THE PAPUA NEW GUINEA NATIONAL AGRICULTURAL RESEARCH SYSTEM: ITS POLICY FRAMEWORK AND DEVELOPMENT PERSPECTIVE

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ABSTRACT

The Papua New Guinea national agricultural research system has undergone four decades of organizational evolution in order to adapt to an ever increasing and changing demand for technology and information of the agricultural sector. This paper gives a brief account of the development of the national research system to the present time and highlights the major constraints and problems to the effective generation, adaptation, assessment and transfer of technology and information. From a global perspective of research and technical change, the paper emphasizes the need for the development of national research capacity in Papua New Guinea for sustained agricultural growth. The paper considers certain key policy issues that are crucial for the enhancement of agricultural research in the country. One of the major policy reforms required for an effective research system is the establishment of an autonomous, statutory, and public funded research organization for improvement of food crops, livestock and alternate crops. A number of policy recommendations are then drawn for consideration by the Department of Agriculture and Livestock and relevant Government agencies involved in implementing these institutional reforms.

Key words: *National Agricultural Research Institute, policy changes, technical changes, problems, constraints.*

INTRODUCTION

Agricultural research involves, by its very nature, the application of the principles of basic sciences to the solution of problems of immediate or prospective usefulness to agriculture. Its objective is to apply a wide variety of scientific disciplines to the development of new approaches to agricultural production, and to the solutions of the problems besetting the farmer. In Papua New Guinea (PNG), agricultural research has played a significant role in agricultural development and continues to be a vital function of central government. In view of its wide implication to national development and its service to the farming community, it is justified that agricultural research should continue to be an important concern of the national Government.

Formal agricultural research, as a conscious and institutionally separate activity, is a relatively new agent of technological change in PNG. Human inquisitiveness and economic interest were already driving technological change before this. It could be claimed that 'informal' research by farmers has been going on for millennia, and has resulted in well-balanced and sustainable farming systems. Only now, with population pressures increasing and people's aspirations changing radically, are the traditional farming systems showing strain.

Since 1980, the PNG national agricultural research system (NARS) has undergone a period of transformation, both in terms of its organisation and structure, and management. Following the separation of export-crop research from the Department of Agriculture and Livestock (DAL) to the export-commodity research institutes (ECRIs), the structure of the NARS has become more complex. Under the new arrangement, the ECRIs (for coffee, cocoa and coconut, and oil palm) are wholly supported financially by their respective industry organisations by virtue of the legislated level of commodity research levies. More recently, the Government through DAL has augmented ECRIs budgets through annual research grants because of the low prices of all commodities.

The responsibility for research into food crops,

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alternative cash crops (spices and essential oils) and livestock remains a function of DAL. This component of the PNG NARS has remained the most fragmented, and it is the intention of DAL to rationalise this programme to improve its efficiency and its services. This paper outlines the approach to be taken in achieving this, and further analyses the policy environment of agricultural research, the organisation of the research system, and the management of the PNG NARS.

THE PNG NATIONAL AGRICULTURAL RESEARCH SYSTEM

A Short History

The National Agricultural Research System (NARS) in Papua New Guinea (PNG) has rapidly changed and expanded during the last fifteen years. Prior to 1980 the bulk of the agricultural research in the country was funded entirely by the PNG Government and executed by the Department of Primary Industry, now the Department of Agriculture and Livestock. The sphere of agricultural research was very wide and covered a range of research activities in tree crops, food crops, resource management, livestock, and pasture agronomy. To an extent the research was biased towards tree crops because of the need to generate cash income from foreign exchange. Research on food crops, livestock and alternate minor crops was largely neglected.

Over the last ten years four semi-autonomous research institutes have been established for coffee, cocoa and coconuts, oil plam and sugarcane. These institutes are financed through a research levy on exports, and annual government grants through the Ministry of Agriculture and Livestock. The setting up of these research institutes was a major policy reform in the tree crop subsector. Whilst the performance and achievements of these institutes have, in general, been satisfactory up to now, their long term sustainability through their own industry funding is in question.

The PNG University of Technology is also developing a post-graduate research programme to link with research activities of other institutions within the PNG NARS. Although the University programme is presently directed mostly towards the support of its teaching function, its scope is being widened to undertake more basic research in the future. Several non-governmental organizations (NGOs) are also engaged in agricultural research, but their activities have been of modest levels. The most prominent of these is the Wau Ecology Institute. As NGOs they operate independently of other NARS components, and hence, there is scarcity of information on their nature of research and the resources available to them.

The Department of Agriculture and Livestock (DAL) operates seven research stations of varying size throughout the country and these are located to cover the highlands and coastal environments with substations in high and mid-altitude environments. The mandate of its programme is to carry out applied research on the major staple food crops and livestock, as well as on minor cash crops (spices, essential oils) and other tree crops (fruits and nuts). DAL also has a farming systems research programme with comprehensive on-farm research activities in several provinces.

The major aim of DAL programmes is to improve productivity of the various food crops and livestock, and to attain sustainable system of agriculture particularly for smallholder semi-subsistence farmers. The establishment of a land use management programme is aimed at achieving this, with a nation-wide agroforestry research and development programme. Several multilocation trials evaluating multipurpose tree species form the basis of the new agroforestry programme.

The field research and development programmes are supported by specialist laboratories in Port Moresby. The specialist disciplines in Port Moresby include agricultural chemistry, entomology, animal and plant pathology, veterinary science and soil science.

Research Constraints and Problems

Resource contraints to agricultural research system over the last decade have undoubtedly affected the national capacity of the research system to assess and transfer technology. This is particularly evident in the food and livestock subsectors. In fact the present high bills of imported food and livestock products are the results of the inadequate and unsustained Government support to research on food crops and livestock in recent years.

A large number of constraints have been identified as being responsible for ineffective and inadequate agricultural research that is being undertaken by DAL. These can be summarized as:

(i) inadequately trained and insufficient scientific, managerial and technical manpower;
(ii) inefficient and inadequate institutional arrange ment and infrastructural facilities;
(iii) poor planning, coordination, direction and link age;
(iv) meagre and highly uncertain funding support;
(v) absence of a national agricultural research policy and focus for sustainable research and agricultural improvement; and
(vi) lack of effective linkage between research, extension, development and farmers.

These constraints have imposed serious setbacks on the present agricultural research system in catering for the ever changing and rising demand for appropriate technology and information. Therefore, there is a long impending and urgent need to build up national capacity and capability of agricultural research in PNG for effective generation, modification, adaptation, assessment and dissemination of technology and information that would be relevant to the present and future needs of the agriculture sector.

RESEARCH AND TECHNOLOGICAL CHANGE

A Global Perspective

Agricultural research is probably the first and the most widespread form of organised research in the world, and one in which both the most developed and underdeveloped countries are engaged. Whilst most forms of research activity, such as in the field of medicine, have world-wide application, agricultural research, by its very nature, has to be regional in focus; practically no research finding can be adopted without studying the results of its application under infinite number of ecological situations with which the farmers of the world are faced.

The improvement of agricultural production is the essential step whereby developing countries can hope to raise their standards of living. Research is therefore an activity in which no underdeveloped country can afford not to engage in; nor can countries in which agriculture has reached a high level of development and sophistication afford to neglect agricultural research. Even when the problems of overproduction weigh heavily on the economy, agricultural research is considered the essential key to further progress: the objectives and goals are simply changed and adapted to the needs of the economy.

In almost every country, agricultural research systems have grown up from humble beginnings, without having been planned or directed. This has resulted in innumerable organisational forms, different for each country. The obvious explanation for this state of affairs is that each country has developed the agricultural research organisation adapted to its needs. A closer analysis of the situation will, however, indicate that the multitude of organisational forms is the result of lack of planning, and that inter- and intra-departmental power politics, institutional prestige considerations and personality problems have had a greater hand in shaping the organisations.

Most developing countries have either remnants of former research services, or are organising their NARS starting, from scratch.

Role of Agricultural Research

The Mission of any NARS, as defined by Aldrich (1966), is:

- to apply all possible sources of scientific discovery to the solution of the technical and practical problems of agriculture;
- to engage in basic research where the lack of fundamental knowledge may impede progress; and
- to solve the specific problems with which agriculture is faced.

The primary objectives of agricultural research are:

- to increase productivity by increasing production per unit area (or animals), or in irrigation agriculture per unit of water, if water is the limiting factor;
- to increase efficiency by reducing the input of labour in relation to production or by making the work less onerous;
- to increase stability of production: by breeding varieties of crops and breeds of animals that are more disease-resistant or more immune to unfavourable environment conditions, by improving methods of crop protection against diseases, pests and weeds;
- to improve quality by breeding varieties

with inherently higher nutritive values, improved flavour or eye-appeal; improving production techniques that affect quality, improving post-harvest techniques;

- to produce the type of products required for consumption, industry and export. This involves the introduction of new crops or methods of production, with the attendant required research, increased control of environmental factors, investigating new uses for established crops, etc; and

- to avoid environmental pollution and prevent soil erosion.

The relative emphasis placed on each of these objectives depends mainly on the stage of development of agriculture in each country and its economic requirements. In the case of PNG, increased productivity can be taken as the first demand that can be made on agricultural research, because the agricultural sector is still relatively undeveloped, the population is increasing rapidly, and demand elasticities are still at levels which would justify and allow increased agricultural output.

The Need for a National Agricultural Research Effort

A tremendous amount of agricultural research is being carried out in all parts of the world, and there is already an enormous fund of knowledge available on how to increase the productivity and efficiency of agricultural production. This knowledge is freely available to all and at practically no cost. The arguments that most of this research has been carried out in developed countries, i.e. in physcial, economic and social environments totally inappropriate to the developing country, has lost much of its plausibility following the establishment of the International Agricultural Research Centres (IARCs) in tropical and sub-tropical regions, whose research is carried out under environmental conditions that are largely representative of those of the developing countries. Two of the IARCs (IRRI and ICRISAT) are located in the Asia/Pacific region.

The need for 'own' research in developing countries themselves can therefore be legitimately questioned. For instance, in many countries of the Pacific which are struggling to establish a sound economy, which lack trained personnel, and in which most farmers are illiterate, research may appear to be a luxury which these poor countries can ill-afford. It may well be asked whether elementary logic does not compel a developing country like PNG to concentrate on disseminating and applying knowledge already available in other countries, or in the international institutes. In other words, should the available limited resources and trained personnel be devoted to extension instead of research.

From a recent analysis of resource allocation in DAL over the last 5 years, it can be concluded that PNG has adopted this policy. This is clearly demonstrated by the establishment of several pilot projects under the Public Investment Program, most notably in food and livestock extension. That this policy has been followed in many developing countries is indicated by the finding that whilst the highly developed regions invest considerably more intensively in research than in extension, the developing countries in Africa, Asia and the Pacific are several times more 'extension-intensive' than the developed Western countries (Pardey *et al.* 1989). A negative correlation was actually found between the level of development and the propensity to invest in extension. The lower the level of per capita income, the higher the proportion of agricultural product spent on extension (Arnon 1989).

The apparent assumption that the already available technology is adequate to achieve production objectives in developing countries is a dangerous fallacy - and as a policy it is self-defeating. Basic principles can be established anywhere in the world, but their application to a specific environment requires a local research effort. Not only in each country, but several regions within a country, have unique combinations of soils, climate, social, economic and other conditions which are not duplicated elsewhere.

It is not necessarily correct to assume that the cost and duration of research can generally be significantly reduced by transfer of technology from one country to another, or from an international research system to a NARS. In all cases, adaptive research is required in the actual region in which the innovation is to be introduced before large-scale adoption can be considered. Without a national capability for adaptive research, the potential benefits of a technology to be transferred cannot be fully realised.

The Need for an Agricultural Research Policy

Agricultural research policy flows from a national agricultural development plan which in turn takes its cue from a national development policy. In many countries, including PNG, agriculture is an important target for development. A policy that makes the most of what modern agricultural science can offer in research, extension, and development, appropriate to the country, is highly desirable.

The presence or absence of an organisation to frame agricultural research policy is a common issue in developing countries. The presence of an apex body in many countries, specifically in South and Southeast Asia and East Asia, has eased the task of agricultural policy formulation. These apex bodies may be permanent councils, agencies or boards, or temporary committees. In contrast, countries in Central and South America commonly have an autonomous or semi-autonomous national institute responsible for formulating research policy.

Apex bodies have invariably evolved from the conventional ministry model of agricultural research management. In many African and Pacific countries where there is no apex body, a ministry in charge of agriculture has to formulate policy through its research arm or with assistance of a transient policy group. In such a situation, formulation of agricultural research policy is generally weak. The principal challenge is to develop a permanent mechanism for national research policy and coordination. Such a body should have the freedom to interact with the political and administrative hierarchies of government. To this end, considerable efforts have been made by DAK in proposing a National Agricultural Research Council (NARC).

Improving the Productivity of the Small Farmer

A major change that has taken place in recent years in agricultural development policy in many developing countries, is the greater recognition of the needs of the small farmer. Formerly, the dominant policy was to favour the agricultural sector that could respond most efficiently to economic inputs, and there has been little responsiveness to sectors of agriculture with poorly organised-small farmers, semi-subsistence farmers, and minority groups. However, since the 1970s the realisation has grown in many developing countries that a public funded research system has the obligation, both for reasons of equity and economic efficiency, to respond to the needs of the deprived rural sector in planning the research programme, not only to the clients who are most affluent and best organised.

At present, many development plans state explicitly that the top national priority is to improve the productivity of the small farmer. This emphasis reflects an awareness that without rapid progress in smallholder agriculture throughout the developing world, there is little hope either of achieving long-term stable economic growth or significantly reducing the levels of poverty.

A policy discriminating against the smallholder subsector, though it may possibly be based on short-term economic considerations, leads, in the long run, to a widening of the economic and technological gap between the two subsectors.

Overall national development requires a more equitable distribution of income which makes possible a wider and more effective demand. In a predominantly agrarian economy, it it likely that the level of saving and investment will be higher if the productivity of land and labour is increased by widespread adoption of new technology on a large number of family farms, than by concentrating resources on a relatively restricted scale in an advanced subsector of farming.

The White Paper on Agriculture (GOPNG 1989) states quite categorically that top priority should be given to addressing the needs of the small farmer. This is the challenge for any national research and development programme. Equally emphasised, is the need for agricultural research and technology transfer in aiming to achieve sustainable agricultural development.

A NATIONAL AGRICULTURAL RESEARCH INSTITUTE

The Conceptual Framework

To help alleviate the constraints to research and to build up sustainable research capacity, a substantitally improved and modified organizational structure is proposed. To appropriately reflect its scope and nature of activities, it will be called National Agricultural Research Institute (NARI).

The institute activities, besides covering the immediate concerns of research and development on food crops, livestock and alternate (diversified) crops, should include wider but closely related aspects of land, soils, environmental resources, labour, institutional and sociocultural issues.

NARI should be seen as a long term investment in research and needs to be developed through reorganization and rationalization of the current research and development activities of DAL. Its immediate aim would be to improve and develop scientific, managerial and technical manpower, and strengthen short term adaptive/farmer relevant research and long term prospective technology oriented research.

This institute should be the national centre of excellence for research, information, education and technology training in the country and basically be guided by the national research strategy and national development objectives. In absence of national agricultural research council, NARI should assume the responsibility of designing national research policy and of coordinating the research activities of other agricultural research institutions in the country. It should eventually become the nodal point for the country's national, regional and international linkage and collaboration in the field of agricultural research.

NARI would be set up on the basis of a direction from the National Executive Council and be established by an Act of PNG National Parliament by early 1995. The institute should be an autonomous, statutory and public funded authority in order to provide the flexibility and dynamism required for effective organization and implementation of agricultural research programmes. As there is very limited scope, at least at present, for the food crops and livestock sectors to generate their own revenue for research and development, NARI will have to be dependent on the public funds for its operation. However, there should be sufficient scope and flexibility for the institute to secure funds from other sources and to undertake cooperative and collaborative research programmes.

To ensure public accountability, long term sustainability and relevant programme directions, the institute's activities should be executed under the direction of an eminent agricultural scientist, to be called Director General, and governed by a board of directors representing the government, various organizations and smallholder farm families. The legislative process should ensure that the institute is empowered with desired level of autonomy, flexibility, control and accountability.

The Focus of Research

The long term goal of the institute should be to help improve and sustain the food production, human welfare and overall economic growth in the country. Equally important should be the consideration of income distribution among various segments of the population and different geographical regions of the country. PNG needs economic growth with equity in income distribution. This is essential not only from the view point of social issues but also for creating multiplier effect in growth and sustainability.

The initial focus of NARI should be on the development oriented research on food crops, livestock, alternative crops, integrated systems, relevant resources and associated cropping and farming systems. Other closely related activities to be included would be the generation and monitoring of farm management information, collection, evaluation, maintenance of germplasm and the multiplication and distribution of seed and planting materials. There should also be flexibility and scope to include, in future, other relevant crops and livestock activities.

The approach of research with farming systems perspective would continue to be used by various multidisciplinary teams of biological, physical and social scientists to capture complexities of the semi-subsistence farm households and their farming systems so as to design and disseminate realistic and appropriate methods, materials and changes to their agriculture.

The Structure of the Programme

The overall research programme would be organized into various regional research programmes to consider location specific constraints, needs, resources, opportunities and potentials and to develop appropriate changes in different agroecological, sociocultural and political regions of the country. Therefore, there would be regional research programmes for the Highlands, Momase, Islands and Southern regions with sub programmes at strategic locations within each region. This will allow the individual programmes to be based on the needs of local farming communities and be demand driven. Furthermore, the integration of the individual programmes into the national re-

search programme would ensure that the national objectives of the agricultural development are reflected and considered in these regional programmes.

The present agricultural situation and potential direction of agricultural changes in the country suggest that the regional research programmes should have inputs from the disciplines of agronomy, entomology, animal science, plant pathology, soils, economics, engineering, and extension with a strong component of adaptive research. The programmes need to be interdisciplinary in nature and will involve contributions from multidisciplinary activites. The type and level of individual disciplines in each regional programme would vary depending on the nature and kind of issues involved in respective regions.

NARI should have research programmes based on the programme thrusts such as sustainable agriculture, livestock-crop integration, and resource management. However, for the purpose of maintaining identity, the regional research programmes should be categorized into the following six subprogrammes.

1. **Crop Production Research** to encompass the disciplines of agronomy, horticulture, and crop breeding.

2. **Crop Protection Research** to include the disciplines of entomology, plant pathology, nematology and weed science.

3. **Livestock Research** to include areas of animal husbandry, animal nutrition, animal health, animal breeding and pasture agronomy.

4. **Resource Management Research** to encompass soils, agricultural economics, agricultural engineering and germplasm.

5. **Scientific Liaison and Extension Unit** to cater for technology testing, adaptation and transfer.

6. **Research Support Services** to include various analytical services, publications, information etc.

These programmes should be closely interlinked and involved in conducting adaptive operational research and in transfer of technology.

Research and Extension Linkage

Without development orientation, research would be meaningless especially in a developing country like PNG. The approach to research therefore should be demand driven and need based so as to make technology and information relevant and acceptable to farm households and their environment. In addition the research programme should be in line with the long term macro policies of the country. Some examples of such policies are self sufficiency in food production, import replacement, export orientation, income distribution and domestic economic growth.

Besides the scientific disciplines, the institute should have a strong component on scientific liaison and extension to provide an effective mechanism of research, extension, development and farmer linkage. This unit could alternatively be called adaptive research team (ART) and should have supplementary inputs from biological scientists, physical scientists, economists, and extensionists. Activities of ART would include descriptive and diagnostic research, research design, adaptive on-farm research, technology testing and assessment, technology packaging, exchange of material and information, publications, and technology training.

The institutionalization of ART would require a long term investment for improved facilities, trained manpower, and adequate operational funds. There should be a strong scientific and policy liaison unit at the national/institute level to ensure that research programmes are consistent with macro development policies.

The approach of farming systems research and development should allow the required linkage and will have a three-way cooperation and interaction between research-extension-farmer. In a cyclic process, it is assured that research is not divorced from farming realities and that innovations are adopted by consensus. In such an arrangement, the farmer is assured that his problems are brought to the attention of the researcher and that necessary attempts are made to provide a solution according to priorities determined under the farmer's own circumstances. The extension worker will be a full partner in the entire process of identifying problems/constraints, planning, technology design, testing, and adoption.

Adaptive research on integrated farming systems involving export tree crops would provide the mecha-

nism of linkage with the commodity research institutes and their respective extension organizations. NARI should be closely involved in providing technical inputs into and collaboration with the public investment programmes and extension activities of DAL, thus ensuring an effective linkage between research, extension and development.

In order to facilitate an effective research and extension linkage and transfer of technology and information, pilot operational research projects in representative areas of each region would be undertaken to involve local extension officials, voluntary agencies and farmers. These projects would be responsible for diagnostic research, design of technology options, testing under local farming environment and eventually for dissemination of technologies and materials. Such projects will eventually be increased in terms of their number and size as the capacity of the institute expands.

POLICY RECOMMENDATIONS

Institutional Reform

In order to alleviate the present constraints to research and to improve the national capacity and capability for technology assessment and transfer, an autonomous organization called National Agricultural Research Institute (NARI) for food crops and livestock be formed. To achieve this reform, it is necessary that the Department of Agriculture and Livestock obtains the approval of the National Executive Council to establish by an Act of Parliament such an organization.

Financing the Institutional Reform

The establishment of NARI would initially require significantly higher level of funding than otherwise would be available within the DAL budgetary ceiling. This institutional reform should therefore be supported through supplementary external source of funding. The Agricultural Research and Extension Project (AREP) Phase II study has recommended that the Asian Development Bank provide the funding required to establish NARI. This loan funding should be negotiated and arranged for execution by NARI for its development and programme implementation.

Resource Reallocation

The current resources - manpower, funding, infrastructural and institutional - of the Department of Agriculture and Livestock that are presently allocated to the activities related to research, technology adaptation studies, various technical and scientific areas need to be reallocated to NARI to form its core resources.

Sustainability of NARI

For NARI to develop a sustainable research capacity and capability, it is crucial to have a consistent and adequate level of funding, both during its formative stage and after the cessation of the supplementary donor support.

Research-Extension-Farmer Linkage

NARI through its scientific liaison and extension component, farming systems research approach, adaptive research teams and operational research projects should create and manage a strong linkage with field extensionists, voluntary organizations, development agencies and farmers.

NARI should be responsible for providing technical inputs into and collaboration with the public investment programmes and extension and development activities of DAL. This should further ensure an effective linkage between research, extension and development.

Adaptive research on integrated farming systems involving export tree crops would provide the mechanism of linkage with the commodity research institutes and their respective extension organizations.

Regional Perspective to Research

The current research and development activities carried out by DAL are largely decentralized and located in various agroecological zones of the country. This regional perspective to research should be maintained but further rationalization and reallocation among the regional programmes would be required. The functions of research policy and coordination should, however, remain centralized.

Research Policy and Coordination

In absence of an apex body for policy and coordination of agricultural research in the country, NARI

should assume the responsibility of formulating national research policy and of coordinating the research activities of other agricultural research institutions in the country. It should be the nodal point for the country's national, regional and international linkage and collaboration in the field agricultural research.

Establishment of the National Agricultural Research Council (NARC) as an apex body should be simultaneously pursued. NARC should be responsible for the overall policy formulation, coordination, and monitoring and evaluation of agricultural research in the country. In addition, it should be responsible for prioritization of research and allocation of resources to various components of NARS.

CONCLUDING REMARKS

The issues discussed and the institutional reform proposed in this paper clearly suggests the need for a long term commitment by the Government for investment in agricultural research to attain sustainable development in the food crop and livestock subsectors. A better organized and well funded national agricultural research system would facilitate the enhancement of national capacity and capability for technology assessment and effective transfer, resulting in improved agricultural growth.

A national agricultural research system can only be considered efficient if it is able to transmit its findings to the extension service and the farming community at large. To enable effective diffusion of new technologies and information, it is necessary to develop appropriate mechanism for linkages between research, extension and farmers. In absence of effective linkages, the process of dissemination of innovations is disrupted and consequently, the effectiveness of research system and its relevance to farmers is substantially reduced.

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