FOCUS FOR AGRICULTURAL RESEARCH IN PNG

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I. INTRODUCTION

In Papua New Guinea, agriculture remains the main source of livelihood, employment and income for eighty percent of about 4 million people. In fact, agriculture is the way of life in rural PNG. Many forums and consultations over the past 25 years have clearly established that the agricultural development is the key to the socio-economic development and hence to the overall human welfare in PNG. This does not need any more emphasis.

However, in today's presentation, we do wish to emphasise the importance of agricultural research, and demonstrate how well targeted and effective agricultural research can contribute to the improved productivity, efficiency and sustainability. All this is the heart of the entire process of agricultural transformation and socio-economic development.

Agricultural research is one of the most important catalytic factors to help accelerate the productivity of all other factors of production in the economic growth. Studies in many countries, including PNG, have shown that agricultural research is a very attractive form of public investment and can give rates of return in the order of 35% or more (Menz 1994).

Particularly important is to note that PNG has unique agro-ecological environment, biological diversity, rugged land terrain, and is inhabited by unique people with diverse socio-cultural background. Therefore, we have unique needs for agricultural research and development. Such needs cannot even partially be met through regional or international efforts.

Therefore, I regard agricultural research in Papua New Guinea as highly essential. It needs to be recognised as long-term economic and social investment for the growth and sustainability of the agricultural sector as well as of the entire national economy.

Before going on to the focus for agricultural research in PNG, we wish to provide a brief overview of the National Agricultural Research System in PNG- called NARS.

II. THE PNG NATIONAL AGRICULTURAL RESEARCH SYSTEM

The history of NARS in PNG goes back to the establishment of the Lowlands Agricultural Experiment Station, at Keravat, in 1928, and the Highlands Agricultural Experiment Station in the Aiyura Valley after the World War Two. During the 1950s, research stations were established in Central, Morobe, and the Western Hghlands (Charles 1982).

Since then the NARS has changed and expanded. Prior to 1980 the bulk of the agricultural research in the country was carried out by the then Department of Primary Industry, now the Department of Agriculture and Livestock.

In the early eighties, after a major review of the Department's crop research programme by the International Service for National Agricultural Research (ISNAR 1982), the NARS in PNG was substantially reorganised (Sitapai *et al.* 1994). Commodity-specific research institutions, associated with their respective commodity boards, were established. The PNG Oil Palm Research Association was the first to be formalised, followed by Cocoa and Coconut Research Institute, and then Coffee Research Institute. In

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1991, Ramu Sugar established a sugarcane breeding centre, and has since expanded into other related disciplines.

The responsibility for research into food crops, alternative cash crops, spices and essential oils and livestock remained a function of DAL until the recent establishment of the National Agricultural Research Institute in 1996, and launched in 1997. The formation of NARI was considered to be one of the major development initiatives by the PNG Government to contribute to and bring about sustainable development in the agricultural sector (DAL 1996).

Besides, the other bodies undertaking some formal agricultural research are:

1. Department of Agriculture and Livestock,
2. PNG University of Technology through its Departments of Agriculture and Applied Sciences, and the Bio-Technology Centre,
3. Trukai Industries,
4. Fresh Produce Development Company,
5. Wau Ecology Institute, and
6. Two Technical Missions: one from the Republic of China and another from the Mainland China.

Several Non-Governmental Organisations (NGOs) undertake some research, while the farmers themselves undertake a vast amount of non-formal trials and testing of new ideas and material.

The major agricultural research institutions and their respective mandates are given in Table 1 (Ghodake 1998a). The linkages of these research institutions with extension, farmers and developmetn are depicted in Figure 1.

III. FOCUS FOR AGRICULTURAL RESEARCH

Although our presentation on the "focus for agriculture research in PNG" has emanated from the NARI's perspective (NARI 2000), it covers and represents the overall perspective of the entire NARS in PNG.

The overall focus for the agricultural research in PNG will need to be on addressing the key national development issues. Therefore, the focus has been and will continue to be on technology development, knowledge creation, and information dissemination on such issues.

1. First such issue being, ensuring supply of adequate quantities and qualities of balanced food and nutrition - calories, protein, essential vitamins, etc. for healthy life for people including producers and consumers;

2. Second being, generating employment and improving income - both cash and non-cash - so as to empower the people including producers and consumers to have access to the higher standard of living and well being;

3. Third being, increasing efficient use of natural and man-made resources such as land, labour, capital, skills, and genetic diversity, through increased productivity per unit of these resources;

4. Fourth being, improving benefits to the less privileged people such as women who have been a neglected lot in the development so far, staying in economically depressed or environmentally threatened or marginal and less favoured areas; so as to advance social welfare and equity; and

5. While doing all these, the fifth issue is of ensuring efficient management of resources so as to assure the long-term sustainability of these resources not only for the present generation but also for the generations to come.

However, we must note that all these cannot be realized simultaneously and with equal focus and vigour. Therefore, focus must be weighed and balanced to ensure the optimization of the overall human welfare - the ultimate indicator of socio-economic development.

Having presented the overall focus, now I wish to give our perspective on the strategic approach to research, and some currently focussed areas of research in PNG. First to begin with approaches which are ten in number.

IV. STRATEGIC APPROACH TO RESEARCH

4.1 Applied and Adaptive Research

The first strategic approach is that agriculture research in PNG is basically an experimental and adaptation programme. Most is applied, problem solving, and need-based. The aim generally is at striking an effective balance between the use of farmer's existing and indigenous knowledge, and adaptation and application of established scientific principles.

This is done by adopting a systems approach and conducting research through multidisciplinary research teams, so that all aspects of the farm-household system and its environment are considered and captured.

4.2 Research-Development Integration

The second approach is that by virtue of its applied and adaptive nature, agriculture research in PNG must essentially be oriented to and integrated into the overall development of the agriculture sector and the national economy. Research and development processes must encompass identification of constraints and opportunities; and technology generation, adaptation and dissemination. The focus is required to be on the testing and validation of integrated production and marketing systems, technology utilisation, and enterprise development.

A mechanism of out-reach programme is being developed under NARI, wherein adaptive research, farmer/extension training, and information and liaison are to become central focus, through which researchers, farmers and extensionists will interact to generate, share and use knowledge.

The key manifestation of development integration is an effective demand as assessed on the basis of:

1. First, the market parameters in terms of quantities, prices and dynamics of all these;

2. Second, the household needs to consider subsistence, safety-net, taste, preferences, and household food security for both producers and consumers; and

3. Third, the domestic and international trade to account for various dimensions such as export, import, foreign exchange, self reliance of the agriculture sector, and national food security.

4.3 The Smallholder Focus

Now coming to third approach. Most of the 85% of the population, who are dependent on the agricultural sector in PNG, are smallholder semi-subsistence/ semi-commercial farmers. These farmers are and will be the main source of agricultural growth, employment, foreign exchange, improved income distribution, overall rural development and broad-based socio-economic development.

1. Therefore, the smallholder agriculture needs to be transformed through increased on-farm productivity, and that requires a significant, well-targeted and effective agricultural research;

2. The increased integration of the smallholder sub-sector into the market economy is crucial to ensure fair competition and efficient use of resources; and

3. The smallholders need help on appropriate knowledge and information to work towards food security, commercialisation, market integration, and sustainability of production.

This will require that agricultural research and information must focus on the needs of the smallholder farm families. Research efforts of

NARI and, to a large extent, of export commodity institutions such as Coffee Research Institute and Cocoa Coconut Research Institute, are directed towards the smallholder semi-subsistence farmers.

4.4 Stakeholder Participation and Partnership

In order for research to be cost effective, relevant, and impacting the development; it must be participatory with farmers and stakeholders and be conducted in partnership with private sector, NGOs, women groups, commodity organisations, provincial governments, developmental institutions.

This includes the involvement and participation by farmers, especially smallholder farmers, in all the stages of technology development and adoption such as problem identification; design, testing, adaptation of technology; and, to an extent, in evaluationand impact assessment.

This will also require forming partnership and forging alliances with national, regional or international institutions, organisations, groups or individuals that are working to address similar needs.

4.5 Agro-Ecological Basis

Farming regions in the country vary widely in terms of diversity in its natural resources, agro-ecological environment, and socio-cultural factors (Ghodake 1998b). Applied agricultural research must, therefore, be regionally based in order to consider area specific constraints, needs, resources, and opportunities; and to develop and adapt appropriate technologies and information for different agro-ecological regions of the country. This will effectively enable material and methods to be tested and adapted in localised areas and in the farmer environment.

Researchers will need to be working directly with selected districts in each agro-ecological zone and will need to be contributing to district develpment plans. This is consistent with the decentralized approach to development, adopted under the reformed systems of provincial and local level government.

4.6 Use of Indigenous Knowledge and Locally Available Resources

PNG agriculture has evolved over centuries, and is based on technologies and methods designed by farmers on the basis of their experience and informal experimentation. Techniques and knowledge emerged to suit discrete environments, cultural values and available resources. Indigenous knowledge has a number of strengths and can contribute to contemporary needs (Hardaker *et al.* 1994). This knowledge will have to be taken into account in the design and modification of new technologies and options. Similarly, locally available resources such as soils, fodder and skills must be optimally used for improving productivity and efficiency.

4.7 Environment Friendly and Culturally Acceptable Agricultural Technologies

In view of the increasing concern for environmental protection, resource degradation and exploitation, and adverse effects on human welfare; the emerging research will need to consider all such negative implications both in the short and long run, while designing new technologies and methods. This means priority to work on technologies such as biological control, integrated crop and pest management, organically grown food, sustainable land management, use of genetic potential, and optimum soil-water use.

All technologies and information will need to be consistent with the socio-economic needsof the farmers and must be acceptable to them. This will help preserve the strength of traitional agriculture and contribute to healthy human life, leading to sustainable growth and development.

4.8 Export Oriented and Import Replacement Technologies

Strategies to improve the PNG economy include diversification and expansion of agricul-

tural exports and reduction in agricultural imports. PNG currently imports in the order of K500 million worth of food products and agricultural inputs annually.

Agricultural research must focus on technologies and opportunities that will help the Nation diversifying and expanding its agricultural export and, where appropriate, in replacing imports of food items and agricultural inputs. Some examples include research on livestock stockfeed, export-tree crops, fruits andnuts, grain crops such as rice, corn and peanuts; and a number of minor crops both indigenous and introduced.

V. CURRENT FOCUS FOR AGRICULTURAL RESEARCH IN PNG

Prioritising and focussing of agricultural research is continuous, iterative and dynamic process. The current knowledge and perception allow us to highlight the following 11 areas of the current focus for agricultural research in PNG.

5.1 Improved Productivity and Production

Primary focus of agricultural research has been on improving and sustaining productivity of crops, livestock, and farming systems through improved husbandry practices, better pest management, and high yielding material. This focus will continue for all crops including staples and vegetables, and livestock species. Focus will also be on increasing production, especially for the established and emerging export crops.

5.2 Integrated Crop/Pest Management

Tropical PNG environment is congenial to crop production and is equally congenial to pests, diseases, and weeds, which cause heavy crop losses both in quantity and quality. Research focus has been and will continue to be on development of integrated pest and crop management practices, including biological control, cultural practices, plant tolerance and resistance, plant derived pesticides, and selective chemical control.

5.3 Crop Diversification

Research on identifying and introducing new and emerging crops to become alternative sources of food and cash has been undertaken for some time. This focus shall continue on crops like vanilla, balsa, okari-nut, galip-nut, cashew-nut, mangoes, spices, and on grain crops such as rice, corn and peanuts. All aspects of these crops will need attention, including post-harvest, processing, quality assurance, and marketing.

5.4 Export Tree Crops

The past research focus in the export-tree crops such as coffee, cocoa, coconut and oil-palm, was on productivity through crop management and plant breeding, and pest and disease management. However, smallholder productivity did not improve significantly, and certainly has a big potential. Therefore, increaseing attention is now focussed on improving productivity of smallholder farming systems, control of pests and diseases, quality assurance, designing novel practices for small-holders, and some work on post-harvest drying and processing. Efforts will also continue on the crop improvement for quality, pest and disease tolerance, and intensive inputs.

5.5 Small-holder Village Livestock

Smallholder village llivestock has the potential to address the present level of low nutrition (protein), income, and sustainability in the rural PNG. The research focus clearly appears to be in the area of integration of small livestock such as sheep, goat, poultry, rabbits into the farming systems; utilization of locally available feed and fodder resources; collection of information and monitoring; and understanding and alleviating factors that constrain technology adoption in this area.

5.6 Sustainable Land Management

Land being the basic resource for agriculture, focus on land management research is crucial and continues to be a priority in improving and sustaining productivity of this resource.

Research focus will need to be on various options such as:

1. Understanding and documentation of current agro-forestry practices;
2. Developing fallow management and fertility maintenance practices;
3. Developing nutrient management techniques for vegetable cropping, including use of inorganic fertilisers; and
4. Managing risks and impacts of excessive and deficient soil water in traditional and innovative cropping systems.

5.7 Management and Development of Genetic Resources

PNG agriculture is endowed with a rich and diverse genetic resources of plants, crops and livestock species; which are a basic research resource for the development of agricultural technologies. This resource has been grossly neglected due to lack of funding and management abilities. The collections have been partially and periodically lost due to natural calamities such as droughts, floods, frosts, pests and diseases.

NARS will need a renewed focus on rehabilitation of available material; undertaking collections of lost and new cultivars; documenting, characterisation and evaluation; maintaining in various forms such as *ex-situ, in-vitro* and *in-situ*; and giving advice on the utilisation of the material for crop management and improvement.

The concerned institutions will need to develop policies and strategies on genetic resources and take into account the resolutions of the Earth Summit, 1992 on maintaining bio-diversity and safeguarding the intellectual property rights.

5.8 Improved Post-Harvest and Value Addition

Important features of agricultural products in PNG are perishability, bulkiness, low value to weight, low nutritive value to price, seasonality, and surplus output. All tree crops are exported with only marginal processing.

If the status of the people growing these crops is to be improved, a pre-requisite is to improve the market demand for these crops through improved post-harvest and value addition, including improved handling, storage, processing, and transport.

At present very little attention is given to this area. Therefore, agricultural research will need to increasingly focus on designing post-harvest technologies and methods that will add value to the product.

5.9 Marketing and Socio-economic Research

Marketing and socio-economic research is another crucial area that has received very little attention. Parameters of demand at household, market and international level are needed for research planning and prioritization. While socio-economic research will aid in generation and adaptation of appropriate technology and information. Future planning and research focus will be increasingly based on results of such marketing and socio-economic research.

5.10 Databases and Monitoring

There is a general lack of databases and monitoring systems, which form the basis for rationalisation and undertaking of appropriate research, and assessment of impacts. A research focus has been and will be on developing and maintaining databases such as GIS, farming systems, soil quality, sustainability indicators, long-term soil and crop monitoring, marketing information, socio-economic information, weed information, etc.

5.11 In-Depth Research Reviews

Continued efforts are certainly required to undertake in-depth research reviews on certain topics and crops. Immediate focus will be on reviewing sweet-potato research and pest management research on taro. Such reviews will allow strategic planning for further work.

VI. MAJOR ISSUES IN AGRICULTURAL RESEARCH

Before we conclude, we wish to take this opportunity out bring but three major issues in agricultural research to this August gathering.

6.1 Financial Support and Stability

The first issue relates to financial suport and stability. Agricultural research institutions in PNG are very young, much younger than the Independent State of PNG. These have been emerging and progressively growing. They need a core but guaranteed financial subvention from the public purse. Being long-term nature of research investment, especially in the context farming systems, land management, livestock and tree crops; the funding requires to be adequate, consistent and sustainable over longer-term. Currently, the Government support is less than 50% of what is planned to be a bare minimum.

6.2 Institutional Capacity and Human Resources

The second issue concerns the institutional capacity and human resources. This is a sovereignty issue of having our own ability and capacity to plan and implement applied and adaptive research and development programme, which will be relevant to the needs and aspiration of the Nation. This capacity improvement is needed in the area of scientific and technical manpower; equipment and facility; databases and networking; and collaboration and partnership. This requires initial investment in this very important science-based knowledge sector. Current scenario is far from satisfactory.

6.3 Policy on Agricultural Research and Development

The third is on policy. The Nation lacks well articulated national agricultural development policy and hence focused agricultural research policy. Research institutions are operating in policy vacuum. That, to an extent, hinders individual institutions in developing effective research policy and strategies for implementation. Given the nature of PNG agriculture and long gestation period of research investment, often difficulties are experienced by policy planners and politicians in appreciating the importance of agricultural research. Concerted efforts must be made by all concerned to develop and implement coherent national policies in the area of agricultural trade, production and marketing, food and nutrition, bio-diversity, intellectual rights, human resources in the agriculture sector, etc.

VII. CONCLUSION

To conclude, over the last two decades, the National Agricultural Research System in PNG has undergone considerable and progressive reforms, leading towards autonomy and flexibility so as to address problems, allelviate constraints and explore opportunities for the agricultural development in the country.

In this context, we would like to stress that well-supported agricultural research in PNG has a huge untapped potential in developing agricultural sector and hence in contributing to the socio-economic development and human welfare of the Nation. We, as a sovereign Nation, must fulfil our role and obligation to strengthen and support the agricultural research institutions in the country for nurturing scientific knowledge and information. This will certainly lead us towards prosperity.

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Table 1. **Major Agricultural Research Institutions in PNG (Ghodake 1998a)**

Institute	Broad Research Mandate
NARI - National Agricultural Research Institute	Food crops, small livestock, alternative cash and food crops (fruits and nuts), and spices, resources management issues, and provision of diagnostic, analytical services, farming and inter-cropping research, agro-forestry, control and management of pests and diseases, socio-economic research, soil, land and water management practices, germplasm maintenance and agronomy, imporvement and adaptation of small livestock species, assessment and improvement of feeds and pastures, and livestock nutrition and management.
CRI - Coffee Research Institute	All aspects of coffee improvement, husbandry and processing, disciplinary research in areas of agro-physiology, genetic improvement, pest management, weed management, soil and plant nutrition, and coffee-based farming systems including inter-cropping to address the needs of smallholder coffee growers.
CCRI - Cocoa and Coconut Research Institute	Cocoa and coconut production and improvement, cocoa management practices, soil and soil nutrient, post harvest, quality improvement, downstream processing, fermentation, drying, small-scale operation, breeding for Low versus high input production systems, introduciton of varieties for breeding purposes.
OPRA - Oil Palm Research Association	Oil palm management, husbandry agronomy, soil nutrients - specifically biological and economic responses, soil plant interaction, volcanic and non-volcanic soils, importance of phosphorus nutrition, smallholder fertiliser demonstration, effective biological control of *Sexava* and monitoring of potential and new insects, crop resource mapping and standardisation.
Sugarcane Research Centre Ramu Sugar Limited	Sugarcane management, husbandry, crop improvement, soil and plant nutrition, pest and disease control, weed control, quality improvement.
Department of Agriculture and Biotechnology Centre Univesity of Technology	Research on smallholder food crops and livestock, including some strategic research in breeding, plant diseases, adaptation of livestock, and relatively basic research in plant and animal sciences.

Figure 1. NATIONAL AGRICULTURAL RESEARCH SYSTEM IN PNG (Organisational Chart and Linkages)