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Agricultural Research Problems in Small Developing Countries: Case Studies from the South Pacific Island Nations

J. Brian Hardaker and Euan M. Fleming

*Department of Agricultural Economics and Business Management, University of New England,
Armidale, N.S.W. 2351 (Australia)*

Abstract

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While research-based technological improvements are an important part of a successful agricultural development strategy, the small South Pacific Island Nations face special difficulties in attaining such innovations because of their particular agricultural production and marketing circumstances and because of diseconomies of small size in research. There is a need to sharpen the focus of national agricultural research efforts on adaptive work, implying both increased international and regional collaboration and the reorientation of national programs to be more receptive to outside ideas and information. It is particularly important to seek a parsimonious research paradigm, involving a broadening of the range of people who contribute to the research process.

1. Introduction

The benefits of a successful program of agricultural research, leading to the uptake by farmers of more productive techniques, are well established (e.g., CGIAR, 1985). However, not all countries have been able to achieve those benefits. In particular, small nations face special difficulties in attaining ‘take-off’ in agricultural development based on the widespread uptake of improved techniques. Some reasons are examined in this paper.

The review is cast in the context of the South Pacific Island Nations (SPINs). These countries range in size from Papua New Guinea, with some 3.5 million people, to some of the smallest countries in the world.

There are difficulties in casting the net of the paper widely across all SPINs. American Samoa is a special case, being effectively a part of the United States of America. Similarly, special considerations apply to the French territories of French Polynesia and New Caledonia. These countries are therefore largely

excluded from further consideration, as are many countries with fewer than 10 000 people which are considered to be below the minimum size for the maintenance of a plausible agricultural research program. For the remainder, while efforts have been made to keep the discussion as general as possible, there is inevitably a bias towards those countries for which information is most accessible and of which the authors have some first-hand experience. These are Cook Islands, Fiji, Papua New Guinea, Solomon Islands, Tonga, Vanuatu and Western Samoa.

While the issues of agricultural research policy discussed are in some ways unique to the circumstances of individual countries and the region, there are some general lessons to be learned for all small developing countries. Moreover, the diversity of conditions found in SPINs is sufficient to illustrate a wide range of research policy issues.

2. Agricultural systems of SPINs

To a varying extent, the agricultural systems of SPINs reflect their colonial heritage. In particular, cash cropping remains strongly affected by the import preferences of the industrialized countries for raw materials, the chief agricultural exports being copra and coconut oil, palm oil, coffee, cocoa and sugar. It is also influenced by the desire of SPIN governments to increase export earnings by exploiting natural resources. The need to expand export earnings is strengthened by the fact that all SPINs have relatively open economies.

Both past and more recent factors account for the dualistic production systems in some (but not all) countries where plantations, privately or publicly owned, exist side by side with semi-subsistence smallholder producers. In most countries, however, smallholder production is the way of life of most rural people, if not always dominating aggregate agricultural output.

The productivity of smallholder systems is generally quite high, at least in terms of subsistence output, so that smallholders' income levels are usually reasonable and absolute rural poverty is relatively rare. Exceptions occur when access to land is constrained, for example by population pressure on resources, perhaps with environmental degradation.

Despite the 'subsistent affluence' of many SPIN smallholder systems (Fisk, 1971), it has proved difficult to expand cash earnings substantially. Traditional export crops have faced variable and often declining prices, discouraging smallholders from production. At the same time, food production for domestic markets has generally lagged so that, in several countries, there has been strong growth in food imports. These problems can be attributed to slow progress in developing and extending improved farming methods, and to poorly developed agricultural marketing systems. In turn, these failures are partly caused by weaknesses in production and market research, respectively. Before examining

the cause of these weaknesses, the agricultural production and marketing systems of SPINs are outlined.

The circumstances of agricultural production in the region vary widely from land scarcity to abundance, from very fertile to barren soils, from low to high altitudes, from peri-urban to isolated locations. Moreover, there is often big variation within countries, e.g., large differences in market access between inner and outer islands.

Most smallholder production is based on some form of shifting cultivation/ bush fallowing. The climate is generally humid tropical. The main subsistence staples are the tropical root crops (yams, taro, sweet potato and cassava), with bananas and (in season) breadfruit also sometimes important. Most cash crops are tree crops, grown as plantation crops or integrated with food crops. Cropping systems are usually very complex, involving intercropping, multistorey cropping, mixed and sequential planting and progressive harvesting.

The socioeconomic context of smallholder production is also often complex. Land tenure is mostly customary and may constrain considerably individual households' access to land and the way they use it. The goals and values of smallholders, and their responsiveness to incentives from better production or marketing opportunities, remain poorly understood.

The agricultural marketing systems in SPINs typically comprise both 'modern' and 'traditional' sectors. The modern sector is cash export and the traditional sector is domestic fresh produce marketing.¹ The two sectors are polar opposites in almost all respects, with export marketing largely in the hands of statutory marketing boards (SMBs) while the primary producers and the final consumers are commonly the only participants in food crop marketing.

3. Some inherent difficulties in the task of improving agriculture in SPINs

Some features of the agricultural production and marketing systems of SPINs impede attempts to lift performance. First, SPINs are characterized by long distances from export markets (with small port sizes and low cargo volumes), fragmented land areas, numerous islands with few good harbours, and high rainfall which makes many villages and farms inaccessible for parts of the wet season. These difficulties are compounded by the bulkiness and perishability of the major staple crops in particular, and of some major exports. The low value-weight ratios, short post-harvest lives, and susceptibility to damage during handling and transportation of the main products together limit scope for commercial exploitation of large areas of SPINs.

Commercialization of agriculture is also inhibited by the limited size of do-

¹This is strictly not traditional in that its origins are comparatively recent. However, it involves local trade in products traditionally produced in village societies.

mestic markets. Price and income elasticities of demand for many food products are low, so that the markets are readily over-supplied, with producers then receiving very low returns. Production for market is therefore risky and the scope is limited for expansion of domestic market sales through production or marketing innovations.

4. Organization of agricultural research

Most official agricultural research is carried out in research divisions of ministries of agriculture, although in some countries special quasi-independent research institutes have been set up for particular cash crops, generally funded by levies on output. Similarly, some of the larger plantations, in countries where these exist, have their own research and development programs.

Agricultural market research is more limited in scope. In some cases there are food processing research facilities within official agricultural research establishments. Market research, as generally understood, is, in the case of export crops, largely the responsibility of the SMBs, though very few have formal research departments. Some agriculture ministries also do some market research on export markets, often mainly information gathering. Apart from some price reporting, market research for domestic food markets is almost wholly in the hands of suppliers, is informal, and of very limited scope.

5. Problems of agricultural research in SPINs

The problems of agricultural research in SPINs are by and large those encountered by most governments of small, resource-poor developing countries.

5.1 Scale and resource problems

It would be useful to compare the resources allocated to agricultural research in SPINs with what that should be. However, it is very difficult to assess the best resource level for a particular country. Moreover, quantitative measures such as dollar allocations or numbers of scientists take no account of qualitative factors. Oram and Bindlish (1981) reviewed trends in resource allocations in a number of developing countries but, unfortunately, they found data for SPINs very sparse.

From these incomplete data it seems that allocations in SPINs are generally above average. Of course, the average itself represents no kind of optimum. The evidence of high rates of return to agricultural research may indicate widespread under-investment (Pinstrup-Anderson, 1982, p. 105). The World Bank (1981) set the optimistic target of 2% of agricultural GDP allocated to agricultural research for Third World countries by 1990 – far more than the levels for Fiji and Papua New Guinea, the only countries for which this measure could

be calculated. However, the application of any standard to the smaller SPINs confronts some special problems, as discussed below.

There may be a minimum size for any plausible agricultural research program. While agriculture is less diverse in small countries than in large, the reduction in research scope is not proportionate. A 'critical mass' may be needed to cover adequately the essential range of disciplinary skills and to promote professional interaction between scientists. Moreover, there may be an administrative overhead in running a research program that implies less time for effective research in small teams. Thus, as Ruttan (1982) notes, research expenditure per hectare in a small country will have to be higher than in a larger one to achieve the same effectiveness.

At any plausible level of funding in all but the largest of the SPINs, it will be difficult to provide an agricultural research system of a size needed for fully effective operation. It certainly is not possible, now or in the foreseeable future, to have research teams generously endowed with skills and resources relative to the range of problems to be tackled. In the past, agricultural research programs in SPINs have been limited in scope and have had few successes. Indeed, after reviewing programs in seven countries, Gamble et al. (1981) reached the remarkable conclusion that "there is little research being carried out in the region" (p. 25). Perhaps because of past performance, SPIN governments seldom give high priority to research funding. The low levels of funding from government budgets mean that many research programs are largely funded from foreign aid. The result is, first, that work programs are determined more by the whim of the donors than as part of an overall research strategy. Second, aid funding is often intermittent, with particular programs started then wound up over relatively short periods. Such efforts seldom yield cumulative benefits since much is lost by the interruptions.

The size of a research program cannot be evaluated in isolation from the degree of specialization among research scientists in the institution. It is probable that many agricultural research institutions in SPINs have staff who are too specialized given the small size of research teams.

Partly because of small size, but also because most SPINs have entered the development race rather late, there is a general dearth of well-trained and experienced local agricultural scientists. For example, in Solomon Islands at last count there was only one local researcher with a postgraduate qualification. In consequence, most research is done by expatriates. While many of these are excellent people, they labour under considerable disadvantages. First, their knowledge of local agricultural systems, particularly village-based systems, may be incomplete due to unfamiliarity compounded by language or other social barriers.

A second disadvantage is that expatriate researchers are often on fixed-term contracts. Many are young, with a career to make, and with progressive localization of employment they cannot expect to stay in one country for long. Inev-

itably they move on, often taking with them a fund of hard-earned relevant local knowledge. Moreover, knowing that their stay is only temporary may give the wrong incentives in the choice of research topics. The next employer is likely to judge a scientist by such criteria of professional competence as publications, not by what was achieved for local farmers.

Smallness is also a problem in market research. There are substantial diseconomies of small size in developing new products, for example, in that research and development costs need to be spread over a fairly large eventual volume of output. Even costs of gathering market information will be higher per unit traded for small-scale operations.

5.2 Problems of isolation

The limited size of SPIN research programs mean they need to draw heavily on relevant overseas work, including work elsewhere in the region. However, the geographical isolation of the islands makes overseas contacts difficult and expensive, not least in lost time. Similarly, isolation from overseas markets for export commodities means the same difficulties in market research. The international agricultural research centres generally take little interest in the South Pacific and, despite efforts to get one going (ADB and ISNAR, 1983), there is no really effective regional research program. The Institute for Research, Extension and Training in Agriculture (IRETA), a part of the University of the South Pacific and based in Western Samoa, was opened in 1983 to help overcome this lacuna. IRETA has made a promising start in this respect and, given adequate funding, may provide a good basis for further development of regional agricultural research programs in the future.

5.3 Problems in research planning and co-ordination

There has been criticism of the level of responsiveness of agricultural research in SPINs to the needs and circumstances of smallholders (e.g. Gamble et al., 1981). Priorities in production research have until recently been heavily biased in favour of export crops and against local staples. Similarly, much research has been oriented to the plantation sector, rather than to semi-subsistence producers. There has been a tendency to try to import 'western', chiefly temperate European, technologies. One manifestation of this is in the many attempts, mostly unsuccessful, to develop beef cattle systems on improved tropical pastures (McKillop, 1988).

Agricultural production research in SPINs often shows a strong bias towards on-station research rather than on-farm work. This is despite a growing consensus that an integrated program of on-farm and on-station work helps keep research relevant to the reality faced by farmers. The bias away from on-farm work is a consequence of several factors. One is the predilections of the re-

search scientists themselves. Another is lack of funds for travel. Third, links are often poor between research staff and the extension staff who are responsible for contacts with farmers.

Another bias has been towards production research rather than market research. The special marketing problems of producers in the region have been overlooked by policy makers, planners and research scientists more used to thinking about research priorities in a quite different context. Particularly unfortunate has been the low public participation in market research for traditional marketing. Lack of basic information about the needs of domestic consumers for goods and services that local agriculture could supply has surely contributed to the growing inroads made into this market by imported foodstuffs.

5.4 Complexity of agricultural production systems

Researchers in SPIN agriculture often have difficulties identifying relevant key constraints. This is partly because of the low level of understanding and documentation of indigenous farming systems, compounded by the research station bias already alluded to. But, in addition, the variability of farming systems from place to place, even from farm to farm, makes learning about them difficult. For example, there are large locational differences in the relative abundance of land. The appropriate research strategy in a land-scarce situation will be quite different from that where land is relatively freely available. Similarly, researchers trained in scientific disciplines have difficulty identifying and coming to grips with socioeconomic constraints such as those impeding marketing.

There are some special problems caused by the nature of SPIN agricultural production systems. For example, varietal selection work with tropical root crops often confronts very many local varieties or strains, each with a specific niche in traditional farming systems that the scientist may find hard to appreciate or duplicate on the research station. Variety selection trials are conventionally conducted with single-variety plots, assessed on the basis of total yield at a single harvest. But on farms, single cropping is rare, most crops are harvested progressively, even, in the case of sweet potatoes, taking only a few tubers from each plant at one time, and characteristics other than yield, such as flavour or tolerance to adverse conditions, may influence farmers' choices. On-farm trials can make evaluations more realistic but present difficulties in adequately monitoring yields and other relevant evaluation criteria.

The bush fallow systems that are widespread in traditional agriculture in SPINs present further research challenges. Raising agricultural productivity requires the successful intensification of these systems, yet experiments and trials on crop rotations are long-term, and so difficult and expensive. More-

over, soil and climatic variations limit the applicability of findings from any one experimental site.

5.5 Institutional issues

Many of the institutional problems in agricultural research in SPINs have already been alluded to above. There is a general problem of providing appropriate incentives for researchers in public research institutions. In production research, the problem is partly one of too few well-trained local staff, who could be expected to be more strongly oriented to national research needs than expatriates on short-term appointments. Yet there are also problems of incentives for local scientists who may see little prospect of promotion in a small research organization. Well-trained local researchers may be tempted to move overseas.

Institutional problems are perhaps most severe in market research. The entrepreneurial input so essential for effective market research is unlikely to be present in SMBs. Yet, by their existence, SMBs tend to 'crowd out' private marketing firms and individuals who could have the required initiative. On the other hand, market failure may also inhibit private market research. If it is impossible for the developer of a new market or a new product or service to maintain exclusive rights to the benefits, private investment will be inhibited.

6. Some possible remedies

Appropriate remedies to the problems of agricultural research in SPINs are well-canvassed in several earlier reviews (ADB, 1980; Gamble et al., 1981; ISNAR, 1982a, b, c, 1983; ADB and ISNAR, 1983). Some common prescriptions include better research priority setting, including making research more responsive to farmers' needs, a focus on adaptive rather than basic research (implying more international collaboration), and building up local research capacity (including some socioeconomic research capacity).

These are sound prescriptions, yet many of the reviews pay too little regard to the fact that the levels of resources that can be made available in all but the largest SPINs will always be highly constrained, especially in the climate of restricted government spending that prevails in most SPINs. Special attention therefore needs to be given to ensuring that research is very sharply focused on relevant issues, to raising the productivity of small teams of researchers and to mobilising more research resources from outside the public sector research cadre. Moreover, research strategies are needed that are better suited to the somewhat unique production and marketing circumstances of SPINs.

6.1 Improving the management of research

In resource-scarce situations, good management is particularly important. SPIN decision makers need to re-examine existing institutional arrangements for agricultural research to seek improvements. For example, Papua New Guinea is experimenting with quasi-independent research institutes for some cash crops, funded largely by levies on production. Such arrangements may give an assurance of continuity to research programs that have too often been buffeted by short-term exigencies of government finance. Yet there are risks, first that research will remain too strongly oriented to the needs of large-scale producers, and second that the integrated nature of many SPIN farming systems may be ignored in commodity-based research institutes. In the smaller SPINs, such arrangements would be infeasible since the institutes would be too small to be viable.

Because agricultural research teams in the region are generally small, it is often difficult to offer reasonable promotion opportunities to motivate ambitious staff. Yet, as noted, restricting upward mobility of good researchers may be false economy if they react by resigning. Opportunities for overseas study, arranged through official channels, may provide incentives for younger researchers, but they too often become frustrated on their return. Career paths for such people should be carefully considered, recognizing that special skills may deserve extra rewards.

Two impediments to better research policy making are shortages of relevant planning skills in the line agencies, and data deficiencies. On the former, aid agencies in the region need to pay more attention to building up local planning capacities. A sustained, progressive approach is needed, combining training programs for key staff with collaborative work between national agencies and appropriate institutions or groups in donor countries. Meantime, better co-ordination by donors, in consultation with national research planners, might reduce the problems noted of discontinuous, sometimes capricious, aid funding of research.

Research planning in many SPINs is constrained by a lack of relevant data, for example on supply and demand elasticities needed to estimate research benefits, on where the key intervention points are for research in farming systems, and on research performance itself, making it difficult in analyses such as this to substantiate general observations and opinions. These deficiencies reflect the dearth of socioeconomic research in most countries. Similarly, there have been few economic evaluations of research benefits to show the profitability of these investments and influence policy makers to allocate more funds to the work. (For some recent exceptions, see Antony et al., 1988a,b.) Here again, remedying deficiencies requires strengthening local capacity.

The strengthening of local capacity depends very much on the training of local staff. Moves towards the 'localization' of research staff presuppose there

are enough local scientists for selection by research institutions which, as mentioned above, is usually not the case. There are numerous issues involved in ensuring adequate numbers of appropriately qualified entrants. These include the actual numbers selected for training, criteria used for selection, the nature of the training, choice of training institutions (notably, in ensuring that the training received is appropriate for someone who has to operate in a small system), appointment procedures on completion of training, impact of donor policies, and the attractiveness of a career in agriculture relative to other disciplines.

Sharpening the research focus must involve improving information feedback to researchers and research managers from the clients of the research output – farmers. The farming systems research (FSR) approach is one means to this end for production research. Essential features of FSR are use of on-farm trials as well as on-station research, feedback from on-farm work to allow better definition of research problems and priorities, and integration of the work of both extension and research personnel in efforts to raise agricultural productivity and incomes. The FSR approach makes the farmer the target of the work. Farmers' problems and circumstances guide the work and the benefits gained by farmers are the measures of research success.

To date, FSR had not been taken up in most SPINs, for several reasons. The small size of many research teams means that scientists are already fully extended. They tend to see FSR as an extra chore, rather than as a possibly better way of doing their present jobs. In addition, many biological scientists see FSR as an invention of social scientists and so may be suspicious of the idea. With so few social scientists in research teams, biological and physical scientists have few opportunities to discuss the ideas with social scientists to reach a better understanding of the different disciplinary viewpoints. But ultimately the research policy makers are the ones who need to be satisfied that FSR makes good sense. Advocates of FSR have yet to get their message across to the relevant decision makers of most SPINs. They also need to be aware of the institutional difficulties likely to be encountered in implementing the FSR approach, such as difficulties in giving participating scientists opportunities to achieve international standing by the normal publication routes. Solutions to these difficulties may be found by adopting more appropriate incentives, for example by changing criteria for promotion.

6.2 Concentrating on adaptive work

A focus on adaptive rather than basic research requires good links with overseas research organizations from which information and results of basic work can be taken. Links are also needed to other national programs in the region to co-ordinate activities and share information on common problems. There is much to be gained by cooperative work, especially if this work can mobilize

international funding and expertise. As Ellman (1987) showed, techniques appropriate for farmers in the region may exist elsewhere, and transfer of these can be cheap and effective.

Regional efforts to co-ordinate national research and extension are still in their infancy and have yet to make a major impact, partly for the same reason of lack of continuity that has limited the effectiveness of aid-funded research in national programs. The international agricultural research centres might have done more in the region than they have, especially in view of the growing competence of many national programs in larger developing countries. Similarly, efforts by regional organizations, such as the South Pacific Commission and the Economic and Social Commission for Asia and the Pacific, to promote cooperation and collaboration across national programs have too often been constrained by lack of resources.

Evidence from elsewhere in the developing world indicates that a network of co-ordinated research approaches in varied environments can enhance national research activities as well as the interchange of information. Examples have been the Tropical Soil Biological Fertility Programme, supported by UNESCO, and the International Board for Soil Research and Management. The most promising way to proceed along these lines at this stage appears to be increased support for IRETA. Because IRETA is part of the University of the South Pacific, its future is closely tied to the fortunes of the University, which have been somewhat clouded recently by political events in Fiji.

The need for a properly funded regional team to co-ordinate agricultural research was fully examined by ADB and ISNAR (1983). Yet, in the end, the experts' recommendations were largely ignored, partly because of jealousies and mistrust between the prospective donors. Similar problems between SPINs, such as disputes about where facilities are to be located, have also contributed to difficulties. But it seems that the main cause of the failure to establish a regional team lay with the ADB which was unwilling to commit even a share of the funds on a long-term basis.

Strong national programs are nevertheless virtually a prerequisite for the success of regional programs. There is a minimum domestic capacity in research for a national program to benefit from international cooperation (Ruttan, 1982). In some SPINs this minimum may not have yet been attained.

6.3 Search for a parsimonious paradigm

The essential feature of a parsimonious research paradigm is the involvement of a wider range of people in the process. Obvious candidates are the ones actually involved in the production and marketing, i.e., farmers and market participants. Biggs and Clay (1981) have noted the importance of indigenous technical knowledge of farmers and the tendency of agricultural researchers and others to undervalue this knowledge. SPIN farmers do test new tech-

niques, in their own ways. Evidence lies in the many innovations, including many exotic crops, trees and animals, that have been taken up with minimal or zero input from official agencies.

The notion of involving farmers in technology development is not new and, indeed, is central to the FSR approach. However, the standard FSR approach has been criticized by Chambers and Jiggins (1987) as too resource demanding for many poorly-endowed national agricultural research systems. They also argue that conventional FSR retains too much power and initiative in the hands of scientists. They advocate the Farmer-First-and-Last (FFL) approach as better fitting the diverse and complex needs and circumstances of farmers and, importantly in the context of SPINs, as making more sparing use of scarce scientists. The parsimonious FFL paradigm avoids intensive inputs of research resources by relying heavily on farmers' knowledge of, and concern for, the important issues. It also depends on their abilities to identify priorities for research and, on occasion, to identify solutions.

While the FFL approach involves many of the same steps as FSR, but on a less ambitious scale, its essential feature is a change in attitudes of scientists. No doubt there will be difficulties in achieving what Chambers and Jiggins call 'reversals' of values and thinking needed for farmers to be put first. Nevertheless, the FFL concept seems to have such merit for SPINs that some testing of it would be desirable.

A second group that could contribute more to agricultural research is extension officers. Typically, extension divisions of agricultural ministries in SPINs are far more generously staffed than research divisions. Yet too often extension officers have few proven improved methods to offer their farmer clients. Many would be enthused by the opportunity to work alongside research scientists and in cooperation with farmers to test new ideas in farmers' fields. Barriers inhibiting such collaboration include stereotyped ideas of research and extension roles, institutional problems such as the 'provincialization' of extension in some SPINs, and lack of funds for extension officers to travel to village sites. SPIN planners need to review these barriers and promote more effective overall performance.

SPINs also desperately need more well-directed research in agricultural marketing (broadly defined to include all aspects of transport and processing). A marketing systems research (MSR) approach, equivalent to the FSR approach, might be used on both domestic and export marketing fronts. The creation of a MSR team, however, would put even greater strains than currently on government research resources. Any initiatives in MSR, therefore, have to be consistent with the parsimonious paradigm above. In general, this means getting market participants as thoroughly involved as possible in the MSR process. The MSR approach has been described by Fleming (1988).

Finally, a feature of any parsimonious paradigm in agricultural research should be a recognition that the scope of research by small teams must be

limited. It is not possible to investigate everything. Priorities must be set and resources allocated to those issues where (a) the chances of 'success' are judged to be high, and (b) the benefits expected to flow from successful research are large. Little such *ex ante* analysis of research priorities for South Pacific agriculture has been undertaken (but see Davis et al., 1987), largely because of data problems. However, even subjective assessments of priorities and areas of concentration of effort would help to ensure that SPIN research resources are not squandered on unfruitful areas of investigation.

Conclusion

Many earlier recommendations for reform of agricultural research in the South Pacific region have been broadly sound (although they have tended to under-rate the need for market research). However, there has been a failure to recognize the special problems of diseconomies of small size in agricultural research in SPINs as in many other small developing countries. The emphasis in this paper is therefore strongly on the need for a parsimonious paradigm.

Something similar to the approach suggested here will only be adopted if policy makers become convinced of its merits. Thus, there is a major marketing job to be done. Moreover, the approach must not be 'oversold', as seems to have happened in the past with FSR, judging by evidence in the literature of growing disenchantment. The reorientation of the research effort, including the required institutional reforms, should be attempted progressively and adaptively, learning by doing to find out what works and what does not under the rather special conditions of SPINs.

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