Towards the establishment of a soil management network for smallholder development in the Pacific

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Abstract

Collaborative research efforts on soil-related research started in the 1970s, and dealt with soil classification problems. Later efforts have been made to tackle soil management problems, and more specifically those raised by the management of sloping acid soils and degraded lands.

The major difficulties in establishing a soil management network in the Pacific stem from:

- *the great diversity of the environment,*
- *the difference in the agricultural use of the land from one place to another,*
- *the strongly held and complex farming traditions,*
- *the lack of trained research personnel, and*
- *the need to convince policymakers of the urgency of the matter.*

Lime and high-fertilizer inputs, which are the classical treatments for improving acid soils, are often difficult to promote among farmers due to their lack of cash, and consequently other techniques using low inputs, minimum or zero tillage, agroforestry, or mulch need to be tested as well.

It will be possible to establish a soil management network if there is a strong agreement on the objectives of the collaborative effort and on the approach which should be taken to reach them.

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Introduction

Since 1970 and even before, many efforts have been made to improve and coordinate soil-related research in the Pacific region. The first, and one of the most important, was the establishment of the FAO/Unesco soil map of Australia and the Pacific, coordinated by Dr. R.B. Miller, then director of the New Zealand Soil Bureau (FAO/Unesco, 1976). In 1976, the South Pacific Commission (SPC), feeling the need to prolong this effort, organized a Regional Technical Conference on Soil and Land Utilization in Suva.

One of the major issues at that time was the adoption of a common soil classification system for the Pacific region. The U.S. *Soil Taxonomy* (Soil Survey Staff, 1975) had just been published, and the Soil Management Support Services (SMSS) organized a series of forums to promote it. In 1981, the first forum was held in Fiji, in cooperation with the University of the South Pacific, with the aim of training young scientists in *Soil Taxonomy* (USP/SMSS, 1982). This forum was followed by three others - one in Port Moresby in 1983 on Soil Taxonomy and Soil Interpretation, one in Guam in 1984 on Soil Survey Techniques, and one in Western Samoa (1986) on Soil Fertility. As a consequence, *Soil Taxonomy* was taught to a generation of Pacific soil scientists and has since been adopted in most of the anglophone countries of the region.

During this same period, ORSTOM undertook surveys in the francophone territories of the region and attempted to adapt and refine the French classification system (CPCS, 1967) with a view to making adjustments to comply with the realities of Oceania. The relationships between *Soil Taxonomy*, the French classification system and the FAO legend have now been established. So even though a common soil language has not developed either in the Pacific or elsewhere, nevertheless most scientists understand each other when they speak about soils.

The next step was to decide how to use and to manage soils. Agricultural scientists in the Pacific, as in other parts of the world, have been more and more aware of the role of the soil and of the soil environment on crop performances. In 1987, SMSS and other organizations (including IBSRAM) organized an international workshop in Palau on the Management and Utilization of Acid Soils in Oceania. The participants at this meeting felt that there was a real need to organize a collaborative research network in the region, and proposed that the objectives of the research should be:

- postclearing management of acid soils, using agroforestry and other techniques to safeguard the environment, in conjunction with the planting of acid-tolerant crops; and
- the rehabilitation of degraded lands by testing methods applicable to the development of forestry, agroforestry or pioneer cover crops.

The subject of this meeting in the Solomon Islands has been given an even more specific focus, relating it to the particular needs of smallholder development in the Pacific Islands. The problems faced are therefore the following:

- What problems need to be solved in order to organize these efforts in the Pacific region?
- Are there any technologies which can help in solving soil management problems?
- What is the proper scientific approach to adopt in addressing these questions?

Problems to be solved

The establishment of a collaborative research network on soil management in the Pacific will certainly not be an easy task. In fact, efforts have already been made during the past three or four years without great success. The success of future ventures will depend on the extent to which a number of environmental, agronomical, human, and political difficulties can be overcome.

In the context of establishing a soil management network, one of the first difficulties in the Pacific is the environment. The variety of the soils themselves and the wide diversity of other environmental factors are one aspect of the problem. Often, too, the environmental units we are dealing with cover very limited areas. Morrison *et al.* (1987) have indicated that, in Fiji alone, 322 soil series have been identified on an area of 15 272 km^2. These series belong to nine out of the ten orders of *Soil Taxonomy*. Similarly Latham *et al.* (1978) have indicated that extended soil units belonging to eight out of the twelve classes of the French classification system are represented in New Caledonia.

This soil diversity corresponds to a wide range of geological materials, landscapes, climates, and types of vegetation. Diversity may well be an asset in the context of conducting scientific studies, but it is a major problem when the objective is to establish a network. In the latter case, we are concerned with the advantages which accrue from having some common ground on which to base comparative and complementary studies. A first attempt to decipher common interests was made during the Palau meeting. The choice of acid soils and degraded lands (which are also mainly acid) is one issue of general concern. The choice of this focal point does, however, raise questions regarding the soils of the atolls - mainly Inceptisols - which were not included, and which are some of the most productive soils of these islands - the alluvial soils - mainly Eutropepts and Vertisols.

The selection of acid soils and degraded lands as the major area of concern is a valid one if we consider that very little soil management research has been conducted on sloping acid soils and degraded lands, whereas other soil units are better known. Also many farmers are presently extending their cultivation in these areas, which cover more than half of the land surface in the Pacific. Another reason for the choice was that these areas are extremely fragile and erosion-prone, and are very quickly transformed into degraded lands covered with poor savannas or thickets (Fosberg, 1965; Latham, 1983). If, however, there is a case for reassessing priorities and perhaps limiting our research to one environmental unit, this meeting will provide a useful forum for a possible reorientation of this sort.

The agricultural use of the lands in the Pacific and the various ways of producing crops probably differ even more than the environmental conditions. It is hardly surprising that so many agricultural geographers have been attracted to the region on account of its unusual diversity. Not only do the crops differ, but the way they are cultivated is also different.

The major soil management system practiced is shifting cultivation, and as in other parts of the world this method of cultivation is rapidly becoming unsustainable. As farmers reduce the fallow period, they preclude the regeneration of soil fertility. Root crops - cassava, sweet potatoes, yam, and taro - are the major crops planted on these sloping lands with acid soils. Unlike cereals - rice, maize, and sorghum - which have benefitted from significant genetic improvements during the last twenty years, genetic work on root crops is still in its early stages, and traditional varieties or clones predominate.

More than eighty varieties of yams are still cultivated in New Caledonia (Bourret, 1976). The yields are low, as agricultural practices are most often reduced to planting and weeding without any fertilizers or other inputs. Other crops, like yaqona (*Piper methysticum*) - which is used for the traditional drink 'kava' in Fiji and Vanuatu - green vegetables, pineapples, and fruits are often intercropped in the root crop field all contributing to a somewhat complicated agricultural pattern (Barrau, 1956; Bayliss and Smith, 1978; Brookfield, 1979). However complicated these systems may appear to us, they most often have a traditional significance which is strongly anchored in the farmer's mind (Crocombe, 1988). This means that they should be respected and integrated in the technologies offered to the farmers.

This point should remind us of the human factor which is involved in any farming system experiment. The importance of understanding farmers' practices, and the reasons for these practices, can hardly be overemphasized. If our purpose is to serve farmers and to facilitate their acceptance of improved systems, their traditional knowledge must be intergrated into the systems being tested. An appreciation of these socioeconomic factors will prevent the testing of identical systems in different locations. The variables to be tested need to be

concerned with some techniques shared in common - such as agroforestry, alley farming, or mulching, for example - which could be adopted by the network as a whole. The choice of the crops and of the crop varieties involved in the cropping systems would be a matter for individual collaborators to decide in accordance with local traditions and socioeconomic conditions.

Still on the subject of the human factor, it needs to be pointed out that for a successful network another requirement is to ensure that local investigators are properly trained in relation to the exigencies of collaborative research. Training exercises in *Soil Taxonomy* have already been mentioned. As far as we know, few of the people who have been trained during the different forums on *Soil Taxonomy* are still working in agricultural research. Even if there are experienced people in the different experiment stations of the region, there will obviously be a need for information on new technologies and for training on specific topics linked to the activities of the collaborative research programme. In the case of the IBSRAM networks in Africa and Asia, for example, IBSRAM is organizing training workshops on specific subjects such as site selection and characterization, the monitoring of experiments, agronomic practices, and data processing. This is being done with the cooperation of local universities and research centres, and also with assistance from international organizations such as SMSS, TropSoils, IITA, and ICRISAT. The training activities in the Pacific Islands could be carried out in collaboration with regional universities, notably the University of the South Pacific and the University of Guam, and could anticipate the support of neighbouring universities and research organizations.

This endeavour could be further supported by IBSRAM's soil management information unit, which we expect to establish in 1989, and which will disperse available published and unpublished information intended to serve the interests of our networks. However, the shortage of skilled collaborators in the Pacific is one of the major problems which we have to face, and the importance of access to specially tailored information sources as well as to relevant training facilities cannot be overemphasized in this context.

One other difficulty which may be encountered is of a more political nature. It may, for example, be necessary to get approval from a meeting of agricultural directors of the region of the South Pacific Commission (SPC), rather than starting at the bottom, so to speak, with the individual collaborators who will actually be responsible for the detailed work of the projects. To procure a decision from the directors of agriculture during meetings of the South Pacific Commission on Soil-Related Research has always been a long and difficult business. At the same time it would not be right to bypass existing regional institutions such as the SPC or the South Pacific Bureau for Economic Cooperation (SPEC). Under the circumstances, it would seem advisable for a small group of collaborators - those who have the possibility of

doing so - to start working together, while at the same time setting the mechanism in motion for obtaining an endorsement by these regional bodies.

Some solutions to be tested

The management of acid soils and degraded lands have aroused considerable interest in recent years. These soils are considered marginal in terms of agricultural potential because of their low fertility rating, but are being increasingly used by poor farmers. The classical approach to the management of acid soils has been to treat them with lime and other fertilizers, and this procedure has proved successful in Hawaii (Fox, 1980), in the Brasilian Cerado (Bouldin *et al.*, 1986), in the Amazonian forest (Kamprath, 1984), in Southeast Asia (TropSoils, 1985), in Fiji (Morrison, 1987), and in New Caledonia (DIDER, 1987).

There is an underlying assumption in using this procedure that it is easy for farmers to give their fields lime and fertilizer treatments. In fact, this is not generally the case. More often that not, poor farmers in the Pacific region lack cash and have considerable difficulties in procuring transportation. This implies that other techniques using low inputs, minimum or zero tillage, and agroforestry or mulch should be tested.

In an experiment conducted on acid soils in Yurimaguas, Peru, Sanchez and Benites (1987) have shown that for a three-year cycle, with adapted varieties and soil management practices - but without fertilizers - seven consecutive crops of rice and cowpea could be achieved with a total yield of 13.8 tons/ha. This compares with one crop of 2.8 tons/ha, which is the usual yield obtained by shifting cultivators.

Scientists of the International Institute of Tropical Agriculture, Ibadan, Nigeria, have shown that proper land-clearing methods and postclearing soil management on Nigerian Alfisols, using *in situ* mulch, live mulch, shrub fallow, or alley cropping, can bring about a notable improvement in crop production, as compared to traditonal shifting cultivation - and make it more sustainable (Lal, 1987). Similarly alley farming has proved attractive to farmers in the Philippines (Paningbatan, 1987), and so have cover crops alternating with food crops in Sumatra, Indonesia (von Uexkull, 1987).

Not only do these solutions lead to an improvement in crop production, they also have the advantage of limiting soil erosion and degradation. They are now being tested in two of the IBSRAM networks - the Management of Sloping Land for Sustainable Agriculture in Asia Network and the Land Development and Management of Acid Soils in Africa Network. At the same time, let it be quite clear that despite the success of these experiments in their specific

environments, the transfer to new environments needs adaptation to local conditions, testing, and validation. The technologies employed need to be tested, and their effects with regards to the sustainability of the system concerned need to be individually assessed - with reference, of course, to their acceptability by the local farmers. Finally, it needs to be appreciated that techniques of this sort do not replace fertilizer inputs, except insofar as some nitrogen is fixed by leguminous cover crops or shrubs, and some nutrients are recycled by deep-rooted perennials. They do, however, offer options to poor farmers facing an increasing demand for food crops and a shortage of land on which to pursue their traditional shifting cultivation.

IBSRAM soil management approach

Soil management research can take many approaches to fulfil its objectives. It can be the classical trial-and-error type of soil fertility experiment, which is a long process as it cannot cope with more than two or three parameters at one time. The crop simulation models of IBSNAT are another option, but they are difficult to apply in highly diversified traditional communities.

IBSRAM, for its part, emphasizes adaptive research, in which recognized technology packages are adapted to local conditions, which means that they are tested and evaluated in accordance with profitability, sustainability, and acceptability criteria. This approach would seem to be the most appropriate for the soil management problems in the Pacific.

IBSRAM was set up in 1983, with the aim of increasing food production in developing countries. Its overall objective has been defined by its Board of Trustees as follows:

> To promote and assist applied agricultural research into the identification, development, use, management and protection of soils and land for food production and other agricultural or agroforestry purposes, so as to enhance and increase economically sustainable agricultural production in developing countries (IBSRAM, 1988).

From its inception, IBSRAM has recognized that some of the major difficulties encountered in the transfer of agrotechnology are as follows:

- Site specificity cannot be avoided. Similar agricultural sites are difficult to find, even if the soil belongs to the same family of *Soil Taxonomy*. Also, results from agronomic research come from agricultural research stations, which are mostly located on fertile soils and not on poor marginal soils, which need more detailed study.

- Mostly, farmers in developing countries use multiple-cropping systems - including intercropping - for which it is much more difficult to develop simulation models than it would be for single crops.
- Socioeconomic factors are primary criteria affecting farmers' decisions.

For these reasons, IBSRAM decided to promote collaborative soil management research networks, in which collaborators test, on well-characterized environments, different cropping systems at different levels of input, using the farmers' common practices as a reference. Therefore two major features are involved in IBSRAM experiments:

- testing cropping systems in order to find options to the present low-productivity systems which are acceptable to the farmers; and
- assessing the sustainability of the system tested in terms of the environment and in relation to socioeconomic factors.

In IBSRAM networks, the subjects are decided according to national priorities and the main IBSRAM targets. Decisions on these matters are taken during meetings similar to this one, when the type of experiment to be conducted and the methodology to be employed are discussed. Once the network has been formed, participants agree to conduct a common-core experiment, concerned with testing different cropping systems which are of mutual interest. Then they decide which satellite experiments may be useful with regard to filling gaps in available knowledge. Each participant prepares a project proposal along the lines defined during the inauguration of the network. This proposal is revised by a network coordinating committee and, if accepted, is integrated into the network after approval by the IBSRAM board.

If external support is necessary to undertake the programme, it must be well budgeted, with clear indications of the national input and of the external aid requested. IBSRAM is not a donor, and consequently support needs to be sought as a joint endeavour, involving the national participating body itself and the promotional efforts IBSRAM can lend to the project. This is a somewhat delicate process, often requiring some reshaping of the project proposal in accordance with the different formats for the project proposal which may be requested by individual donors.

For each network, there is normally an IBSRAM coordinator who helps the different participants in shaping their project proposal and in carrying out the different stages of network operations. IBSRAM also provides information and training facilities on specific aspects of the project, in accordance with the requirements of network development.

Conclusion

During this meeting, ways and means of developing a collaborative research effort in the Pacific will be discussed. The difficulties which lie ahead are considerable, and many problems will need to be ironed out. We will have time during the meeting and in the course of the field exercise to discuss technologies and the scope of the proposed network. By the end of next week, we must be sure that if a collaborative research effort is recommended, the subject chosen is a priority area in your countries, and that the approach in dealing with it meets with general acceptance.

Although at present there are no funds to support this effort, no doubt some can eventually be found. This meeting may recommend the preparation of a project proposal which may later find some support among donors. But there will not be any donor support if there is not the feeling that this research effort is of high priority and corresponds to the wishes of the countries or territories participating in the project.

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