics | Constraints | Opportunities |
|---|---|---|---|---|---|---|
| Cluster 3: HLH **(HLH, MLH, MLM)** | **10.3** | **3.2** | **Staple crops:** Taro, chin taro, Sweet Potato, banana<br><br>**Cash income:**<br>coconuts, cocoa, betelnut, Coffee A and R, potato, vanilla, vegetables | • Population. Pressure<br>• transport-time consuming<br>• Prevalence of communicable diseases like TB, Vit A deficiency, Nutritional issues,<br>• Difficult terrain, hard life,<br>• Literacy, health services, nutritional issues<br>• Manam islanders resettled to Mainland (currently social problems at Care Centres);<br>• cultural issue hindering appropriate nutrition, social obligation induced burden/stress,<br>• family planning issues to tackle burgeoning population<br>• out-migration to economically active regions,<br>• politically induced dependency on hand outs-shirkers (free money??) | • Islands of volcanic origin (Manam, Karkar, Bagabag) with active volcanoes;<br>• Threat by CPB;<br>• Risks of sea travel; high transport cost<br>• some parts long dry seasons, frequent cloud cover; steep slopes, declining soil fertility<br>• Poor extension services<br>• Law and order problems (tribal fights, criminal activities)<br>• High agricultural pressure and land vulnerable to degradation and declining soil fertility<br>• Lack of markets | • High absolute potential;<br>• Already established cash crops (cocoa, coconut);<br>• Local market opp;<br>• Some transport services existing<br>• low vol high value crops<br>• LNG project impact area<br>• Remittances from relatives,<br>• tourism opportunity |

| ADD Clusters[1] (agr. potential, market access, pop. density) | % total pop | % total area | Important staples/cash crops | Socio-economic characteristics | Constraints | Opportunities |
|---|---|---|---|---|---|---|
| Cluster 4: HLL (**HLL, MLL**) | **29.8** | **43.5** | **Staple crops**: Sweet Potato, sago, Chinese taro, Taro, Banana<br><br>**Cash income**: cocoa, coffee A, galip nut, oilpalm, betelnut | • very low incomes<br>• high level of malnutrition<br>• recovering from civil strife<br>• low educational status<br>• affected by periodic food shortages<br>• Poor infrastructure (electricity, roads, bridge)<br>• Out migration | • coca pod borer incursion<br>• High rainfall and cloud cover; flooding and seasonal inundation, medium to high risk of drought<br>• steep slopes, low soil productivity;<br>• Environmental degradation due to excessive logging<br>• Agriculture has varying importance<br>• Cocoa pod borer incursion; incursion of Bogia coconut syndrome (phytoplasma)<br>• Labour shift from agriculture to mining<br>• Poor means of communication<br>• Unavailability of superior planting materials<br>• Limited knowledge on relevant improved technologies and practices | • High production potential<br>• Underutilized land;<br>• Value addition on crocodile products;<br>• rich in resources (potential for non-agricultural<br>• Emerging food product markets for mining projects (LNG project impact area) and urban markets;<br>• Potential for high value light weight cash crops (e.g.vanilla)<br>• Underutilized land |

| ADD Clusters[1] (agr. potential, market access, pop. density) | % total pop | % total area | Important staples/cash crops | Socio-economic characteristics | Constraints | Opportunities |
|---|---|---|---|---|---|---|
| Cluster 5: LHH **(LMH, LHM , LMM)** | **2.1** | **1.0** | **Staple crops**: Banana<br><br>**Cash income**: fresh food, betelnut, coffee A, betel pepper, oilpalm | • Poor infrastructure (electricity, roads, bridge)<br><br>• Lack of incentives for health and agriculture extension workers and other social services | • Limited knowledge on: improved technologies and practices and access to agriculture extension services<br><br>• Unavailability of improved planting materials<br><br>• Land is prone to drought, flooding, landslides<br><br>• Infertile land limiting food production<br><br>• Limited access to markets<br><br>• Labour shortage/labour shift from agriculture to mining; outmigration<br><br>• Agricultural pressure and vulnerability of crop yield decline; infertile soil (clay & stoney)<br><br>• Much of the better land already under oil palm<br><br>• Limited access to alternative crops<br><br>• Lack of farm implements (tractors and accessories) for semi-commercial farming | • Mining (large scale and alluvial)<br><br>• Non-agricultural employment<br><br>• Potential for agricultural development around Kokoda and the volcanic plains inland of Popondetta |

| ADD Clusters[1] (agr. potential, market access, pop. density) | % total pop | % total area | Important staples/cash crops | Socio-economic characteristics | Constraints | Opportunities |
|---|---|---|---|---|---|---|
| Cluster 6: LHL (**LHL, LM**) | **0.34** | **0.35** | **Staple crops**: Banana, Yam,<br><br>Cassava, Sweet potato<br><br>**Cash income:**<br><br>Vegetables, sago, betelnut, fishing; Arts and crafts; informal economy (retailing stores goods); tourism and hospitality; performing cultural groups performing dances for visitors; forestry royalties | • Influences of Port Moresby city; peri-Urban<br>• High incidences of malaria, anaemia, malnutrition and increases of incidences of HIV/ AIDS cases<br>• Limited access to water & sanitation<br>• Law & order<br>• Diverse ethnic groups,<br>• Resistance to change to altenative farming practices by traditaional leaders (chiefs) in fear of losing their powers/status<br>• High malnutrition and anaemia, infant mortality<br>• Uncontrolled logging;<br>• Hunters & gatherers,<br>• Poor health services, lack of appreciation of value of education, | • Limited land,<br>• Hilly terrain within POM & peri urban areas, soil erosion, land degradation; poor soils; steep slopes<br>• significant in-migration (encroaching of traditional land);<br>• Long dry periods; low rainfalls; seasonal inundation in flood plain areas; water-logging<br>• Irregular supply of hybrid vegetable seeds,<br>• Limited labor for agricultural activities<br>• High incidence of pest/disease<br>• Cross-border biosecurity threats, smuggling life specimens;<br>• Food shortages;<br>• High and/or prohibitive freight cost;<br>• Lack of improved planting materials of food crops,<br>• Feral animals as pests (deer, wallabies, pigs) | • Good access to markets;<br>• Very good network of roads;<br>• Potential for non agriculture activities<br>• Royalties;<br>• Food demand created by expansion of Port Moresby City<br>• Niche markets<br>• Access to electricity supply<br>• Employment/income opportunities in and around Ramu Sugar;<br>• LNG Spin-off benefits<br>• Trans high way spin-off benefits<br>• Border trading with Australia (Torres Straits)<br>• Unexploited natural stock of barramundi fish<br>• Food and protein demand from Ok Tedi mine<br>• OK Tedi Mine royalties,<br>• Vast unused land |

| ADD Clusters[1] (agr. potential, market access, pop. density) | % total pop | % total area | Important staples/cash crops | Socio-economic characteristics | Constraints | Opportunities |
|---|---|---|---|---|---|---|
| **Cluster 7: LLH (LLH, LLM)** | **3.1** | **1.2** | **Staple crops**: Sweet Potato; banana<br><br>**Cash income**: Coffee A, fresh food, peanut, pyrethrum | • Informal markets (buai sales),<br>• Land ownership disputes (leads to tribal fights).<br>• Increasing incidence of HIV/AIDS<br>• Law and order;<br>• High malnutrition, stunting;<br>• Low education status | • Strong agriculture pressure (land degradation);<br>• Disruptions to food supplies;<br>• Low yield & quality of produce;<br>• Increased costs of agric inputs (e.g. chicken feed)<br>• Lack of information on agric cropping/ farming systems;<br>• Labour migration into LNG activities leads to shortage at family farm level<br>• Steep slopes, frequent cloud cover, high rainfall | • Low market accessibility is changing to medium/high market access due to LNG<br>• Market Potential with LNG;<br>• transfer of technical knowhow in f/mechanization |
| **Cluster 8: LLL (LLL)** | **8.5** | **34.3** | **Staple crops**: Sago, Sweet Potato, Yam, Chinese Taro,<br><br>**Cash income:**<br><br>Some rubber, pineapple, fresh food, fish, logging, oilpalm, betelnut, coffee | • Small/isolated//mostly subsistence based/ self-sustaining communities<br>• Some small semi-subsistence/semi-commercial activities<br>• People not traditional farmers (hunters and gatherers) and nomadic<br>• Serious infant malnutrition and nutritional deficiencies,<br>• Low cash income<br>• strong cultural attachments and beliefs<br>• Poor access to service<br>• Regular flooding (but important for maintenance of soil fertility); agriculture not important; trade fish for sago | • unproductive environments (high rainfalls in North Fly; poor soils, flooding); population confined to productive land;<br>• drought risks; Salinity problems<br>• royalty payments discouraging other economic activities;<br>• Sago decline (low starch, depleting stock,) | • Niche opportunities (mine and LNG project impact area - opportunity for selling to mines);<br>• Resource rich/pristine natural environment<br>• Eco-tourism: Lakekamu Basin (Conservation), Game Fishing)<br>• Underutilized land and fresh water and marine resources |

*[1] Market access: low – 4-8 hrs to reach prov. capital of urban centre (more than 1000 people); moderate – 1-4 hrs to a prov. capital or urban centre (>2000 people); high – less than 1 hrs to major regional centre. Information sources: the Rural Development Handbook (Hanson et al. 2001), the Text summaries for the 'Agricultural Systems of PNG' (Bourke et al. 1998) supplemented by data and information available from the 2001/2002 NARI priority setting exercise (NARI 2004), personal observations of NARI staff and partners and other sources*

# Appendix 4. Consolidated Project Area Objectives and Project Areas in eight ADD clusters and four NARI Programmes

## Programme - Agricultural Systems Improvement

**Programme Objective: Productivity, efficiency and stability of agricultural production systems enhanced**

| Consolidated Project Area Objective (Sub-programmes) | Project Area Objectives | Agricultural Development Domain Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Smallholder farmers use improved and sustainable land and soil fertility management practices | 1. Men and women small holder farmers use improved and sustainable land and soil fertility management practices | X (5/11) | | X (3/6) | X (2/7) | X (1/6) | [x (4/7)] | X (1/9) | X (1/3) |
| 2. Smallholder farmers effectively integrate crops, livestock and aquaculture systems | 2. Improved integration of crops, livestock and fisheries | | X (2/6) | | | X (4/6) | X (1/7) | | |
| | 3. Adequate cultivable land/Reduced land pressure | | | X (5/6) | | | | X (4/9) | |
| | 4. Alternative low input crop options and improved varieties integrated into sago and sweet potato based production systems | | | | | | | | X (2/3) |
| | 5. Adapted low maintenance livestock and fishery options integrated in LLL communities | | | | | | | | X (3/3) |
| 3. Increased use of suitable quality planting materials, breeding stock and other farm inputs by smallholder farmers | 6. Farm inputs are more affordable for men and women smallholder farmers | X (6/11) | | | | | | | |
| | 7. Access to and appropriate use of farm inputs for crop and livestock production increased | | | | X (6/7) | | | | |
| | 8. Access to suitable quality planting materials and breeding livestock by men and women smallholder farmers improved. | X (4/11) | | X (2/6) | X (3/7) | | X (3/6) | X (3/9) | |
| | 9. Management and production of depleting Sago stocks improved. | | | | X (4/7) | | | | |
| 4. Marketing systems for crop and livestock products improved | 10. Marketing of and value addition opportunities for crop and livestock products improved | X (1/11) | X (1/6 & 4/6) | X (1/6) | X (1/7) | X (3/6) | X (2/6) | X (5/9) | |
| 5. Biotic agro ecosystem threats are sustainably managed by smallholder farmers | 11. Men and women smallholder farmers use effective and sustainable crop pest, disease and weed management practices | X (2/11) | X (6/6) | X (4/6) | X (5/7) | | X (5/6) | X (2/9) | |
| | 12. Men and women smallholder farmers have increased capability to manage livestock health threats | X (2/11) | X (6/6) | X (4/6) | X (5/7) | | X (5/6) | X (2/9) | |

| Consolidated Project Area Objective (Sub-programmes) | Project Area Objectives | Agricultural Development Domain Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 6. Smallholder farming communities are better prepared to cope with abiotic stresses due to seasonal weather patterns or climate change and natural disasters | 13. Men and women smallholder farmers are better prepared to manage impacts of frost and excessive cloud cover | | | | | | | X (7/9)) | |
| | 14. Improved capability of men and women smallholder farmers to manage periods of water shortage and water excess (incl. high rainfall, sea water inundation) | X (9/11) X (8/11) 10/11 | X (3/6) | X (6/6) | X (7/7) [x (2/7)] | 2/6) | X (4/7) | X (6/9 | |
| | 15. Smallholder farming communities and institutions can effectively respond to natural disasters with agricultural rehabilitation | X (11/11) | | | | | | | |
| | 16. Opportunities explored to produce low altitude crops in high altitudes with increasing temperature due to climate change | | | | | | | X (9/9) | |
| 7. Farm mechanization and availability of farm labour from smallholder farmers increased and more efficiently used | 17. Adequate energy input into agricultural production | X (7/11) | | | | | | | |
| | 18. Availability of farm labour increased | | X (5/6) | | | X (6/6) | X (6/6) | X (7/9) | |

*Figures in parentheses are the priority rankings of the project area objectives in the respective ADD clusters*

## Programme - Enabling Environment

**Programme Objective: Enabling environment (policy, market, institutions) for sustainable agricultural development influenced**

| Consolidated project area objectives (Sub-programmes) | Project area objectives | Agricultural Development Domains Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Improved marketing opportunities for agricultural commodities available to smallholder farmers | 1. Improved market access | X (1/3) | | | | X (1/6) | | X (1/2) | |
| | 2. Access to developed and new markets improved | X (3/3) | | | | | | | |
| | 3. Effective marketing and trade (barter) for remote LLL communities | | | | | | | | X (5/5) |
| 2. Conducive socio-cultural environment influenced | 4. Conducive Socio-cultural environment | X (2/3) | X (3/4) | | X (5/5) | X (5/6) | X (3/4) | X (2/2) | |
| 3. Improved ability for farming communities to mobilize land for agricultural development | 5. Improved access to land (include peri-urban) | | | | X (3/5) | | X (4/4) | | |
| | 6. Efficient use of deforested and mine impacted land (Rehabilitation) | | | | X (4/5) | | | | |

| Consolidated project area objectives (Sub-programmes) | Project area objectives | Agricultural Development Domains Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 4. Access to socio-economic services for smallholder farmers improved | 7. Improved access to basic socio-economic services (health, education, roads, bridge, communications) | | X (2/4) | X (1/5) | X (2/5) | X (6/6) | | | |
| | 8. Improved investment in social service infrastructure | | | | | | | | X (1/5) |
| | 9. Effective and improved communication and allied infrastructure (from P2) | | | X (5/5) | | | | | |
| 5. Institutional arrangements improved | 10. Adequate access to agricultural and allied inputs | | | X (3/5) | | X (2/6) | X (1/4) | | |
| | 11. Increased investment in agricultural research and wealth creation. | | | | X (1/5) | | | | |
| | 12. Adequate price support system established | | | | | X (3/6) | | | |
| | 13. Relevant and user friendly seed policy established | | | | | X (4/6) | | | |
| | 14. Optimized access to border trading | | | | | | X (2/4) | | |
| | 15. Improved access to affordable transport options to remote LLL communities | | | | | | | | X (2/5) |
| | 16. Appropriate response to natural disaster and emergency response | | | | | | | | X (3/5) |
| | 17. Adequate social security at community level (with regards to access to opportunities) | | | X (2/5) | | | | | |
| 6. Income opportunities identified for farming communities | 18. Alternate income earning opportunities (agro-tourism) | | X (4/4) | X (4/5) | | | | | X (4/5) |
| | 19. Increased employment opportunities | | X (1/4) | | | | | | |

*Figures in parentheses are the priority rankings of the project area objectives in the respective ADD clusters*

## Programme - Information and Knowledge

### Programme Objective: Use of information and knowledge in the agricultural sector effectively enhanced

| Consolidated Project Area Objectives | Project Area Objectives | Agricultural Development Domain Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Information is effectively packaged and disseminated to NARI clients and stakeholders | 1. Information appropriately packaged | X (2/4) | | | X (3/5) | X (2/2) | X (1/2) | | |
| | 2. Improved access to information | X (4/4) | X (1/2) | X (1/2) | X (1/5) | X (1/2) | X (2/2) | X (1/3) | X (2/2) |
| | 3. Improved responses of farming communities | | | X (2/2) | | | | | |
| | 4. Improved access to information on livelihood options | | | | | | | | X (2/2) |
| 2. Learning needs of smallholder farmers identified and appropriately addressed | 5. Farmers learning facilitated | X (1/4) | | | | | | X (3/3) | |
| | 6. Improved understanding of appropriate livelihood options | | | | X (2/5) | | | | X (1/2) |
| | 7. Appropriate extension models identified | | X (2/2) | | | | | X (2/3) | |
| 3. Information is effectively managed by NARI | 8. Improved information management system established | X (3/4) | | | X (5/5) | | | | |
| 4. Appropriate and effective Information facilities developed in NARI and assistance provided to partners | 9. Appropriate and effective Information facilities developed in NARI and assistance provided to partners | | | | | X (4/5) | | | |

*Figures in parentheses are the priority rankings of the project area objectives in the respective ADD clusters*

## Programme - Institutional Management and Development

### Programme Objective: Enhanced efficiency and congenial institutional environment for effective ARD

| Consolidated Project Area Objectives (Sub-programmes) | Project Area Objectives | Agricultural Development Domain Clusters | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Research performance of the Institute and staff effectively improved in NARI | 1. Effective results-based performance management system | | | | X | | | | |
| | 2. Result-oriented plans | | X | | | | | | |
| 2. Human talents, financial and material resources adequately mobilized and managed in NARI | 3. Effective resource mobilization | X | | | | | | | |
| | 4. Appropriate capacity available (staff and facilities) | X | X | X | X | X | X | X | X |
| 3. A congenial working environment established, fostered and maintained within NARI | 5. Conducive working environment | | | X | | | | | |
| 4. Effective development and management of partnerships, collaborations with and provision of efficient technical services to stakeholders | 6. Conducive environment established for effective partnership & collaboration | X | | | | | | | |
| | 7. Effective networking | | | X | | X | | | |
| | 8. Effective collaboration and partnership | | X | | X | | X | | X |
| | 9. Efficient technical services provided to stakeholders and clients | | | | | | | | |
| 5. Appropriate conducive institutional policies and strategies developed and implemented in the Institute | 10. Workplace policy on gender developed | X | | | | | | | |
| | 11. Workplace policy on HIV/AIDS for partner institution | | | | X | | | | X |
| 6. Effective and prudent leadership and stewardship incorporating the mechanisms, processes and structures | 12. Effective NARI and partner institution governance and leadership | X | | | | | | | |

# Appendix 5. Prioritization process for Project Areas

The core planning team at NARI HQ (R. Ghodake, N. Omot, P. Kohun, S. Bang, B. Komolong, J. Ryan, J. Maro) developed a priority setting process for the PAs in Programmes 1-3, while Programme 4 was be considered at a later stage as it builds on the results from the other three programmes. The following section outlines the priority setting process that was applied for PAs in Programmes 1-3. The programmes were prioritized in the following order: Programme 1, 3 and 2. Members of the panel initially scored individually for each of the criteria and subsequently averaged to produce the end score per PA.

## A5.1 Prioritization methodology Programme 1 – Agricultural Systems

**Step 1: Macro Environment**

a) Direct or indirect impact pathway to Institute Goal

b) Direct or indirect impact pathway to Institute SO

Score all PA against the two criteria with 5 = yes and 1 = no

**Step 2: Human and physical environment and national importance**

c) Relevant to maximum number of clusters (5 = targeting all clusters, 4 = targeting 6-7 clusters, 3 = 4-5 clusters, 2 = 2-3 clusters, 1 = 0-1 clusters)

d) Targeting maximum population (absolute values of percent population covered by respective PAs were used and converted into proportionate scores with 5 = 100%, e.g. 82.5% population is equivalent to a score of 4.1 (82.5x5/100).

e) Targeting neglected difficult and isolated population areas (5 = at least 1 cluster having neglected/isolated areas targeted; 1 = no neglected/isolated areas targeted)

Note: isolated/neglected areas are generally in those clusters with low access

f) Nationally important with or without considerations (c-e)

Nationally important issues directly considered in PAs:

- export orientation
- border security through ARD
- market supply & demand chain
- climate change
- natural disasters
- enclave development

criteria c-f were considered parallel in this Step.

**Step 3: Impact and Feasibility**

g) potential benefits (5 = 5 and more potential benefits expected, 4 = 4 of the benefits expected, 3 = 3, 2 = 2, 1 = 1 of the benefits expected), weight 0.3

- income generation
- food security (subsistence)

- environmental quality
- improved rural employment
- community welfare (social, equity incl gender, youth, disadvantaged)
- internal benefits (increased capacity)
- potential spill-over effects (e.g. addressing outcomes in other sectors, collaborations with commodity RD org, regional application of outputs)

h) Adoption likelihood (5 = not very complex, 1= complex; scored from 1-5), weight 0.2

**Note:**

**consideration is about:**

- What is involved (effort required to make things happen)
- The simpler the new practice is the lower the level of local adaptation needed; complexity of the issues)
- much under NARI control or many externalities

i) scientific potential (5 = yes there is scientific potential; 1 = no scientific potential), weight 0.1

Note: scientific potential includes biophysical and social science

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

Criteria g-j were considered simultaneously and after scoring each of the criteria, an aggregated weighted score was calculated for Impact and Feasibility.

**Step 4: an overall aggregated, weighted score was produced using**

- aggregated, weighted score for Impact and Feasibility (weight 0.5)
- Relevant to maximum number of clusters (weight 0.1)
- Targeting maximum of population, proportionate score (weight 0.4)

**Step 5: High priority PAs will include those with the highest overall aggregate, weighted score; criteria e and f (neglected/isolated areas, nationally important issues) will also have to be considered in final decision making (Table 7). Results of the different prioritization steps are shown in Table A5.1.**

**Table A5.1. Results of Prioritization steps in Programme – Agricultural Systems**

| Programme 1 | Step 1 | | Step 2 | | | |
|---|---|---|---|---|---|---|
| | Macro Environment | | Human and physical Environment and National Importance | | | |
| **Project area** | **Direct or indirect impact pathway to Institute Goal** | **Direct or indirect impact pathway to Institute SO** | **Relevant to maximum number of clusters** | **Targeting maximum population** | **Targeting neglected difficult and isolated population areas** | **nationally important with or without considerations (D, E, F)** |
| | yes = 5; no = 1 | yes = 5; no = 1 | score 1-5 (5=highest priority, targeting all clusters, 4= 6-7 clusters, 3=4-5, 2=2-3, 1= 0-1 clusters) | proportionate score (100% population =5) | 1= neglected areas not addressed; 5= neglected areas addressed | yes (either one of the criteria addressed) = 5; no = 1 |
| 1. Men and women small holder farmers use improved and sustainable land and soil fertility management practices | 5 | 5 | 4 | 4.1 | 5 | 5 |
| 2. Improved integration of crops, livestock and fisheries | 5 | 5 | 2 | 4.6 | 1 | 1 |
| 3. Adequate cultivable land/Reduced land pressure | 5 | 5 | 2 | 4.6 | 5 | 1 |
| 4. Alternative low input crop options and improved varieties integrated into sago and sweet potato based production systems | 5 | 5 | 1 | 4.7 | 5 | 1 |
| 5. Adapted low maintenance livestock and fishery options integrated in LLL communities | 5 | 5 | 1 | 4.5 | 5 | 1 |
| 6. Farm inputs are more affordable for men and women smallholder farmers | 5 | 5 | 1 | 4.5 | 1 | 5 |
| 7. Access to and appropriate use of farm inputs for crop and livestock production increased | 5 | 5 | 1 | 1.9 | 5 | 5 |
| 8. Access to suitable quality planting materials and breeding livestock by men and women smallholder farmers improved. | 5 | 5 | 3 | 1.9 | 5 | 5 |
| 9. Management and production of depleting Sago stocks improved. | 5 | 5 | 1 | 1.5 | 5 | 1 |
| 10. Marketing of and value addition opportunities for crop and livestock products improved | 5 | 5 | 4 | 4.6 | 5 | 5 |
| 11. Smallholder farmers experience reduced crop losses due to pests, diseases and weeds | 5 | 5 | 4 | 4.5 | 5 | 5 |
| 12. Smallholder farmers experience reduced livestock losses due to pests and diseases | 5 | 5 | 4 | 4.5 | 5 | 5 |
| 13. Men and women smallholder farmers are better prepared to manage impacts of frost and excessive cloud cover | 5 | 5 | 2 | 1.6 | 5 | 5 |

| Programme 1 | Step 1 | | Step 2 | | | |
|---|---|---|---|---|---|---|
| | Macro Environment | | Human and physical Environment and National Importance | | | |
| **Project area** | **Direct or indirect impact pathway to Institute Goal** | **Direct or indirect impact pathway to Institute SO** | **Relevant to maximum number of clusters** | **Targeting maximum population** | **Targeting neglected difficult and isolated population areas** | **nationally important with or without considerations (D, E, F)** |
| 14. Improved capability of men and women smallholder farmers to manage periods of water shortage and water excess (incl. high rainfall, sea water inundation) | 4 | 5 | 4 | 4.6 | 5 | 5 |
| 15. Smallholder farming communities and institutions can effectively respond to natural disasters with agricultural rehabilitation | 3.5 | 5 | 1 | 1.9 | 1 | 5 |
| 16. Opportunities explored to produce low altitude crops in high altitudes with increasing temperature due to climate change | 4 | 5 | 1 | 0.2 | 5 | 5 |
| 17. Adequate energy input into agricultural production | 5 | 5 | 1 | 1.9 | 1 | 5 |
| 18. Availability of farm labour increased | 5 | 5 | 3 | 0.6 | 5 | 5 |

**Table A5.1 continued**

| Programme 1 | Step 3 | | | | |
|---|---|---|---|---|---|
| | Impact and Feasibility | | | | |
| **Project area** | **potential benefits** scoring: 1 issue addressed = 1; 2 = 2; 3 =3; 4 = 4; 5> = 5 | **Adoption likelihood** 1= complex; 3= medium; 5= less complex (can be scored from 1-5) | **scientific potential** yes (issues involved that can be addressed through science or there are research needs) = 5; no = 1 | **research capacity** 1=little; 3 = some; 5 = good | **Aggregated weighted score (Step 3)** |
| weights | 0.3 | 0.2 | 0.1 | 0.4 | |
| 1. Men and women small holder farmers use improved and sustainable land and soil fertility management practices | 4 | 3 | 5 | 3 | 3.5 |
| 2. Improved integration of crops, livestock and fisheries | 5 | 4 | 5 | 4 | 4.4 |
| 3. Adequate cultivable land/Reduced land pressure | 4 | 2 | 5 | 2 | 2.9 |
| 4. Alternative low input crop options and improved varieties integrated into sago and sweet potato based production systems | 3 | 4 | 5 | 4 | 3.8 |
| 5. Adapted low maintenance livestock and fishery options integrated in LLL communities | 4 | 4 | 5 | 4 | 4.1 |
| 6. Farm inputs are more affordable for men and women smallholder farmers | 4 | 4 | 5 | 3 | 3.7 |
| 7. Access to and appropriate use of farm inputs for crop and livestock production increased | 4 | 3 | 5 | 3 | 3.5 |
| 8. Access to suitable quality planting materials and breeding livestock by men and women smallholder farmers improved. | 4.5 | 4 | 5 | 4.5 | 4.45 |
| 9. Management and production of depleting Sago stocks improved. | 3 | 2 | 5 | 1 | 2.2 |
| 10. Marketing of and value addition opportunities for crop and livestock products improved | 5 | 4 | 5 | 3 | 4 |
| 11. Smallholder farmers experience reduced crop losses due to pests, diseases and weeds | 4 | 3 | 5 | 3 | 3.5 |
| 12. Smallholder farmers experience reduced livestock losses due to pests and diseases | 4 | 3 | 5 | 2 | 3.1 |
| 13. Men and women smallholder farmers are better prepared to manage impacts of frost and excessive cloud cover | 3 | 3 | 5 | 3 | 3.2 |
| 14. Improved capability of men and women smallholder farmers to manage periods of water shortage and water excess (incl. high rainfall, sea water inundation) | 4 | 3 | 5 | 4 | 3.9 |
| 15. Smallholder farming communities and institutions can effectively respond to natural disasters with agricultural rehabilitation | 3 | 3 | 5 | 3 | 3.2 |
| 16. Opportunities explored to produce low altitude crops in high altitudes with increasing temperature due to climate change | 3 | 3 | 5 | 3 | 3.2 |
| 17. Adequate energy input into agricultural production | 4 | 4 | 5 | 3 | 3.7 |
| 18. Availability of farm labour increased | 5 | 3 | 5 | 2 | 3.4 |

**Table A5.1 contin.**

| Programme 1 | Step 4 | | | |
|---|---|---|---|---|
| **Project area** | **Aggregated weighted score (from Step 3)** | **Relevant to maximum number of clusters (from Step 2)** | **Targeting maximum population (from Step 2)** | **Final aggregate weighted score** |
| weights | 0.5 | 0.1 | 0.4 | |
| | **High priority** | | | |
| 8. Access to suitable quality planting materials and breeding livestock by men and women smallholder farmers improved. | 4.45 | 3 | 1.9 | 4.2 |
| 10. Marketing of and value addition opportunities for crop and livestock products improved | 4 | 4 | 1.9 | 4.2 |
| 14 Improved capability of men and women smallholder farmers to manage periods of water shortage and water excess (incl. high rainfall, sea water inundation) | 3.9 | 4 | 0.6 | 4.2 |
| 1. Men and women small holder farmers use improved and sustainable land and soil fertility management practices | 3.5 | 4 | 4.1 | 4.0 |
| 11. Smallholder farmers experience reduced crop losses due to pests, diseases and weeds | 3.5 | 4 | 1.6 | 3.9 |
| 12. Smallholder farmers experience reduced livestock losses due to pests and diseases | 3.1 | 4 | 1.5 | 3.7 |
| | **Medium priority** | | | |
| 6. Farm inputs are more affordable for men and women smallholder farmers | 3.7 | 1 | 4.5 | 2.7 |
| 17. Adequate energy input into agricultural production | 3.7 | 1 | 1.5 | 2.7 |
| 2. Improved integration of crops, livestock and fisheries | 4.4 | 2 | 4.6 | 2.6 |
| 15. Smallholder farming communities and institutions can effectively respond to natural disasters with agricultural rehabilitation | 3.2 | 1 | 0.4 | 2.5 |
| 13. Men and women smallholder farmers are better prepared to manage impacts of frost and excessive cloud cover | 3.2 | 2 | 0.4 | 2.5 |
| 7. Access to and appropriate use of farm inputs for crop and livestock production increased | 3.5 | 1 | 1.9 | 2.4 |
| | **Low priority** | | | |
| 5. Adapted low maintenance livestock and fishery options integrated in LLL communities | 4.1 | 1 | 4.5 | 2.3 |
| 18. Availability of farm labour increased | 3.4 | 3 | 0.2 | 2.2 |

| **Programme 1** | **Step 4** | | | |
|---|---|---|---|---|
| **Project area** | **Aggregated weighted score (from Step 3)** | **Relevant to maximum number of clusters (from Step 2)** | **Targeting maximum population (from Step 2)** | **Final aggregate weighted score** |
| 4. Alternative low input crop options and improved varieties integrated into sago and sweet potato based production systems | 3.8 | 1 | 4.7 | 2.2 |
| 3. Adequate cultivable land/Reduced land pressure | 2.9 | 2 | 4.6 | 2.0 |
| 9. Management and production of depleting Sago stocks improved. | 2.2 | 1 | 0.5 | 1.8 |
| 16. Opportunities explored to produce low altitude crops in high altitudes with increasing temperature due to climate change | 3.2 | 1 | 0.7 | 1.8 |

## A5.2 Prioritization methodology in Programme 2 – Enabling Environment

**Step 1: The first step for Programme 2 Enabling Environement was to score the Programme PAs on four different criteria**

a) Relevant to maximum number of clusters (5 = targeting all clusters, 4 = targeting 6-7 clusters, 3 = 4-5 clusters, 2 = 2-3 clusters, 1 = 0-1 clusters)

b) Targeting maximum population (absolute values of percent population covered by respective PAs were used and converted into proportionate scores with 5 = 100%, e.g. 82.5% is equivalent to a score of 4.1 (82.5x5/100)

c) extent of independent contribution to the P3 SO (score from 1-5; 5 = very high contribution, 1 = very little contribution)

d) extent of linkage to P1 PAs (score from 1-5; 5 = very high linkage, 1 = very little or no linkage)

An average score was calculated for c and d and will be considered parallel to the scores in a and b.

**Step 2: Impact and Feasibility**

e) potential benefits (5 = 5 and more potential benefits expected, 4 = 4 of the benefits expected, 3 = 3, 2 = 2, 1 = 1 of the benefits expected), weight 0.3

- income generation
- food security (subsistence)
- environmental quality
- improved rural employment
- community welfare (social, equity incl gender, youth, disadvantaged)
- internal benefits (increased capacity)
- potential spill-over effects (e.g. addressing outcomes in other sectors, collaborations with commodity RD org, regional application of outputs)

f) Adoption likelihood (5 = not very complex, 1= complex; scored from 1-5), weight 0.2

Note: consideration is about:

- What is involved (effort required to make things happen)
- The simpler the new practice is the lower the level of local adaptation needed; complexity of the issues)
- much under NARI control or many externalities

g) scientific potential (scored with 3 or 4; 3 -less tools, techniques, models, methods, data, approaches etc available; 4 = more available), weight 0.1

h) Research capacity (scored from 1-5, 5 = very good, 1 = very little to no capacity), weight 0.4

Criteria e-h were considered simultaneously and after scoring each of the criteria, an aggregated weighted score was calculated for Impact and Feasibility.

**Step 3: an overall aggregated, weighted score was produced using**

- aggregated, weighted score for Impact and Feasibility (weight 0.4)
- Relevant to maximum number of clusters (weight 0.1)
- Targeting maximum of population, proportionate score (weight 0.2)
- Average score for c and d (see Step 1, independent contribution to P3 SO and linkage to P1 PAs), weight 0.3

**Step 4: High priority PAs will include those with the highest overall aggregate, weighted score (Table 7). Results of the different prioritization steps are shown in Table A5.2.**

## A5.3 Prioritization methodology for Programme 3 – Information and Knowledge

Only a simple prioritization process was applied in Programme 3 Information and Knowledge. It was also decided to exclude PA 1-4 (Table 7) from the prioritization process as all of them are horizontally linked to Programmes 1 and 3 and get inputs from respective programmes and vice versa provide important inputs to the other programmes.

The remaining PAs were scored according the criteria above for Impact and Feasibility:

**Table A5.2. Results of Prioritization steps in Programme 2 – Enabling Environment**

| Programme 3 | Step 1 | | | | |
|---|---|---|---|---|---|
| | Relevant to maximum number of clusters | Targeting maximum population | extent of independent contribution to the P3 SO | extent of linkage to P1 PAs | Average aggregate score |
| 1. Improved market infrastructure (access) | 2 | 4.1 | 5 | 5 | 5 |
| 2. Access to developed and new markets improved (creating knowledge on markets) | 1 | 2.2 | 4 | 5 | 4.5 |
| 3. Effective marketing and trade (barter) for remote LLL communities | 1 | 1.9 | 4 | 4.5 | 4.25 |
| 4. Conducive Socio-cultural environment | 4 | 1.5 | 4 | 4 | 4 |
| 5. Improved access to land (include peri-urban) | 2 | 0.6 | 3.5 | 4 | 3.75 |
| 6. Efficient use of deforested and mine impacted land (Rehabilitation) | 1 | 0.1 | 2.5 | 3 | 2.75 |
| 7. Improved access to basic socio-economic services (health, education, roads, bridge, communications) | 3 | 0.4 | 4 | 1 | 2.5 |
| 8. Improved investment in social service infrastructure | 1 | 0.3 | 3 | 1 | 2 |
| 9. Effective and improved communication and allied infrastructure (from P2) | 1 | 0.1 | 3 | 1.5 | 2.25 |
| 10. Adequate access to agricultural and allied inputs (mostly credit) | 2 | 2.5 | 4 | 5 | 4.5 |
| 11. Increased investment in agricultural research and wealth creation. | 1 | 1.5 | 4 | 3 | 3.5 |
| 12. Adequate price support system established | 1 | 0.4 | 4.5 | 3 | 3.75 |
| 13. Relevant and user friendly seed policy established | 1 | 1.3 | 4 | 4 | 4 |
| 14. Optimized access to border trading | 1 | 1.5 | 2.5 | 2.5 | 2.5 |
| 15. Improved access to affordable transport options to remote LLL communities | 1 | 0.5 | 3 | 2 | 2.5 |
| 16. Appropriate response to natural disaster and emergency response | 1 | 0.4 | 4 | 4 | 4 |
| 17. Adequate social security at community level (with regards to access to opportunities) | 1 | 0.4 | 3 | 1 | 2 |
| 18. Alternate income earning opportunities (agro-tourism, alternate use of forest resources) | 2 | 0.0 | 3 | 1.5 | 2.25 |
| 19. Increased employment opportunities | 1 | 0.5 | 4 | 3.5 | 3.75 |

**Table A5.2 continued**

| Programme 3 | Step 2 | | | | |
|---|---|---|---|---|---|
| | potential benefits | Adoption likelihood | scientific potential | research capacity | weighted aggregate score for Impact/Feasibility |
| Weights | **0.3** | 0.2 | **0.1** | 0.4 | |
| 1. Improved market infrastructure (access) | **4** | 2 | **3** | 3 | 3.1 |
| 2. Access to developed and new markets improved (creating knowledge on markets) | **4** | 4 | **4** | 3 | 3.6 |
| 3. Effective marketing and trade (barter) for remote LLL communities | **3** | 2 | **3** | 2 | 2.4 |
| 4. Conducive Socio-cultural environment | **2.5** | 2 | **3** | 3 | 2.65 |
| 5. Improved access to land (include peri-urban) | **3** | 2 | **3** | 2 | 2.4 |
| 6. Efficient use of deforested and mine impacted land (Rehabilitation) | **2.5** | 3 | **3** | 1 | 2.05 |
| 7. Improved access to basic socio-economic services (health, education, roads, bridge, communications) | **3** | 3 | **4** | 2 | 2.7 |
| 8. Improved investment in social service infrastructure | **3** | 2 | **3** | 2 | 2.4 |
| 9. Effective and improved communication and allied infrastructure (from P2) | **3** | 3 | **4** | 2 | 2.7 |
| 10. Adequate access to agricultural and allied inputs (mostly credit) | **4** | 3 | **4** | 3.5 | 3.6 |
| 11. Increased investment in agricultural research and wealth creation. | **5** | 4 | **4** | 4 | 4.3 |
| 12. Adequate price support system established | **4** | 3 | **4** | 4 | 3.8 |
| 13. Relevant and user friendly seed policy established | **4** | 4 | **4** | 4 | 4 |
| 14. Optimized access to border trading | **2** | 2 | **3** | 1.5 | 1.9 |
| 15. Improved access to affordable transport options to remote LLL communities | **3.5** | 2 | **3** | 1 | 2.15 |
| 16. Appropriate response to natural disaster and emergency response | **4.5** | 3 | **4** | 3 | 3.55 |
| 17. Adequate social security at community level (with regards to access to opportunities) | **2.5** | 1 | **3** | 1 | 1.65 |
| 18. Alternate income earning opportunities (agro-tourism, alternate use of forest resources) | **3** | 3 | **3** | 2 | 2.6 |
| 19. Increased employment opportunities | **4.5** | 4 | **4** | 3 | 3.75 |

**Table A5.2 continued**

| Programme 3 | Step 3 | | | | |
|---|---|---|---|---|---|
| **Project area** | **Aggregated weighted score (from Step 2)** | **Relevant to maximum number of clusters (from Step 2)** | **Targeting maximum population (from Step 2)** | **Average score Column 4 and 5 Step 1** | **Final weighted score** |
| **weights** | 0.4 | **0.1** | **0.2** | 0.3 | |
| | **High priority** | | | | |
| 4. Conducive Socio-cultural environment | 2.65 | 4 | 4.1 | 4 | 3.5 |
| 1. Improved market infrastructure (access) | 3.1 | 2 | 2.2 | 5 | 3.4 |
| 2. Access to developed and new markets improved (creating knowledge on markets) | 3.6 | 1 | 1.9 | 4.5 | 3.3 |
| 11. Increased investment in agricultural research and wealth creation. | 4.3 | 1 | 1.5 | 3.5 | 3.2 |
| 10. Adequate access to agricultural and allied inputs (mostly credit) | 3.6 | 2 | 0.6 | 4.5 | 3.1 |
| 13. Relevant and user friendly seed policy established | 4 | 1 | 0.1 | 4 | 2.9 |
| | **Medium priority** | | | | |
| 16. Appropriate response to natural disaster and emergency response | 3.55 | 1 | 0.4 | 4 | 2.8 |
| 19. Increased employment opportunities | 3.75 | 1 | 0.3 | 3.75 | 2.8 |
| 12. Adequate price support system established | 3.8 | 1 | 0.1 | 3.75 | 2.8 |
| 7. Improved access to basic socio-economic services (health, education, roads, bridge, communications) | 2.7 | 3 | 2.5 | 2.5 | 2.6 |
| 5. Improved access to land (include peri-urban) | 2.4 | 2 | 1.5 | 3.75 | 2.6 |
| 3. Effective marketing and trade (barter) for remote LLL communities | 2.4 | 1 | 0.4 | 4.25 | 2.4 |
| 18. Alternate income earning opportunities (agro-tourism, alternate use of forest resources) | 2.6 | 2 | 1.3 | 2.25 | 2.2 |
| | **Low priority** | | | | |
| 6. Efficient use of deforested and mine impacted land (Rehabilitation) | 2.05 | 1 | 1.5 | 2.75 | 2.0 |
| 9. Effective and improved communication and allied infrastructure (from P2) | 2.7 | 1 | 0.5 | 2.25 | 2.0 |
| 15. Improved access to affordable transport options to remote LLL communities | 2.15 | 1 | 0.4 | 2.5 | 1.8 |
| 8. Improved investment in social service infrastructure | 2.4 | 1 | 0.4 | 2 | 1.7 |
| 14. Optimized access to border trading | 1.9 | 1 | 0.0 | 2.5 | 1.6 |
| 17. Adequate social security at community level (with regards to access to opportunities) | 1.65 | 1 | 0.5 | 2 | 1.5 |

**Table A5.3. Results of Prioritization steps in Programme 3 – Information and Knowledge**

| **Programme 2** | **potential benefits** | **Adoption likelihood** | **scientific potential** | **research capacity** | **weighted aggregate score for Impact/Feasibility** |
|---|---|---|---|---|---|
| | scoring: 1 issue addressed = 1; 2 = 2; 3 =3; 4 = 4; 5> = 5 | 1= complex; 3= medium; 5= less complex (can be scored from 1-5) | scoring: 3-4; 3 -less tools, techniques, models, methods, data, approaches etc available; 4 = more available | Scoring from 1-5; 5 = very good capacity, 1 = very little or no capacity) | |
| **weights** | 0.3 | 0.2 | 0.1 | 0.4 | |
| 1. Information appropriately packaged | not considered, will come from P1 and P3 | | | | |
| 2. Improved access to information | | | | | |
| 3. Improved responses of farming communities | | | | | |
| 4. Improved access to information on livelihood options | | | | | |
| 5. Improved information management system established | 4 | 4 | 3 | 3 | 3.5 |
| 6. Appropriate and effective Information facilities developed in NARI and assistance provided to partners | 4 | 3 | 4 | 3 | 3.4 |
| 7. Appropriate extension models identified | 4 | 3 | 3 | 3 | 3.3 |
| 8. Farmers learning facilitated | 5 | 3 | 4 | 2 | 3.3 |
| 9. Improved understanding of appropriate livelihood options | 4 | 3 | 3 | 2 | 2.9 |

*1 Figures in parentheses are the priority rankings of the project area objectives in the respective ADD clusters.*

**Copies available from:**

**The Publications Unit**
**Information and Knowledge Programme**
**National Agricultural Research Institute**
**PO Box 4415,**
**Lae, Morobe Province**
**Papua New Guinea**

**Tel: (675) 475 1444/1447**
**Facsimile: (675) 475 1450**
**Email: naripng@nari.org.pg**

**Website: www.nari.org.pg**