

Addressing national development in the Pacific through a regional crop improvement program

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Governments throughout the Pacific islands seek policies to improve agricultural productivity and nutrition, and conserve genetic resources, by working at both national and regional levels. The objective is to achieve sustainable food security within the framework set by the Rome Declaration of the 1996 World Food Summit (WFS), reaffirmed at the WFS five years later and expressed in the Millennium Development Goals (FAO 2002). However, throughout the region there is little agriculture research and development (R&D) to improve productivity, even for the major food crops, and where it occurs the results are neither widely shared nor disseminated. If increased productivity is not achieved, it is unlikely that people will have sufficient time for other economic enterprises such as processing and value addition of presently grown crops, or diversification into new economic activities. Thus, unemployment will continue to rise, with concomitant increases in migration to urban centres.

The challenge faced by most Pacific island countries and territories is how to address these problems and carry out the R&D activities related to food crop improvement under the circumstances of prohibitively high costs of research, limited capacity, and the complexity of the

regional development issues. The concept of a Pacific Regional Crop Improvement Programme (PARCIP) arose to address these issues and is outlined below, together with the rationale for collaboration and networking amongst Pacific island countries and territories to undertake research into food crop improvement. An analysis of the issues, challenges and opportunities of such a program to achieve food security in the Pacific region is presented.

Rationale, genesis and development of PARCIP

Output of roots and tubers in the region grew less than one per cent per year over the period 1985 to 2005, much less than the rate of population growth. Banana production fared better, growing at about four per cent over the same period. Crop yields have remained almost static: even declining in some cases. Because of the static crop yields and stagnant production, agricultural productivity is not keeping pace with population growth rate (AusAID 2006) and food security in the region is in jeopardy. Many of the Pacific island countries and territories have indeed been identified by FAO as having a poor food security status.

Ensuring food security is complicated by the continuous loss of genetic diversity, which is already limited for many crops or islands because of local selection, dietary changes, and lack of cross breeding. Due to the limited genetic diversity, many food crops are highly vulnerable to biotic and abiotic stresses and tend to perform poorly when under stress. Lack of wild relatives and co-evolution with pests and diseases exacerbate this problem of limited genetic diversity. The problem was exemplified by the devastating outbreak of taro leaf blight disease in Samoa in 1993.

The PNG National Agricultural Research Institute (NARI) proposed PARCIP in 2003 (PARCIP 2003). The proposal advocated that countries of the region and regional organisations cooperate to improve and utilise available food crop genetic resources using the principles of conventional crop breeding and modern biotechnologies for the benefit of all regional stakeholders. The importance of PARCIP to long-term food security was acknowledged by the Heads of Agriculture and Forestry Systems (HOAFS) at the First Regional Conference, Fiji, 9–10 September 2004. Their communiqué supported the conservation of plant genetic resources (PGR), diversity of food availability and the genetic improvement of the staple foods of the region. A meeting of Pacific island experts was suggested and this was held on 6–7 December 2004 at NARI in Lae. NARI researchers and representatives from Fiji, Tonga, the Federated States of Micronesia, FAO, and the Secretariat of the Pacific Community (SPC) drew up the principles of PARCIP and proposed the crops of focus and priority activities. Representatives at this meeting agreed on the following guiding principles for PARCIP

- strengthen present crop PGR networks and collaboration
- foster equitable access to and sharing of PGR for food and agriculture

- utilise participatory and consultative approaches
- utilise the advanced R&D status of the more developed partners.

Strengthen present crop PGR networks and collaboration

PARCIP emphasises the intensification of PGR network activities through crop improvement, long-term maintenance of national and regional germplasm collections, and appropriate national PGR policies. Strengthened collaboration should allow wide access to the regional PGR and at same time avoid duplication of effort by resource-poor countries. Collaboration can also have a synergistic effect, improving the quality and timeliness of the research outcomes.

Foster equitable access to and sharing of PGR for food and agriculture

Although countries within the Pacific are diverse in their PGR, none is self-sufficient and countries need to share genetic resources both within and outside the region. Therefore, PARCIP utilises these collections, strengthens national programs, and stimulates collaboration amongst them. Under PARCIP, countries can agree to share their PGR and the products from crop improvement programs under the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

Utilise participatory and consultative approaches

PARCIP encourages the need-based strengthening of national R&D systems by developing close relationships with government and non-government organisations, including community development organisations, farmer networks, lead farmers and agricultural companies, religious institutions, schools, universities, national agencies, and regional and international organisations. The

program recognises that there is a need to strengthen the interface between farmers and breeders for enhanced PGR utilisation, specifically in building farmer participation in the identification of priorities, germplasm evaluation and improvement to include participatory plant breeding (PPB).

Utilise the advanced R&D status of the more developed partners

PARCIP recognises that the more developed national programs need to play an increased role in upgrading the capacity of the less developed programs. For instance, only Papua New Guinea among the Pacific island countries and territories has managed to maintain a platform for scientific research on subsistence crops over a number of years. NARI maintains large collections and runs breeding programs and pre-breeding activities for major regional staples. NARI has been very active in every regional PGR initiative and has even offered to act as 'breeders for the region' through PARCIP. Similarly, the Centre for Pacific Crops and Trees–CePaCT (formerly Regional Germplasm Centre–RGC) of the SPC has expertise in tissue culture, maintains core collections and carries out research on many Pacific crops. Sharing of agricultural information and taking advantage of the advanced status of the Pacific partners is a priority for PARCIP.

Crops of importance for the region and PARCIP

The Pacific Plant Genetic Resources Network (PAPGREN) 2005 regional meeting prioritised the important Pacific crops for research on the basis of food security, nutritional value, cultural value, and income-generation potential. The 2004 NARI meeting for PARCIP also considered prioritisation and placed the crops into two groups. The first

group included the major staples—banana, sweet potato, taro and four species of *Dioscorea* yams—grown throughout the region. The second group contained those crops that are grown widely but are only locally important (aibika, aroids (*Alocasia* and *Cyrtosperma*), breadfruit, cassava, pandanus and certain atoll species).

The first group of crops (where flowering and seed formation are possible) is the main priority of PARCIP, and will require strategies for crop improvement that depend on selection and plant breeding. The second group of crops is important to PARCIP, but it would be best to seek alternative resources to work on them as these crops are more important in specific countries. The most appropriate strategy for these crops is to collect (or further collect) the varieties, transfer them to CePaCT, establish them *in-vitro*, index for viruses, check their genetic diversity (including the identification of core collections, as appropriate) and make them available to interested countries for evaluation and pre-breeding.

Opportunities and challenges for PARCIP

Improved sustainable agricultural systems

PARCIP offers ample opportunities for improving the sustainability of agricultural systems in the region by improving the productivity and quality of major staples, reducing risks from biotic and abiotic stresses and broadening the genetic base of crops. In addition, there will be economic benefits such as saving of resources (e.g. land, labour and chemicals), increased resource use efficiency, and contributions to export growth and national economic development.

Utilisation of plant genetic resources

Germplasm collections maintained in the region are under-utilised and are

turning out to be more of a liability than a resource because of high maintenance costs. Many national programs, although maintaining these collections, lack adequate resources, facilities, and commitment from decision makers. PARCIP will give priority to rationalisation and utilisation of the available PGR and hence broadening of the current genetic diversity.

Dissemination of improved cultivars

A major challenge for the regional crop improvement program will be to ensure that improved varieties are accessible by farmers. Promising characteristics and the release of a new variety do not necessarily mean that the variety will be diffused and adopted efficiently. Efficient dissemination of improved cultivars to farmers will enable crop improvement to have an impact on food production. To ensure that newly released varieties will be widely diffused in the farming communities, it will be extremely important that projects within PARCIP develop effective dissemination strategies.

Intellectual property rights

Although PARCIP will aim for equitable sharing and exchange of germplasm using the standard Material Transfer Agreement (MTA) recently adopted by the ITPGRFA, it is likely that, with the release of new varieties, the issue of intellectual property rights (IPR) will become more important and complex. For successful and equitable sharing of crop improvement products and germplasm, the region needs to give more attention to strengthening of IPR legislation. It would be inappropriate for the Pacific island countries to develop their own administrative and technical capabilities for plant variety protection, especially as this would distract the few plant breeders in the region from their main task. The logical way forward is a regional approach as proposed in the PARCIP framework with flexibility

for modification to accommodate breeders' rights and advances in international IPR policies.

Safe exchange of germplasm

Transfer of germplasm and the crop improvement products of PARCIP within the region, or introductions from outside the region, will involve the risk of introducing plant pests and pathogens—in particular, pathogens that are often symptom-less, such as viruses. There are international technical guidelines available to facilitate germplasm exchange but the challenge lies in developing and implementing virus indexing procedures that need advanced technologies and expertise. A strong regional coordination of plant health and quarantine is necessary for movement of germplasm with safeguards and guidelines. For success, it is important for PARCIP to develop a regional strategic framework, in collaboration with experts and advanced partners, for safe and efficient distribution of materials specific to each crop and country. There will be a continuous need to develop new protocols and sub-projects relevant to safe exchange of germplasm within the main program.

Gap analysis and the way forward

The gaps between crop improvement issues and research for key crops of regional importance (aibika, banana, taro, sweet potato and yam) and of local importance (alocasia, breadfruit, cassava and cyrtosperma) were identified during the 2004 PARCIP meeting in Lae. These also formed the basis for the development of a Pacific strategy for *ex-situ* conservation and utilisation of crop diversity in the region (Global Crop Diversity Trust 2007).

The PARCIP proposal was endorsed and supported fully by the Second Conference of HOAFS, held on 18–22 September 2006 in Nadi. HOAFS support paves the way for

developing regional cooperation among Pacific island countries and territories and seeking funding support from donors and technical co-operation among important regional agencies. Strategies need to be developed in consultation with donors. Some general proposals and discussion papers have been developed by NARI and SPC in line with PARCIP priorities and the Pacific regional strategy. Detailed work is required to continue the progress from priorities to projects on the ground. At a national level NARI is in the process of developing and implementing some of the crop improvement activities relevant to Papua New Guinea and the region.

There is no doubt that collaboration and networking on crop improvement research have been beneficial, given the nature of the countries in the Pacific region and the difficulties they face in maintaining effective NARS (Ghodake and Quartermain 2003). Hence, NARS in the Pacific should continue their collaborative crop improvement activities through PARCIP by implementing networking projects via SPC and other regional and international agencies. However, there need to be clear partnership arrangements for countries such as Papua New Guinea to share expertise, facilities, and genetic materials with the smaller Pacific island countries and territories. Networking by itself is not sufficient but can be used to seek technical assistance, secure funding on a regional basis, and build capacity.

It is clear that international donors are more amenable to funding projects with multi-country benefits. The problems and opportunities transcend national boundaries, giving benefits from the sharing of genetic materials and knowledge. Informal networks for the exchange of ideas, materials and results, and for mutual support, have always operated amongst scientists and technicians in the Pacific

island countries and territories. What is implied by the PARCIP concept is formal arrangements with donor and technical support agencies, collaboration through memoranda of understanding or agreement between agencies or elements of the individual R&D systems, and the use of collective resources and capacities to get crop improvement issues addressed.

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