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# RESEARCH PRIORITY-SETTING IN PAPUA NEW GUINEA: POLICIES, METHODS AND PRACTICALITIES

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**ABSTRACT**

Agricultural research priority-setting at best promotes the effective and efficient use of scarce research resources. This paper reviews firstly the priority-setting methods used in Papua New Guinea for agricultural R&D and examines the practicalities of implementing these and other methods. Secondly, this paper reports on key factors affecting the strategic directions for agricultural R&D in Papua New Guinea. These factors include:(i) the long term trends in international crop prices; (ii) long-term trends in crop production by sector (plantations or smallholders); (iii) the cost of production by sector and its effects on the long-term economic sectoral sustainability; and (iv) the potential impact of pests and diseases. Related issues of research capacity, remuneration, funding and administration are also explored. Conclusions are drawn about desirable research directions and the capacity of PNG to deliver appropriate R&D products.

**Key words**: Research and development, research priority-setting, Papua New Guinea

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## 1. INTRODUCTION

An important feature of agricultural research and development (R&D) planning and priority setting is that it enables research managers to effectively and efficiently plan better research programs. Such programs are more likely to have greater relevance to farmers' needs and will facilitate better use of scarce R&D funds. In practice, agricultural R&D planning and prioritisation depend on being able to define R&D objectives and assess the merits of different R&D directions.

Agricultural R&D in Papua New Guinea (PNG) has had a long tradition,[1] yet it has evolved under national priorities that were not clearly defined. The lack of a written statement on research policy in PNG (ISNAR 1982) and the fact that the Department of Agriculture and Livestock's (DAL) Agricultural Research Division (ARD) did not have 'any systematically designed information on research management and research programming' (Ghodake and Wayi 1994:1) supports this assertion. As a consequence, R&D has been pursued under broad national development goals, and at best, performed mostly on an *ad hoc* basis.

Significant structural changes in the way agricultural R&D were organized began in the early 1980s. This effectively involved an institutional shift in the way R&D was administered and managed from a ministry of agriculture model to a semi-autonomous institute model, where research responsibilities lay within an administratively independent organization (Trigo, 1987). The ISNAR review in 1982 and subsequent projects such as the PNG Agricultural Research Priorities Project[2] between 1985 and 1987 provided a major boost to this transformation. By the mid-1980s, most public research functions for most export crop research were transferred to specialized export crop research institutions (SECRIs). These transitions arguably served as catalysts for greater commitment to agricultural R&D planning and national research priority setting and for greater accountability within the decision-making process.

The last decade has seen significant improvements in the strategic planning and decision-making processes aided by ex ante economic evaluation methods and a greater focus on research management in research institutes. These developments are likely to impact significantly on the way agricultural R&D is pursued in future.

This paper reviews the methods used for agricultural research priority setting in PNG and examines the practical relevance of these methods. Some key factors in setting strategic direction for R&D also are presented. Some conclusions are drawn about desirable

[1] The first agricultural research experiment station in PNG was established in 1928, and began as a public–funded Demonstration Plantation at Keravat in East New Britain province, which later became the Lowlands Agricultural Experiment Station (LAES) after World War II, in 1946. With the formation of NARI, the station now operates as one of it wet-lowland research subprogram centres.

[2] See Antony & Parton (1991) for a detailed overview of this project. The project was funded by the Australian Centre for International Agricultural Research (ACIAR).

research directions and the capacity for PNG to deliver appropriate R&D products. The paper ends with a brief summary.[3]

## 2. INSTITUTIONAL FRAMEWORK

Until the 1980s, the administration and management of almost all agricultural R&D was the responsibility of the national DAL (formerly the Department of Primary Industries (DPI)). Reorganization of public research functions in the 1980s led to the absorption of export crop research by SECRIs whilst food crops, livestock and land utilization research remained under DAL. Accordingly there has been a reorientation of public R&D efforts away from export commodities research towards a farming systems research (FSR) approach where emphasis is placed on carrying out farm level research through a farmer/researcher relationship in problem identification and farm level testing of improved technologies. Hence agricultural R&D can be divided into two main parts: (a) export crop research and (b) food crops, livestock and farming systems research. This distinction is maintained in the rest of this paper.

### 2.1 Export crop research

Specialized export crop research is carried out by the Oil Palm Research Association (OPRA)/New Britain Oil Palm Development (NBOPD), Cocoa and Coconut Research Institute (CCRI) and the Coffee Research Institute (CRI). The formation of OPRA appeared to stimulate other export crop industries to similarly finance research for their respective crops (ISNAR 1982), eventually leading to the formation of the CCRI and CRI in 1986. Brief overviews of their transition and major R&D focus are outlined in the rest of this section.

#### *2.1.1 Oil Palm Research*

An expansion of commercial oil palm development in the 1970s was the catalyst that led to the formation of the PNG Oil Palm Research Association (OPRA) in 1980 (Antony, Kauzi and Prior 1988). Prior to this, R&D was carried out by the New Britain Oil Palm Development Limited (NBOPD). The establishment of OPRA resulted in a reorganization of oil palm R&D and related activities between OPRA and NBOPD. Both of these are located at Dami, in the West New Britain province.

Research at OPRA focuses mostly on crop management/agronomic and crop protection research whilst NBOPD concentrates on breeding. Crop management research focuses on the development of biological and economic response models for different oil palm areas and the development of management practices targeting smallholders through fertilizer demonstrations. Crop protection R&D includes entomology research on effective biological control of *sexava* and monitoring of potential and new insect pests. Plant pathology R&D concentrates on developing control measures to *ganoderma* infection. NBOPD on the other hand engages mostly in breeding research and seed production.

[3] Whilst efforts have been made to keep the discussions as general as possible, there is an inevitable bias toward cocoa and coconut research for which information is easily accessible and of which the principal author has some first hand experience.

### *2.1.2 Cocoa and Coconut Research Institute*

The PNG Cocoa and Coconut Research Institute (CCRI), was established in 1986, created by the amalgamation of the public research and the privately owned Cocoa Research Company, and is responsible for cocoa and coconut research for PNG. The institute is jointly owned by two government statutory entities – the Cocoa Board (CB) and Copra Marketing Board (CMB) of PNG. The CCRI's board of directors (BOD) is appointed by its stakeholders and meets on a quarterly basis to consider the Institute's R&D operations, financial matters and other Institute business (CCRI Annual Report 1996). The institute is accountable to its BOD and shareholders in carrying out its R&D mandate.

The CCRI has its headquarters in Rabaul in the East New Britain province (ENB), a research station in the Madang province majoring in coconut research, and five provincial centres.

Research programs at CCRI include cocoa and coconut agronomy, breeding, product quality improvement/downstream processing, entomology, plant pathology and economics. The institute has an interdisciplinary approach for undertaking R&D for the cocoa and coconut industries in PNG.

### *2.1.3 Coffee Research Institute*

The CRI was formed in 1986 and is based in Aiyura in the Eastern Highlands Province (EHP). The CRI is the research division for the Coffee Industry Corporation (CIC) and is responsible to the latter's BOD.

The CRI has a research sub-station at Pangia in the Western Highlands province and a lowlands research sub-station at Omuru in the Madang province. The latter mainly focuses on research into better yielding Robusta coffee varieties.

The CRI's R&D activities cover all aspects of coffee improvement and husbandry, and processing that are appropriate to the industry. Disciplinary research programs include agrophysiology, breeding (including germplasm collection and genetic improvement), entomology, plant pathology, soil and plant nutrition, and coffee processing.

## 2.2 Food crops, livestock, and land utilization research[4]

Prior to the establishment of the National Agricultural Research Institute (NARI), the Agricultural Research Division (ARD) at DAL was responsible for public agricultural research functions. Research was conducted mostly at five regional research stations:

(a) The highlands FSR at Aiyura in Eastern Highlands province with R&D emphasis on coffee intercropping, agroforestry, vegetable agronomy & adaptation, food crop management, cash crop diversification, soil management, alternative crops (fruits & nuts) and spices.
(b) The lowlands FSR at Bubia in the Morobe province focussing on taro improvement, crop rotations and cropping systems, pests and diseases control and management, vegetable adaptation, socioeconomic and farming systems research.

[4] This information is based on DAL's presentation to the PNG–ACIAR Consultations on Agricultural Research Collaboration in October 1995.

(c) The cocoa-coconut based FSR or lowland agricultural experiment station (LAES) at Keravat in East New Britain province majoring in cocoa-coconut cropping systems, adaptation and improvement of alternative crops, improvement and management of food crops and vegetables, agroforestry, soil and land management, pest and disease management of food crops, vegetables, fruits, nuts and spices.
(d) Dry-lowlands research based at Laloki in the Central province majoring in biological and integrated pest management on food crops, vegetables and fruits; food crop management; vegetable adaptation and improvement; and germplasm maintenance, and
(e) The Livestock Research Station at Labu in the Morobe province majors in the improvement and adaptation of chicken, sheep, goats, ducks, and guinea pigs; assessment and improvement of feeds and pastures; and livestock nutrition and management.

The DAL also has a land utilization section based in Port Moresby that engages in land resource evaluation and assessment for rural development. Some of its activities include land use planning, soil surveys, soil erosion research, land suitability evaluation, and management of the PNG Resource Information System (PNGRIS) –a computerized land resource database.

A reorganization of public research functions, which began in the mid-1990s, eventually led to the establishment of NARI in July 1996 by an Act of the PNG National Parliament and officially launched in May 1997. NARI is a statutory organization with primary R&D focus on traditional food crops, alternative food and cash crops, livestock, and land/soil resource management. The research programme is subdivided into five subprograms based on agroecological zones: two in the highlands – main highlands, based at Aiyura and high altitude highlands, based at Tambul; and three lowlands – wet-lowlands (mainlands) based at Bubia, wet-lowlands (islands) based at Keravat and dry-lowlands based at Laloki. Most of the research personnel under DAL were seconded to NARI in the initial transition period and eventually taken onboard on a full time basis. Strategic planning issues and an orientation towards smallholder semi-subsistence farm households are becoming increasingly important in the process of setting research priorities and allocating research resources.

Most of these institutions are supported partly by variable output (export) levies and direct public and external funding.

The quasi–autonomous arrangement means that public sector input both on policy advice and funding is still a feature of these institutions. The government is represented by the Secretary of the DAL or his appointee on the boards of the industries and the Research Review or Advisory Committees. This is a key linkage since it serves as a bridge between the research system and the public policy-making mechanism and national leaders whose support is crucial in years when export commodity prices have been at their lowest.

## 3. RESEARCH PRIORITY-SETTING POLICIES

The lack of clearly defined national policies for R&D priorities has been a feature of the public research system in PNG for many years. However, to a large extent agricultural R&D priorities have been generally demand-driven or problem-led. Thus research

priority-setting has been influenced largely by demand created by problems in particular industries. However, strategic planning issues are beginning to influence R&D priority-setting.

## 3.1 Strategic planning and related issues

Strategic planning is described as the 'process by which an organization builds a vision for its future and develops the necessary structure, resources, products, procedures and operations to achieve it' (Collion 1993:173). Part of the strategic planning process for an agricultural R&D organization is the acquisition of knowledge necessary to facilitate the setting of R&D directions. Specifically, the knowledge acquired includes (a) national and global trends and regional issues that may affect producers, consumers and research providers, (b) identification of critical success factors for R&D such as funding levels, market access, equipment, technology and intellectual capacity.

Economic and industry trends affect farming practices and crop profitability in PNG and in turn influence R&D requirements of PNG agriculture. These trends form part of the strategic backdrop to agricultural R&D in PNG and increasingly they are taken into account by the planning, design and implementation of agricultural R&D programs and projects. Some of these trends are reviewed in the next section.

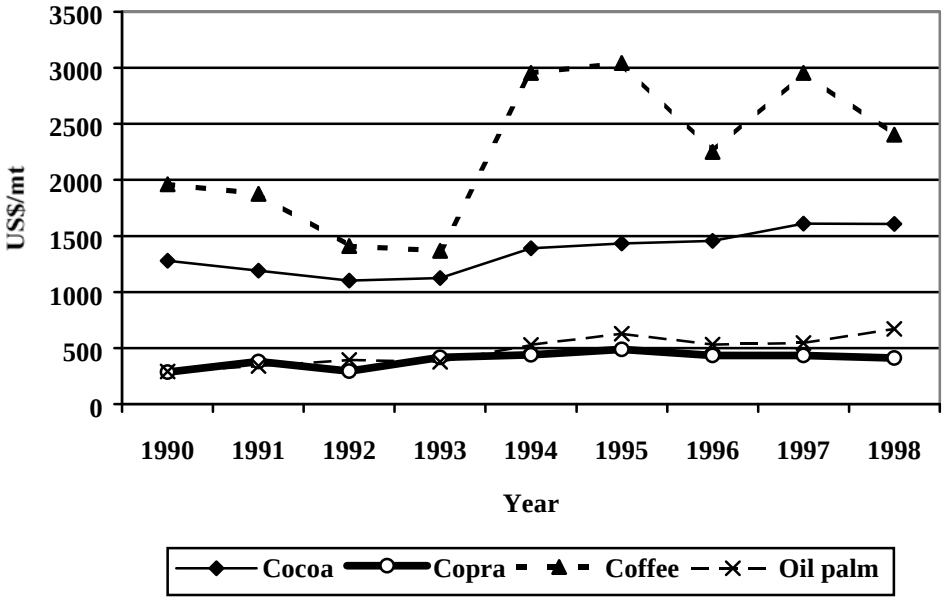
### *3.1.1 National and global industry trends*

Four main factors are currently viewed as important at the strategic planning level. The factors are (a) long–term trends in crop prices; (b) long–term trends in the proportion of crop production generated by different sectors (smallholders versus plantations); (c) cost of production by sector and their long–term profitability and sustainability; and (d) major production risks, in particular the potential impacts of pests and diseases (Overfield and Kufinale, 1993; CCRI Annual Research Review Report 1996).

*Long–term trends in international commodity prices*

Historical international prices for coffee, cocoa, copra and oil palm have stagnated or fluctuated in the last decade (Figure 1). For most of the 1990s (1992–1997) producers have been subsidized by a government price support scheme. In some years the subsidy amounted to 50 per cent of the average price either delivered in store or received at farm-gate. This support price was intended to make the industries more efficient and to facilitate reduction of production costs to a level where the industries could compete at world prices. However, recent cost of production studies by Fripp (1996), Omuru (1997b) and Stapleton (1997) indicate otherwise. In general, production costs have continued to rise and given current market fundamentals, low world prices are likely to persist in the long–term.

**Figure1: Historical world prices of cocoa, copra, coffee and oil palm**




Different grades of individual crops are subject to price discounts and/or premiums from time to time. For example, Overfield and Kufinale (1993) indicated that PNG Y-grade coffee attracts a discount of up to 13 cents/lb. whilst the top plantation produce receives a premium of up to 40 cents/lb. against the international indicator price. In a recent study, McConnell, Rambaldi and Fleming (1996) report that PNG coffee is being discounted increasingly against Other Mild coffee in the international market. Furthermore, one of the biggest complains regarding PNG cocoa is smoke contamination that is a taint of the cocoa introduced during drying. There is no fixed percentage discount on cocoa with this quality attribute, but the volume below ordinary fair average quality (FAQ) cocoa beans varies with the intensity of the smoke taint. It has been estimated that a discount of up to K450–K500 (≅US$160-180) per tonne is usual (Omuru, 1997a).[5]

*Trends in crop production by sector*

Since the mid–1970s, the smallholder sector's proportion of production for export crops has increased significantly (Figures 2, 3 and 4). Currently it is the economically dominant sector, producing about 67 per cent of total cocoa production, over 80 per cent of copra, around 70 per cent of coffee, and about 50 per cent of oil palm in PNG. Plantations (and/or blockholders (coffee) and mill owners (oil palm)) produce the balance. The organization of R&D output and input should account for the relative economic

[5] A major component of the CCRI's post–harvest research by the Cocoa Quality Section is focussed on addressing this problem.

**Figure 2: Cocoa bean production by sector in PNG**

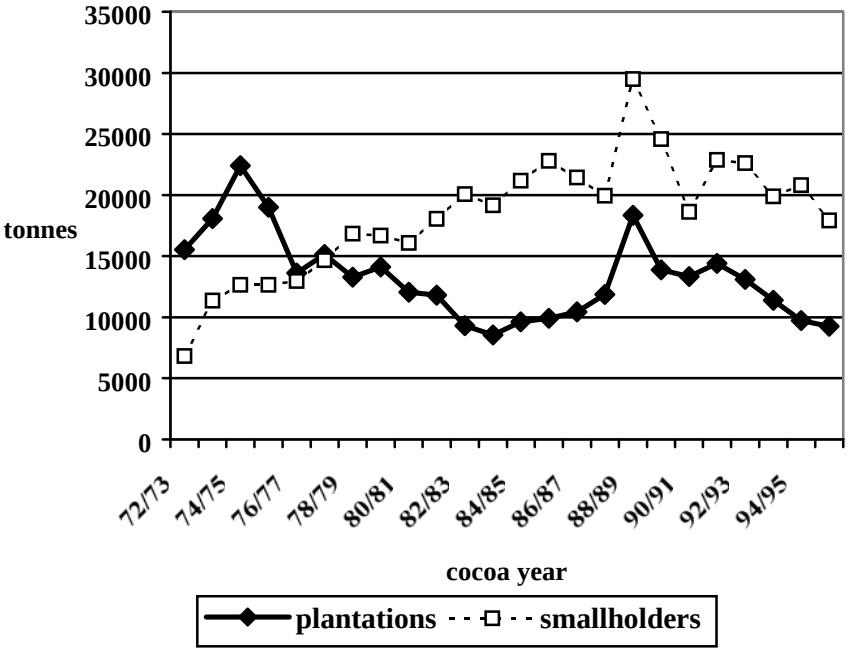
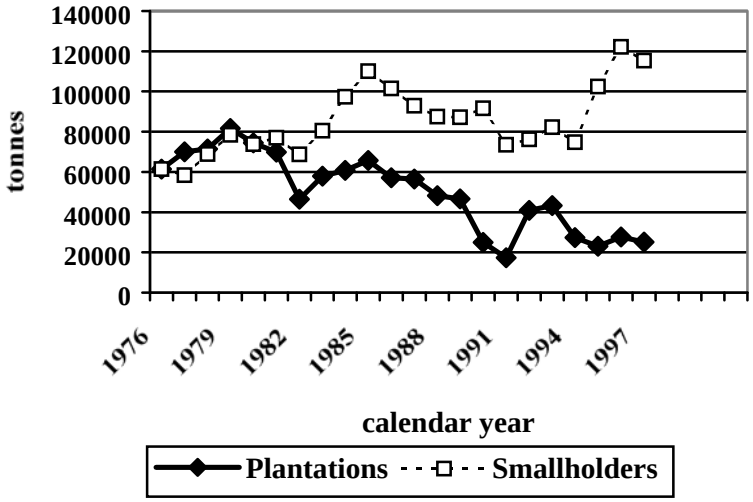
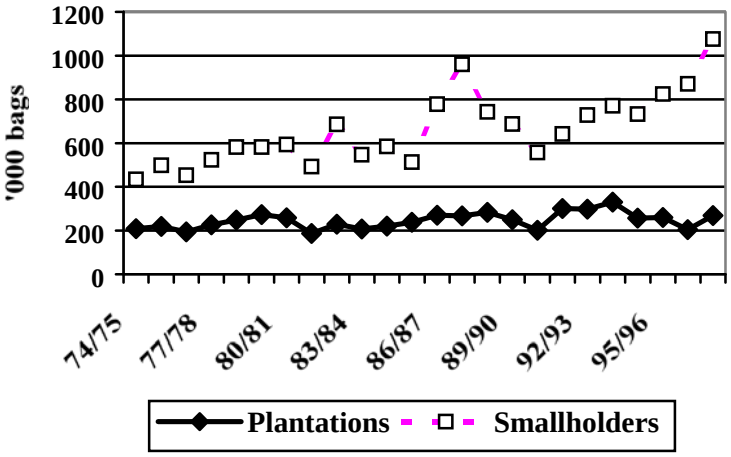



**Figure 3: Copra production by sector in PNG**



importance of each sector, their capacity to pay and their capacity to benefit from any R&D activities (Overfield and Kufinale, 1993).

**Figure 4: Coffee green bean production by sector in PNG**



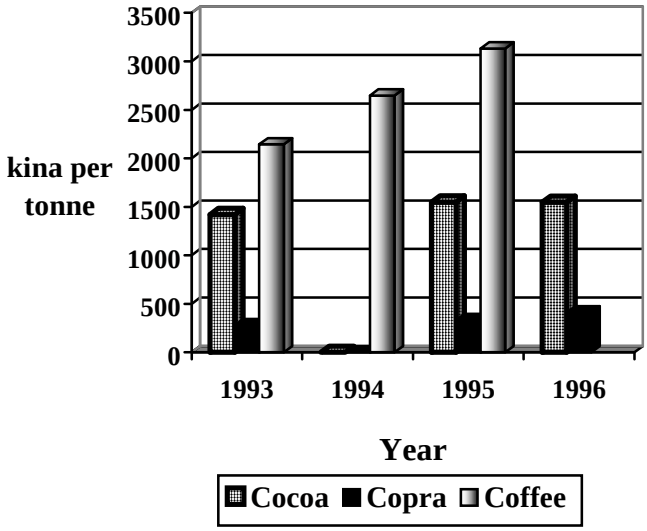

The industries fund part of the research through a variable levy on each tonne of the crop exported. Since a relatively larger proportion of the production comes from the smallholder sector and therefore a similar proportion of R&D funding, it is widely felt that research priorities and resources should be oriented more toward development of technologies that will help address problems faced by this sector. In general, the largeholder plantation sector's share of production has stagnated in recent years thus strengthened the debate about prioritizing and allocating research resources more according to the proportion of sectoral output.

PNG is not isolated from this debate about the allocation of R&D resources according to size of production unit. Similar situations exist in some other developing countries like Zimbabwe and other east African countries (Mutangadura and Norton, 1999).

*Cost of production by sector and implications for long–term economic sustainability*
Average costs of production estimates for the plantation sector have been on the rise in recent years for each of the export crops (Figure 5).[6] Between 1993 and 1996, cocoa plantation cost of production (COP) increased by 9 per cent and copra by 47 per cent whilst coffee plantation COP increased by 46 per cent between 1993 and 1995. For cocoa, the increase in COP have been attributed to increases in processing costs (54%),

[6] Insufficient cost data was available for cocoa/copra in 1994 due to the twin volcanic eruptions in Rabaul where most of the plantations are concentrated. 1996 COP for coffee is not available.

**Figure 5: Average plantation cost of production by export crop: 1993-1996**




fixed/overhead costs (21%) and harvesting costs (16%). Field variable costs have remained steady. There have been gradual declines in the share of expenditure for fertilizer (38%), pesticides and fungicides (60%) due to high costs but these have been offset by increases in expenditures in pruning (13%), weeding (16%) and census and infill (43%) (Fripp 1996; Omuru 1997b).

The devaluation and subsequent floatation of the local currency (kina) in late 1994 and its free- fall in 1997 through to 1998 have consistently increased the nominal value of commodities exported. However, a large component of inputs used in the production processes in PNG are imported. Hence, Kannapiran and Fleming (1999) state that in the case of PNG, it is difficult to say if devaluation improves competitiveness. High costs of imported inputs squeeze any potential profits. Without price support cocoa/coconut plantations were operating with negative margins in 1993, 1995 and 1996 (Fripp 1996; Omuru 1997b).

Production costs for the smallholder sector are difficult to estimate. However, their direct cash costs are low and the main input is unpaid family labour, hence costs are likely to be very low. This therefore suggests that output is likely to be sustainable at current international prices. Kannapiran and Fleming show that exchange rate policy changes (devaluation) has significantly improved this sector's competitiveness and comparative advantage in producing oil palm, coffee, cocoa and copra.

At current cost of production levels, the long–term economic sustainability of the plantation sector is uncertain. The smallholder sector on the other hand, with its low cost of production is likely to sustain the industries in the long–term; hence the argument to direct more research to this important group of growers.

*Impact of Pests and Diseases*
Crop pests and diseases pose a serious threat to future production of both export and food crops in PNG.

Devastating pest attack of young hybrid coconuts by beetle pests —*Scapanes australis* and *Rhinocophrus bilineatus* are particularly damaging in the islands region (Bougainville, New Britain and New Ireland) which unfortunately has the largest number of coconut palms in PNG. It has been estimated that over 95 per cent of palms in this region were destroyed by pests within seven years after planting (Turner, 1988). Accordingly, the CCRI acknowledges that 'the most important constraint to the rehabilitation and expansion of the PNG copra industry is beetle pests' (CCRI Annual Report 1996). Consequently a large component of the entomology research at CCRI concentrates on new ways to control this problem.

*Phytophthora* pod rot (cocoa) and coffee berry diseases (coffee) have the potential to cause huge damage to cocoa and coffee, respectively. The former is estimated to destroy about 20–40 per cent of the total PNG cocoa crop on an annual basis.

In each of NARI's regional research programs R&D on pest and disease control and management ranks relatively high. Projects categorized as high priority include: biological control of banana skipper and spiraling white fly and integrated pest management of diamond back moth in brassicas at Laloki; integrated pest management on aibika at Keravat (LAES); and biological control of corn stem borer and green vegetable bug at Bubia. Between 1993-95, 18 per cent of the total ARD annual research budget was earmarked for crop protection research, second in magnitude only to resource management (23%) (Ghodake and Wayi, 1994).

### 3.1.2 Size of R&D programs and professional capacity
The last decade has seen steady growth in the relative size of research programs and the number of local research scientists with postgraduate qualifications has increased gradually. In addition, the institutional reorganization of the public funded experimental research stations under the NARI with semi–autonomous administrative and management status, has been a huge boost for R&D in food crops such as tropical root crops (yams, taro, sweet potato etc) and farming systems research. However, with these changes comes the need to improve remuneration for researchers to maintain capacity.

*Size of R&D programs*
New research programs have been established and existing programs have been expanded where funds are available. Consequently the number of research scientists and research assistants and other support staff have increased, albeit modestly due to cash constraints. There is a general awareness of the need to expand research programs, but financial constraints curtail any further expansion at present. These financial constraints increase the need for and relevance of sound process of research priority-setting. Future R&D activities and their likely social pay–payoffs need to be identified.

*Professional capacity*
There has been an increase in the number of local research scientists obtaining postgraduate qualifications. This is a huge boost to enhancing the professional capacity of

R&D organizations in PNG. Currently 79 per cent (11/14) of national scientists at CCRI have acquired postgraduate qualifications compared to 10 per cent (1/10) a decade ago, whilst NARI has 50 per cent of its national research scientists with postgraduate qualifications. The CRI/CIC has also experienced similar trends. In general, the number of research scientists with postgraduate qualifications in all agricultural research institutions has increased in the last decade.

Until 1998, remuneration for local scientists in general was relatively unattractive and a huge salary gap existed between their expatriate colleagues. However, beginning 1998 all CCRI research scientists were placed on three–year contracts with improved remuneration whilst scientists at NARI have also experienced improvements in their remuneration due to the reorganization compared to the case under the old DAL regime.

Competitive remuneration and a stable research environment are two important factors in attracting and maintaining a pool of qualified and experienced researchers in an organization. The latter contributes to an accumulation of institutional capacity in the form of knowledge and expertise that are readily available to respond quickly and effectively to research problems when they arise (Wright and Zilberman, 1993). However, the reverse is also true, poor remuneration and uncertainty within the research environment could force researchers out. For example, abolishing of public funding to research organizations in 1999 created uncertainty among research scientists of their long-term employment prospects. This has the potential to cause an exodus of experienced and qualified researchers and should be avoided at all costs especially at this crucial time of these institutions' development. In addition, a lot of resources, time and effort have been committed to training of local scientists. Many of them have acquired skills and experience that are vital to agricultural R&D over time, hence the need to maintain them.

The danger of losing local scientists to organizations within PNG and overseas, especially in the South Pacific region is limited at the moment for two reasons. Firstly, the scope of employment opportunities outside of agriculture sector are somewhat limited for biological or physical scientists; and secondly, it may take a while for these scientists to create research niches to attract employment opportunities from regional institutions. However, with the increasing trend in regional and international research collaboration, this may eventuate sooner than is currently anticipated.

## 4. METHODS

Methods for research priority-setting in PNG are mostly embedded in the deliberations of research review or advisory committees (henceforth RRC) for each of the research institutions.[7] These committees are usually made up of appropriately qualified and experienced members of the agricultural scientific community and industry organizations. Ex ante research evaluation processes have only been introduced recently and only exist at the CIC and CCRI. Their application in research priority-setting and portfolio

[7] For example, the CCRI's research review committee is comprised of the Institute Director, Director of the Agricultural Research Division (national DAL), Head of the Agriculture Department (PNG University of Technology), Executive Director (PNG Growers' Association) and an entomology professor (University of PNG).

management is somewhat limited. Methods for setting priorities for R&D in PNG can be divided into three main categories: (a) research reviews, (b) ex ante economic evaluations, and (c) tiered fiscal procedures. These are described below.

## 4.1 Research reviews

Most of the institutions covered in this paper conduct research reviews at 6–monthly intervals each year or in some cases, on an annual basis. Where there are two reviews in a year like at CCRI, the first of these is a mid–term research review convened in May and the second is an annual research review in November. These reviews are for monitoring and evaluating the progress and performance of ongoing R&D projects and programs to ensure research direction and are where research priority-setting decisions are derived and implemented. These are more of what the OECD (1987) regards as a modified peer–review as opposed to a direct peer–review, due to its accommodation of socio–economic considerations in the review process.

The decision to accept or reject a new research project is largely based on 'expert opinion' and consensus by those on the RRC. Decisions of this nature have also been reported for some other commodities (see for example, OECD, 1987 and Lal et al. 1994).

### *4.1.1 Mid-term research management reviews*

The midterm review is a management review and comprises mainly the RRC and research program section heads. The main purpose of this review is to monitor the progress of research activities within a six-month period.

Projects are monitored to see how they evolve over time and also provide an opportunity for research programs managers to present problems that may delay implementation of projects. The minutes from the previous annual review are used as the basis to monitor progress and provide research direction.

### *4.1.2 Annual research program reviews*

The annual review is mostly an evaluation review and the scope of representation is much wider compared to a mid-term review. It usually involves research scientists, resource persons or scientists from other research organizations, academics, and provincial and national government representatives. All trials in each research program are evaluated in detail and new trial proposals are reviewed and approved.

Research managers present progressive results for the respective research projects or programs. The reviewers examine the results, progress and prognosis for achievements of each R&D program and future plan for R&D. In some institutions like CCRI the reviews are usually preceded by field visits which provide opportunities for reviewers to observe the actual field research. This provides reviewers with additional insight into research projects and enables greater participation in the review. At NARI, the research programme review is an in-dept technical review that assesses and audits its research programs. Due to the locations of its subprograms, the review process takes over two weeks because each subprogram is visited to conduct the review. Representation at these reviews is mostly by senior NARI researchers and advisors from the Australian Contribution to a National Agricultural Research System (ACNARS) in PNG.

In addition to the overall review of all existing research programs, new trial proposals are subject to scrutiny. The scientific approach and trial design and the likely economic/social impact of the trial are reviewed. If a trial is judged by 'consensus' to be of future benefit to the industry, it is approved to proceed, sometimes subject to minor modifications and usually in the proposed trial design (biometrics design).

The reviews are recorded as research review minutes and serve as the basis to monitor progress and address outstanding issues and/or decisions reached in the meeting.

## 4.2 Ex ante economic analysis

The Industry Affairs Division of the Coffee Industry Corporation (CIC) and the Economics Section at CCRI currently use two methods for ex ante research evaluation to help set R&D priorities and make resource allocation decisions. These are the scoring criteria model (SCM) and benefit-cost analysis (BCA).

### *4.2.1 Scoring method*

The scoring technique takes the form of applying scores to each new research trial proposal. The scores are based on a range of 1 to 10, with 10 being the highest possible desirable score. The total score has two components, each with a maximum score of 5. The first 5 points represent the proportion of producers for which the project will provide useful information.[8] The second 5 points relate to the potential usefulness of the information to the producers.

The scoring is applied partly by utilizing information derived from an economic evaluation questionnaire, and partly on information from annual cost of production surveys, and the market trends (prices, production, etc.) of the commodities.

The economic evaluation questionnaire is distributed to research section heads or the scientist in-charge one to two months prior to the annual research review. The questionnaire is filled out only if there is a new trial being proposed. It attempts to extract as much information as possible to carry out both the scoring and BCA.

Upon receipt of the completed questionnaire(s), the industry economists (qualitatively) evaluate the likely effects (costs and benefits) of the proposed research. The economists then discuss the evaluations with the respective scientists thus enabling the research scientists to gain the economic perspectives of their research. The evaluation is then incorporated into a standard format for presentation at the annual research review.

Thomson and Morrison (1996) and Upton (n.d.) have highlighted some of the pitfalls of the scoring method relative to BCA. The former point out that 'there are no well–established standards for parameters to be scored or weighted, and is subjective therefore cannot be disputed or challenged in the way assumptions of BCA can' (p.12) whilst the latter presents similar reasons and further contends that scoring models 'lack a rigorous theoretical framework' (p. 10). However, its popularity and wide use is attributed to its simplicity and facilitation of active participation by research managers and researchers (Falconi 1993).

[8] For example, a score of 1 would equate to 20% of the producers and a score of 5 would equate to 100% of the producers.

### *4.2.2 Benefit–cost analysis*

This method is the more formal of the two techniques, and has been carried out only when there is an identifiable and quantifiable output from a proposed research activity. The BCA has been used to assess the stream of discounted net benefits and costs over time using most commonly the internal rate of return (IRR) as the measure of project worth to rank projects.

Quantifiable data is difficult to obtain especially at the early stage of a trail; hence in the initial stages ex ante research evaluation work has been restricted to the scoring method. For example, only a third of the total trials at CRI have been subjected to BCA (Overfield and Kufinale, 1993), whilst at CCRI the proportion is even less.

## 4.3 Tiered Fiscal Procedures

Antony and Parton (1991) describe three main levels of decision–making for agricultural R&D resource allocation in PNG. These are (a) national level, (b) DAL and (c) research station level.

Allocation of the national government's contribution to agricultural R&D initially occurs at level (a). This is done through the national government's budgetary process. Submissions from various R&D organizations are considered together with all other public sector departments and appropriations are made accordingly. However, there has been growing uncertainty in the allocation of these funds in recent years, as was the case in 1999. Except for the coffee industry, all the recurrent budget allocations for the other agricultural R&D institutions were abolished!

Since the reorganization of R&D related activities to be undertaken by semi–autonomous institutions, the role played by DAL to allocate agricultural R&D funds to these institutions as described by Antony and Parton has shrink to a very minor one.

In the semi-autonomous institutions, resource allocation is the prerogative of the board of directors (BOD) on advise from senior management which in most cases are the chief executive and the finance manager.

Research program budgets are usually prepared by the research section heads. These are then submitted to the Accounts Section. The Finance Manager incorporates these section budgets into the institute budget for the next fiscal year. During this process he consults with section heads to make revisions where necessary to be within the forecast cash-flow limit. The draft budget is then scrutinized by a finance committee prior to its presentation to the BOD. The BOD then deliberate on the budget presented to them and approves the budget subject to revisions especially on major cost items in consideration of the forecast cash flow for the next fiscal year. The budget meeting usually takes place in November each year.

For public funded programmes, the budgets are prepared in September of each year and submitted to the national Department of Finance/Treasury for consideration in the national budget session in November.

## 5. PRACTICALITIES

It is not always easy to implement the policies and methods described in the previous sections. Antony and Parton (1991) reported the complexity of resource allocation at the research station level. Jolly (1987a, 1987b) and Antony et al. (1988) experienced and expressed concerns about the lack of data to successfully conduct economic analysis. Fripp (1996), Omuru (1997b) and Stapleton (1997) also faced difficulties in conducting cost of production surveys due to poor response. Some of the issues that relate to the practicalities of applying policies and methods for priority setting and resource allocation are examined in this section.

### 5.1 *Ex ante* economic analysis

The findings of an ex ante economic analysis should be used to establish an order of priority among competing projects because there are always more projects than can be implemented with a given amount of R&D funds.

The application of ex ante research evaluation methods is relatively new in the institutions that use them viz. CRI and CCRI. Efforts to introduce and implement these have encountered major hurdles, some of which are outlined below.

#### *5.1.1 Data constraints*

The lack of essential baseline R&D data and information has persisted over many years and thus inhibited sound economic analysis from which baseline economic and statistical information can be drawn. This has been exacerbated by complex farming practices of smallholder farmers about which written information is sparse. There is also a problem, to some extent, of timely availability of market information for some of the industries.

The economic research evaluation questionnaires are sometimes poorly filled out by research scientists and therefore make evaluation difficult. This usually reflects a lack of sufficient time spent in reviewing literature and thinking carefully before compiling a research proposal.

This lack of essential information makes the application of benefit cost analysis (BCA) sometimes impossible because of its vast data requirements and it also renders the scoring techniques, with their subjective judgements even less credible.

#### *5.1.2 Clash of cultures*

Marbin, Menzies, King and Joyce (n.d.) assert that ‘any priority-setting, particularly where there is likelihood of changes in existing patterns of distribution of resources, is likely to arouse apprehension among those who perceive they may loose out in the new order’ (p. 585). This has been largely true in the PNG experience. The concept of evaluating research was new to research scientists at CCRI, hence a degree of apprehension was shown by scientists that their work was being evaluated. This led to difficulties in obtaining their cooperation in the initial establishment phase of the research evaluation methods. The CCRI experience reflects the view expressed by Prinsely (1993), that economic evaluation of research ‘is an anathema to many scientists and can clash very strongly with the scientific culture which is largely “curiosity–driven”’(p.10).

Strong support from senior management is an essential initial prerequisite to allow economic evaluations of research project proposals. Often without this support inadequate responses can come from project staff. However, often in time, as project staff interact with project analysts and use the analysts to improve the value of their projects, then the strong support from senior management is less necessary. When project staff come to see merit for themselves in project assessment then that can be sufficient incentive for their collaboration in project appraisals (Thomson and Morrison, 1996).

A related issue has been the lack of understanding of the purpose of an ex ante economic evaluation of research projects. Hence these evaluations are not viewed in their proper context nor sometimes are they applied appropriately to better service and facilitate priority-setting and resource allocation decisions. For example, there have been cases at CCRI where several new trials were conducted after requests for ex ante economic evaluation. Consequently an ex ante economic analysis is not possible and the analysis becomes ex post or more of a 'post-mortem' and at best serves as some form of 'false advertising' that Kingwell (1999) describes. This has been exacerbated by the method of program budgeting and the preparation of operational plans. Most of the budgeting and programming work is done on an *ad hoc* basis and it is difficult at times to distinguish the order of these activities. Currently these processes take place at different times, not necessarily in their 'proper' sequence as would be suggested by a logical framework.

### *5.1.3 Lack of competition for research funds*

Another reason why ex ante economic analysis has not received the attention that it might require is that in some circumstances there is no 'competition for scarce resources.' For example, in programs where R&D funds are provided by external sources, these funds are mostly earmarked for specific projects and/or programs thus nullifying the need to conduct ex ante economic analysis at an institute level.

Hardaker and Fleming (1989) pointed out two likely outcomes of external donor-funded R&D programs: (i) research programs tend to be determined by the whims of the donors than as part of an overall research strategy, and (ii) funding arrangements are often intermittent, with particular programs implemented and cease over relatively short periods thus achieving very little due to interruptions (p. 283).

Relatedly an inadequate understanding of the local agricultural R&D environments has partly resulted in achieving very little in the agricultural sector. For example, some programs are being repeated to address the "oversight" in earlier research projects. By illustration, the ex ante economic evaluation framework designed to assess R&D projects (Antony, Kauzi, Loh and Anderson 1988; Antony, Kauzi, and Prior 1988) in an earlier project funded by ACIAR has not been utilized partly because of a lack of time devoted to mentoring and training of industry economists to adopt and apply the techniques.

## REMEDIES AND DESIRABLE R&D DIRECTIONS

### 6.1 Diversification of R&D revenue generating sources

Unpredictability of the political environment in PNG should stimulate research managers and administrators to prudently plan their finances and to identify alternative sources of funding. In the midst of public funding uncertainties, diversifying agricultural R&D revenue sources is an option that needs to be explored. The acquisition of three commercial plantations by CCRI in 1998 is a case in point. This investment has proved worthwhile; especially in providing support to the CCRI's cash flow in 1999 when recurrent public funding which accounts for about 20 per cent of the institute's annual budget was abolished by the Skate government.

### 6.2 Agricultural and socio economics

Economic input into and evaluation of R&D activities have been lacking until recently. Past economic contribution has been largely in terms of sectoral and socio-economic surveys, market analysis and policy advice. Ex ante economic evaluation of R&D began in CIC in 1992 and at CCRI in 1995. For the latter it took almost two years (1994/95) to establish an economic section to provide an appraisal service to support R&D and also to conduct agricultural economic research.

Ex ante economic analysis should complement and assist research management in setting research priorities and guide in R&D resource allocation decisions. Unfortunately to a large extent this is not the case in PNG. There is therefore a need to adopt a logical framework in the planning, programming and budget processes of many research organizations. For this to work effectively and efficiently greater consultation between research managers and financial managers is paramount.

It is also important to identify the economic requirements of R&D organizations and establish economic units to conduct economic analysis and participate in strategic planning and R&D evaluation to guide priority setting and portfolio management. The ratio of research scientists to economists is biased toward the former. For example, in 1999 the ratio of research scientists to economists was 10:1 at CCRI and CRI. At present there are no economists at NARI and OPRA.

### 6.3 Establish and maintain sustainable data and information collection processes

Data gathering processes need to be established to provide data on R&D projects/programs and adoption of new technologies by farmers on a regular basis. This would then facilitate economic evaluation and other R&D impact assessments.

The CCRI with financial assistance from the Australian Centre for International Agricultural Research (ACIAR) is currently engaged in a smallholder socio–economic survey to help gather baseline data and information to identify problems, constraints, and opportunities. The information generated will then be used to plan and prioritize research projects so that research resources can be allocated to initiate projects to address some of these problems, constraints and opportunities. In addition, monitoring processes are being designed to conduct similar surveys, or rapid rural appraisals, on a regular basis.

### 6.4 Improving R&D capacity through mentoring and training

Mentoring and training are crucial for enhancing the productive capacity of researchers. This can be done in a number of ways: (a) Establish in-house training and refresher courses on a regular basis. This will not only improve the productivity of the participants but will serve as an incentive for the incumbents to contribute to the organization. (b) Create flexibility in involving researchers to participate in consulting jobs that are offered by external public and private organizations. This will allow researchers to more widely apply their research skills and to engage in collaborative research. Currently, only NARI has a policy for its researchers to utilize their expertise on a consultancy basis to generate revenue for the institute and encourage or enhance professional development of its staff (NARI Annual Report 1998).

The R&D evaluations are more advanced in CIC than at CCRI. A major reason for this is that the CIC economists have benefited from an Overseas Development Assistance (ODA) economist, who was attached to the CIC and undertook the task of establishing a research evaluation and priority setting framework and training national counterparts. Consequently, the transition was smoother for them than for the Economics Section at CCRI.

## CONCLUSION

The aim of this paper has been to review the policies and methods used for agricultural R&D priority setting in PNG and to examine the practicalities in applying them.

The lack of clearly defined national agricultural R&D priorities and written statement on research policy in PNG has been a major setback for research. However, a reorganization of R&D functions from the public sector to semi-autonomous organizations has led to greater commitment to agricultural R&D planning and national research priority setting and accountability within the decision-making processes. Generally R&D in PNG has been demand-driven. Strategic planning considerations are beginning to influence R&D priority setting at present. In the PNG context these have included economic and industry trends that affect farming practices and crop profitability issues which in turn influence R&D requirements of the PNG agriculture sector. Some of these factors are: (a) long-term trends in crop prices; (b) long-term trends in the proportion of crop production by each sector; (c) cost of production by sector and their long-term profitability and sustainability; and (d) major production risks, in particular the potential impacts of pests and diseases.

Methods used for agricultural research priority setting in PNG are mostly through research reviews. Ex ante research evaluation processes have only been introduced recently and only exist at the CIC/CRI and CCRI. Their application in research priority setting and portfolio management is somewhat limited at present. Some of the underlying reasons which limits their effective application are a lack of data, lack of cooperation by research scientists in the initial stages of its establishment and a lack of competition for research funds.

Size of R&D programs continue to increase so as the postgraduate qualifications obtained by local research scientists. Adequate funding and competitive remuneration and a stable research environment, respectively are necessary prerequisites for maintaining research programs and attracting and maintaining professional capacity. These will enable research organizations to have the capacity to carry out their R&D activities.

Agricultural R&D in PNG has the potential to make a greater contribution. Some of the areas that may assist to realize this include: (a) diversification of R&D revenue generating sources in addition to traditional sources of funding, (b) establishing and supporting agricultural economic input and research in research organizations. This would facilitate ex ante appraisal of research projects and help to adopt a logical framework in planning, programming and budgeting processes; (c) establish and maintain data and information collection processes and improve mentoring and training which are crucial for enhancing the productive capacity of research scientists.

There have been improvements in the organization of the research system in PNG, however, there are also constraints that limit the impact of these in PNG agriculture. Some possible remedies have been examined which could alleviate some of these constraints. The capacity for research organizations in PNG to deliver appropriate R&D products therefore depend on firstly addressing some of the issues raised in this paper.

## REFERENCES


Antony, G, Kauzi, G. Y, Loh, D. W and Anderson, J. R. (1988) *Returns to Cocoa Research 1965 to 1980 in Papua New Guinea.* ACIAR/ISNAR Project Papers, No. 9, ACIAR, Canberra.

Antony, G, Kauzi, G. Y and Prior, R N B. (1988). *Returns to Research on Insect Pollination of Oil Palm in Papua New Guinea.* ACIAR/ISNAR Project Papers, No. 10, ACIAR, Canberra.

Antony, G and Parton, K. (1991). "Papua New Guinea's Export–Crop Research: Past Returns and Expected Economic Effects." *Prometheus,* 9 (1): 62–80.

Collion, M. (1993). "Strategic Planning," In: D. Horton, P. Ballantyne, W. Peterson, B. Uribe, D. Gapasin and K. Sheridan, (1993), *Monitoring and Evaluating Agricultural Research: A Source Book.* ISNAR, The Hague, The Netherlands.

Falconi, C. A. (1993). "Economic Evaluation." In: D. Horton, P. Ballantyne, W. Peterson, B. Uribe, D. Gapasin and K. Sheridan, (1993), *Monitoring and Evaluating Agricultural Research: A Source Book.* ISNAR, The Hague, The Netherlands.

Fripp, E. (1996). *Plantation Cost of Production Survey 1993 & 1995*. Economic Section Discussion Paper # 1/96, PNG CCRI, Rabaul.

Ghodake, R and Wayi, B (1994). "Research Management Information System: Research Program [1994-95]." In: *Proceedings of PNG-ACIAR Consultations on agricultural research collaboration*. Port Moresby.

Hardaker, B. J and Fleming, E. (1989). "Agricultural Research Problems in Small Developing Countries: Case Studies from the South Pacific Island Nations." *Agriculture Economics*, 3: 279–292.

International Cocoa Organization. (1999). *Quarterly Bulletin of Cocoa Statistics*. Vol. XXIV, No. 4, 1997/98. :London.

ISNAR (1982). *Review of the Program and Organization for Crops Research in Papua New Guinea*, Report to the Government of Papua New Guinea, The Hague, Netherlands.

Jolly, L and Beck, A. (1990). *Commodity Price Stabilization in Papua New Guinea.* ABARE Discussion Paper 90.2, Canberra.

Jolly, L. (1987a). *Developing projection methods for Papua New Guinea cocoa production*, Draft Paper, Bureau of Agricultural Economics, Canberra.

Jolly, L. (1987b). *Developing projection methods for Papua New Guinea copra production*, Draft Paper, Bureau of Agricultural Economics, Canberra.

Kannapiran, C and Fleming, E. (1999). *Competitiveness and Comparative Advantage of Tree Crop Smallholdings in Papua New Guinea.* Working Paper Series No. 99-10, Graduate School of Agricultural and Resource Economics, University of New England.

Kingwell, R. (1999). "Institutional and social influences on R&D evaluation in agriculture." *Australian Journal of Agricultural and Resource Economics,* 43 (1): 115–128.

Lal, P, Holland, P and Collins, D. (1994). *Benefits and Costs of Fisheries Research in Australia: evaluating fisheries research and developing projects*. ABARE Research Report 94.3, Canberra.

Mabin, V, Menzies, M, King, G and Joyce, K. (n.d.). *Allocating Public Sector Research Funds: The use of Multi-criteria Decision Making and Electronic Brainstorming to Guide Resource Allocation.* Victoria University of Wellington/Ministry of Agriculture, Wellington, New Zealand.

McConnel, C, Rambaldi, A and Fleming, E. (1996). *New Guinea Gold or Bust: detection of Trends in the Quality of Coffee Exports in Papua New Guinea*. Working Paper No. 85. Working Papers in Econometrics and Applied Statistics. Armidale: Department of Econometrics, University of New England.

Mutangadura, G and Norton, G. W. (1999). "Agricultural Research Priority Setting under Multiple Objectives: an example from Zimbabwe. *Agricultural Economics,* 20: 277–286.

National Agricultural Research Institute (1999). *NARI Annual Report 1998,* Lae.

Omuru, E. (1997a). *Economic benefits of adopting miniboxes and solar driers in the cocoa smallholder sector in Papua New Guinea,* Discussion Paper # 4, Economic Section, PNG CCRI, Keravat.

Omuru, E. (1997b). *Cocoa and Coconut Plantation Cost of Production Survey 1996*. Economic Bulletin # 1, Economic Section, PNG CCRI, Rabaul.

Organization for Economic Co–operation and Development (1987). *Evaluation of Research: a selection of current practices*. OECD, Paris.

Overfield, D and Kufinale, K. (1993). *An Economic Assessment of Coffee Research Industry Dynamics and Research Priorities*. Coffee Discussion Paper # 14, Industry Affairs Division, Coffee Industry Corporation, Goroka.

PNG Cocoa & Coconut Research Institute. (1998). *PNG Cocoa & Coconut Research Institute Annual Report 1996*. PNG CCRI, Rabaul.

PNG Coffee Industry Corporation. (1999). *Coffee Report No. 47*. Industry Affairs Division, CIC, Goroka.

Prinsley, R. T. (1993). *A Review of Research and Development Evaluation. Rural Industries Research and Development Corporation*, Occasional Paper No. 93/1, Canberra.

Stapleton, G. (1997). *Plantation Cost of Production Survey 1995*. Coffee Discussion Paper # 19, Industry Affairs Division, CIC, Goroka.

Thomson, N and Morrison, D. (1996). "Research Evaluation and Priority–setting in Research–providing Agencies in Australia." In: Brennan, J and Davis, J. S (Eds.) *Economic Evaluation of Agricultural Research in Australia and New Zealand.* Proceedings of a Research Evaluation Group for Agricultural Economics Workshop in conjunction with the Australian Agricultural and Resource Economics Society 40th Conference, Melbourne, Australia. ACIAR Monograph No. 39, Canberra. Pp. 11-17.

Trigo, E. J. (1987). "Agricultural Research Organization in the Developing World: Diversity and Evolution." In: Ruttan, V. W and Pray, C. E (Eds.) (1987), *Policy for Agricultural Research*. Westview Special Studies in Agriculture Science and Policy.

Upton, M. (n.d.). *Reflections on the Design and Prioritization of Agricultural Research.* University of Reading.

Wright, B. D and Zilberman, D. (1993). *Agricultural Research Structures in a Changing World*. University of California, Berkerly.