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SOCIO-ECONOMIC MODELLING OF FARMING SYSTEMS*

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** As is our practice, this unholy trinty is ordered by the accidents of alphabet and parentage. Responsibility for errors and misconceptions, however, properly rests with the most senile author, JLD.

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1. Introduction

In the early days of FSR (around, say, half a century ago), practitioners recognised the farm as an entity with interrelated production and consumption dimensions. got on with the job and did it, often with very modest physical and financial resources. More recently, but especially since the advent of the big spenders supported by the CGIAR, USAID and others (see Fresco 1984) (including ACIAR?), more seems to be said than done in a proliferating literature that is long on pontifical evangelism and anecdote (e.g., Dillon and Anderson 1984) but short on substantive method and genuinely successful work of significant impact.

Among the gentle persuaders, few have been as prolific as the socio-economists. It is thus with considerable trepidation that we embark on this essay. Who would have thought that the prospect of a free lunch at Hawkesbury College could be so persuasive? Rather, perhaps it was the anticipated good company that has us seeking to rediscover this critical wheel of the FSR Trojan horse!

The practice of FSR has surely matured to the point where it is no longer necessary to argue the importance of socio-economic considerations in FSR work or, indeed, in other even more important work. Accordingly, we eschew such missionary zeal in this coven of the converted. One convenient indicator of the extent of socio-economic territorial relevance is the (somewhat arbitrarily sketched) hatched area in Figure (which, before the added hatching, was due to another socio-economist!).

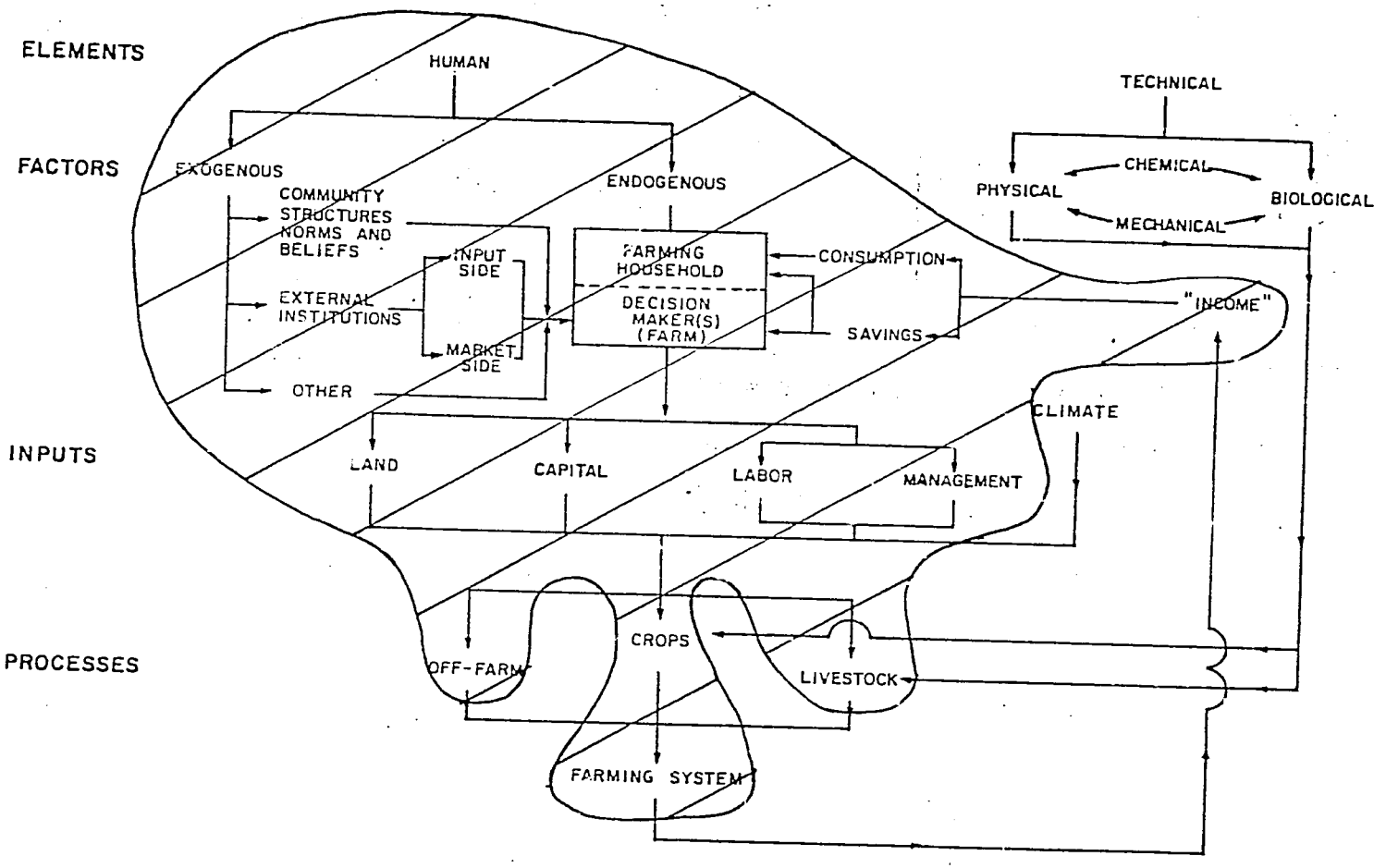

Figure 1. Schematic representation of some determinants of a farming system (after Norman 1980). Hatched domain of socio-economics added.

One of the few (almost) universally agreed concepts of FSR is the centrality of dealing with the human element in any FS. To the extent that farmers' and their households' interests are nurtured and kept to the fore, socio-economics must play a rather central role in any serious FSR. Better that the socio-economic concerns are maintained enthusiastically, even if by other than socio-economists (by which we muster together sociologists, anthropologists, economists and other social scientists who on occasion may include political scientists, historians, geographers, etc.), than neglected for the absence of appropriate disciplinary specialists.

As in all science, modelling plays a central role in social science research generally and in the socio-economic aspects of FSR in particular. This role is charted briefly in Section 2 as a prelude to some of the contributions and limitatons of modelling adumbrated, respectively, in Sections 3 and 4. Finally, to conclude this overview of socio-economic modelling in FSR, in Section 5 we sketch our view - an optimistic one - of the way forward.

The Role of Modelling

Inclusion of socio-economic considerations in FSR may be necessary but is certainly not sufficient for worthiness and virtue in such work. Again, as in all sciences, there are many inherently artistic elements that condition progress (Ladd 1979). We suggest a scheme of the real world (including a FS under study and the rest of reality) which is separate from the FSRer's world (including its assumptions, concepts, models, insights and conclusions) by a 'threshold of relevance' (Anderson and Pandey 1986, Ch. 1). The necessary condition for crossing this

threshold is an artistic achievement of acceptability and accuracy in the modelling of the system under study. The artistry is emphasised here to caution on the lack of speedy, objective or even possibly knowable criteria for ensuring safe passage to reality with useful impact.

The process of modelling per se is beyond our concern here, but features multistage and somewhat cyclical steps of problem definition, system analysis, system synthesis, model implementation, model verification, model validation, model experimentation and interpretation (see, e.g., Anderson 1974). Not all steps are taken by all modellers on all assignments. The general process, however, is remarkably similar across the spectra of socio-economic modelling - micro to macro, rural to industrial, etc. (see, e.g., Thomson and Rayner 1984).

2.1 How does it best fit in?

The place of socio-economic modelling in FSR is most readily seen by reference to a chart of the typical FSR process. Figure 2 is such a chart which might best be referred to as a juxtaposed, gyrating, testicular schema. Within this schema, the heartland of socio-economic modelling consists of items 1, 2 and 3, constituting, respectively, aspects of problem definition, system analysis and system synthesis and beyond, and spanning both the downstream (on-farm) and upstream (research station) activities of FSR.

We must hasten to add that, in so placing socio-economic researchers at the centre of things, we do not wish to overstress their importance in

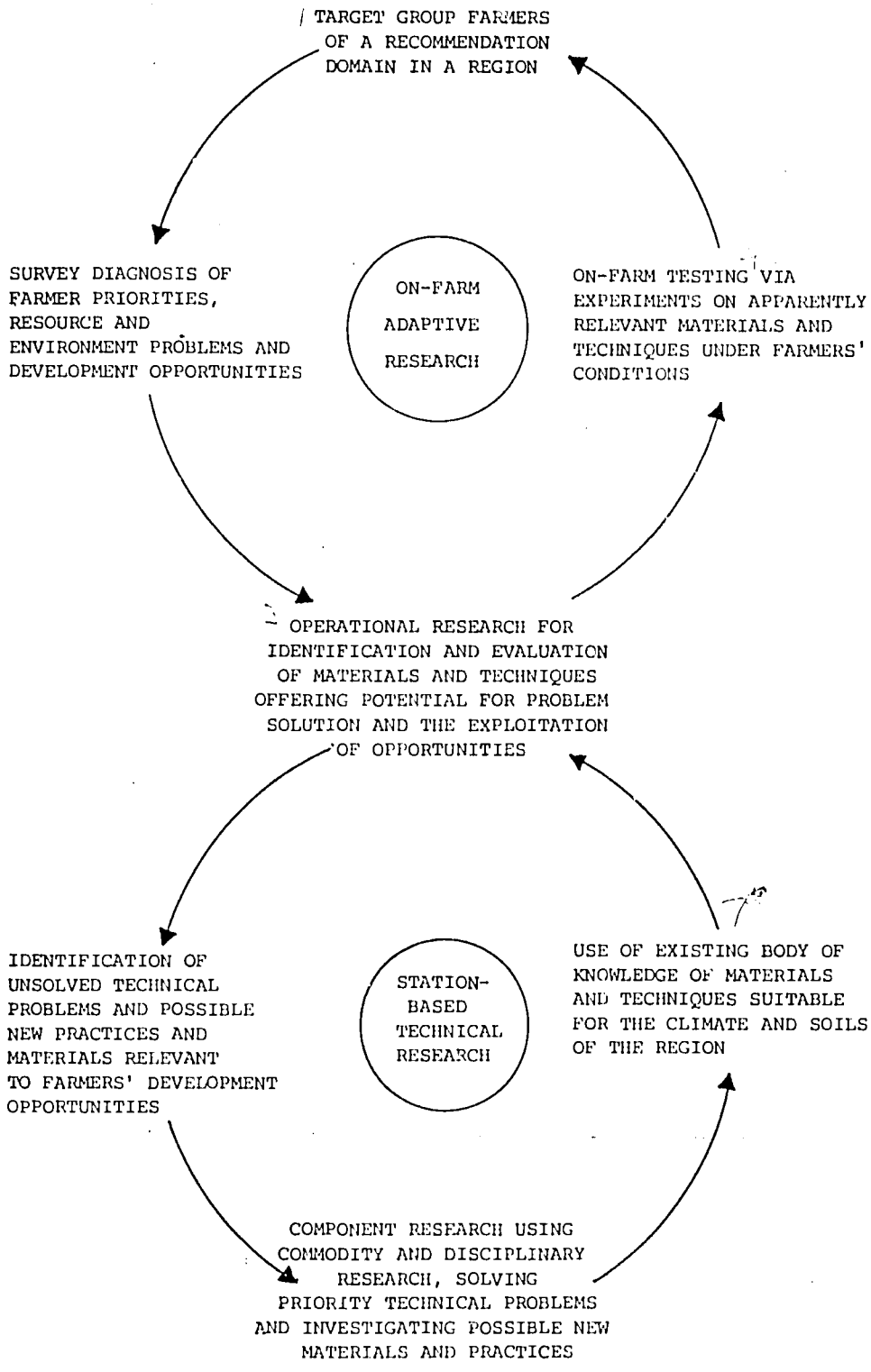

Figure 2 — Schematic view of farming systems research method (after Collinson 1982)

the overall process. FSR teams must be transdisciplinary (Dent and Anderson 1971, p. 8, and nearly every recent author). The track record of, for example, economists going it alone has been less than impressive, if not disastrous.

Implementation of socio-economic research elements in FSR continues to evolve on essentially ad hoc or experimental lines. Everyone agrees on the importance of survey/diagnostic work but not on its style, precision and timing (e.g., rapid reconnaissance vs. the typical village studies of several IARCs). There are analogous divergencies among practitioners at later stages of modelling (e.g., back-of-the-envelope budgets vs. multistage risk-programming formulations of farm planning problems). Not that we should expect uniformity in approach and method across the great diversity of FSs to be researched - rather, it's a matter of 'horses for courses'.

2.2 Horses for courses

Models, in their every aspect, come as different as their builders. Some of us even misspent our youth in trying to classify them (Anderson 1972). For the present purpose, a simple taxonomy based on whether or not the model incorporates an optimising algorithm will serve to structure our remarks. Unfortunately, no matter how simple the taxonomy, any attempted classification faces some difficulties. First, given the already vast literature on socio-economic modelling and its rapid rate of growth, any classification is likely to be both incomplete and soon outdated. Second, there is by no means a one-to-one correspondence between model form and the purpose for which a model is, or could be, used. As a result, any classification of modelling techniques will inevitably be somewhat 'fuzzy', with the same type of model falling into

different categories according to how it is used. These provisos should be borne in mind in what follows. In addition, our emphasis is on models that imply an economic (though not necessarily financial) orientation to FS analysis. Models of a purely physical and biological orientation are not considered. Nor are those of more purely social nature, such as might be oriented to questions of social status and power between the FS household and its environment. Note, however, that a variety of non-economic considerations, such as nutritional and demographic elements, if need be may be allowed for within a FS model of economic orientation.

A first criterion for classification of socio-economic modelling approaches is whether the model itself incorporates an optimising algorithm, i.e., whether it directly generates a 'solution' for the system, as represented in the model, that maximises or minimises some specified objective function. The distinction is important because of the appeal of the optimum for economic analysis and because the availability of an optimising algorithm generally affects the way the model is used. At the same time, it must be recognised that optimising models tend to be more rigid in structure than other types, thereby making it more difficult to represent the real system closely. In consequence, the optimum for the model may depart appreciably from the (usually unknown) optimum for the real system.

Non-optimising models can be further sub-divided according to whether the model incorporates (or is used with) a search procedure designed to identify 'preferred' solutions, so bringing the approach close to the optimising algorithms, or whether the model is constructed solely or primarily to describe a FS.

In this latter category of descriptive models, the most widely used in FSR is budgeting. Although budgeting models are conceptually quite simple, involving merely summarisation of the physical and financial features of the selected FS, they are nevertheless powerful, flexible and very useful (Brown 1980; Dillon and Hardaker 1980). Via repeated application with changed parameters, budgeting models can be used in an evaluative way. Their limitations arise less from the technique itself than from the limited intuitive capacity, conceptualising powers, creativity and diligence of the analyst (Anderson and Hardaker 1979). The advent of appropriate computer software, particularly spreadsheet programs for microcomputers, has enhanced the utility of budgeting models.

In this same category of non-optimising descriptive models might be placed a group of econometric models, based usually on least-squares regression-type analysis of cross-sectional farm data, that purport to describe the production system and/or consumption system of a group of farms or farm households. Such models typically involve fitting one or several equations that are intended to describe the way the farm or household resources are allocated to alternative uses or the way that different types of output are generated. Some econometric models are related to the optimising models in that they are based on an assumption of utility-optimising behaviour on the part of the farm household. However, we should distinguish and exclude from present consideration those econometric models that permit an optimum to be identified by use of differential calculus, as in production function analysis. Rather the concern here is with econometric models that are primarily descriptive. (See, e.g., Alamgir and Horton 1980; Deolalikar, 1985; Pradhan and Quilkey 1985; Rosenzweig 1984; Strauss 1984.)

For FSR purposes, econometric models provide a good means of summarising some of the key relationships in an existing FS. They do not, of themselves, identify causality in observed relationships between variables, but they do permit relationships, identified on the basis of theory as important, to be quantified. Their limitation lies in the limited extent to which estimated relationships can be extrapolated from the existing situation as circumstances, especially available technologies, change.

Finally in this group of descriptive models lie some of the simulation models, especially those that are designed to represent agrobiological production processes. Such models tend to be relatively detailed and hence best suited to describing and evaluating specified FS or, more usually, component parts of such systems, rather than exploring the consequences of alternative management options imposed on them. In economics, there has perhaps been some disenchantment with models of this kind, probably because of the high research resource costs typically involved in model development, related in part to the need for effective interdisciplinary co-operation. Anderson (1974) provides a comprehensive review of simulation in agricultural economics. See also Dent and Blackie (1979).

Simulation also falls into the category of non-optimising models incorporating search techniques designed to identify near-optimal solutions. Search may be conducted by means of an appropriate 'experimental design' selected to span system response to the range of values of key decision variables of interest (e.g., Crawford and Milligan 1982). If the relationship between the decision variables and the value of the choice criterion is 'well-behaved', it may be possible to identify

the optimal solution with considerable precision. However, simulation models that are to be used in this way, in an experimental design, need to be reasonably simplified if computing costs are not to be excessive. This typically means some sacrifice of detail that might be incorporated in agrobiological models to be used for evaluative or descriptive purposes only.

Bellman-type dynamic programming also falls on the frontier between optimising and non-optimising techniques. Although usually thought of as an optimising method, dynamic programming, as usually implemented, is no more than an efficient search technique. The so-called 'curse of dimensionality' limits the applicability of this type of model, but some important questions in FSR, such as the replacement of tree crops, can be effectively explored using dynamic programming (Jayasuriya 1976).

Monte Carlo programming, which can be thought of as a hybrid between simulation and mathematical programming (MP), has proved useful as a means of modelling farm systems under circumstances where the assumptions of linearity in the constraints and objective function, usually required for MP models, are not well satisfied (Anderson 1975; Wardhani 1976). The essence of the method, which is nearly always implemented by computer, is that a large number of possible solutions are generated at random, tested for consistency with the specified constraints and adjusted if necessary to satisfy those constraints, then evaluated in terms of a specified objective function. Typically, the score or so best solutions are stored and reported.

As noted, Monte Carlo programming is a close relative of MP. Mathematical programming models constitute the chief optimisation

approach to FS modelling. The suitability of the method is indicated by the very large number of applications (e.g., Andrews and Moore 1976; Barlow, Jayasuriya and Price 1983; Flinn, Jayasuriya and Knight 1980; Hardaker 1975; Heyer 1971, 1972; Low 1984; Ogunforwora 1970; Roth and Sanders 1985; Sanders and Dias de Hollanda 1979; Schluter 1974; Wardhani 1976; Wills 1972). The appeal of MP lies first in the fact that it is a method of constrained optimisation, which appears to match the reality of small farmers striving, with limited resources, to improve their lots. Second, the method is relatively easy to learn and to use to produce models of FSs that appear to be reasonably realistic while simple enough to manipulate and interpret. The fact that the necessary calculations to solve a MP model are done by computer, usually very speedily, means that it is quite easy to undertake sensitivity analysis with the models.

Of course, MP, and especially linear programming, is not without its faults. The underlying assumptions are somewhat strong, particularly those of infinite divisibility of resources and activities, and of single-valued coefficients. Extensions of the basic linear programming model, such as integer programming and risk programming impose extra computational difficulties. Finally, access to a relatively powerful computer with suitable software is essential. These facilities, so easily taken for granted in the developed countries, are often not readily available in the developing countries. Even some of the IARCs have faced considerable difficulty in securing access to suitable computer hardware and software for MP applications.

Among other optimising techniques that have some applicability in FSR, perhaps only production and profit function analysis deserve mention here. These methods involve econometrically estimated functions, usually

based on cross-sectional farm data, that can then be manipulated to derive the conditions for farm production to take place at maximum profit (e.g., Barnum and Squire 1978; Yotopoulos and Lau 1973). The technique is relatively simple to use and permits judgement of the scope for profitable reallocation of resources within a given set of available farming technologies. As with other econometric methods, however, production or profit function analysis is not applicable to situations where new technologies, not presently represented in the cross-sectional farm data, are to be evaluated. Nor do these methods deal as convincingly as MP with multi-enterprise farming systems.

In summary, two modelling approaches stand out for their widespread utility in FSR. These are budgeting and MP, which can perhaps be seen as polar extremes of the spectrum of modelling methods. The former has advantages of simplicity and flexibility, while the latter is a powerful approach to optimising whole-farm systems.

Contributions of Modelling

Expectations about what socio-economists can contribute to an FSR program may be more or less realistic among research administrators but minimally, and as reflected in their modelling, the socio-economists' activities, as noted by Dillon and Anderson (1984, p.181), should encompass an appreciation of such fundamental matters as (a) the social milieu in which farm decisions are made, (b) the institutional setting and policy environment in which farming is conducted, including details on land tenure, credit and taxation, (c) the economic environment of farms, including long-term market prospects for inputs and outputs and, most importantly, understanding of the opportunity costs and transactions

costs faced by farmers, and (d) the attitudes and personal constraints of farmers, including their desire or otherwise for change, for leisure, for education, for different foods and so on, and their human and other capital. The purpose of such understanding is to assist, via the manipulation of relevant models, in the identification of effective changes to, and the design of, practices, techniques, enterprises, activities and policies that are acceptable to and appreciated by the target groups in FSR. The days of the 'quick technological fix' through improved seed, fertiliser and a favourable environment have just about gone. Progress now must be won in the context of the full reality of generally resource-poor farming systems.

Understanding of the wider reality of farming systems does not come easily. But unless such understanding is gained, the construction of relevant models for FSR analysis is unlikely. Conversely, the necessity for such understanding as a prerequisite to socio-economic modelling can have significant positive spin-off to the FSR program at large across all the disciplines involved. Ideally, social scientists glean their knowledge of such systems through long and close contact with the people of the systems. Horton (1984) documents such a recent CIP endeavour in Peru. The ideal, however, rarely obtains and more formal methods of description and understanding must be sought. The most widely used approach is a survey that garners detailed information on what happens in the village and on farms, to whom and when. Several alternative survey approaches developed at CGIAR and other centres are contrasted by Chambers and Ghildyal (1984). From these, profiles of labour availability, cash flow, work demands, prices received, etc. can be built up and, if the collections run for long enough, the variability of these attributes over time, especially in response to natural hazards like flood, drought, frost and fire, can also be quantified.

Many elements sought in survey activities as a preliminary to modelling are subtle and/or sensitive. Particular skills are required to ensure faithful description of reality. For instance, some transactions costs such as bribe payments for access to inputs may not be readily forthcoming in simple interviews, but may involve considerable inflation of factor costs. Production levels may be systematically understated if farmers fear linkage between research workers and taxation authorities. For a final example, attempts to elicit information on farmers' attitudes to risk are fraught with the danger of interviewer bias clouding the sought information. Such anecdotes underscore the costs of reliable survey work in FSR. In short, it is (a) time consuming, involving repeated contact both to develop confidence on the part of farmers and to gain an understanding of intertemporal effects, and (b) demanding of a high degree of professionalism on the part of those in direct contact with the farmers. Senior social scientists themselves must be actively involved in the direct contact, even if this is (perhaps linguistically) difficult. As a minimum, interviewers should be conversant with the theoretical underpinnings as well as the empirical applications of the data being collected - a situation that has not always prevailed in recent attempts at implementation.

All this is easier said than done, especially in the Third World where many governments have evinced a reluctance to institutionalise a socio-economic element in FSR. In some cases, it may prove best to handle social science aspects through new bureaucratic entities such as 'FSR Coordination Units' wherein the leads being facilitated by, say, CIMMYT in East Africa, ILCA in Ethiopia, ICARDA in Tunisia and ICRISAT in Burkina Faso and Niger might be implemented in national programs of rural research and extension.

3.1 Standing back from the field

Hopefully it will not be seen as intellectual imperialism to assert that the hands-on modelling phase of FSR - encompassed in the third component depicted in Figure 2 - lies at the centre of the FSR approach. That is, it provides both an integrative link betweeen on-farm and on-station activities and, along with other mechanisms, constitutes an important mechanism for the evaluative sieving of proposed system changes and the generation of ideas for potentially fruitful component research.

Modelling the existing farming system should permit the performance of that system to be evaluated in detail, with strong and weak points identified. This analysis, by itself, may well be suggestive of aspects where technical improvements can most usefully be sought. Ideas about how the system might be changed can then be incorporated in the model. While new technologies that might be proposed at this stage as potential 'solutions' may be no more that quarter- or half-baked (Anderson and Hardaker 1979), in the sense that they may require considerable research and development before they could be regarded as candidates even for on-farm testing, modelling may permit the more promising options among them to be identified and less appropriate ones to be culled. In other words, this use of modelling provides an input into the research management task, useful in deciding which lines of research should receive priority.

Modelling can also be valuable in the evaluation of the results of on-farm testing of more highly developed technologies. Usually the extent of on-farm testing is limited by practical considerations such as lack of research resources. Consequently, it is unlikely that many

alternative prospective technologies can be tested on a whole-farm scale. Even such tests as are performed are likely to be restricted to a few farms that will not span the full spectrum of farms existing in the recommendation domain. Modelling can go some way to make up for these deficiencies. Results of on-farm experiments can be scaled up to whole-farm level and their resource implications and other features investigated. Similarly, the results can be 'transplanted' to models of types of farms other than those on which the trials were conducted, and similar analyses made. Conformity of the modelled results with farmers' objectives can be judged.

Modelling in this way may reveal that a prospective technology that 'works' in on-farm testing in fact needs further development before it may safely be promoted for widespread adoption by farmers. Perhaps resource needs are too great for resource-poor farmers to afford, or perhaps the associated degree of risk is too great. Such modelling results should, as part of the FSR process, lead to further on-station and on-farm development work, leading hopefully to a revised technology more suited to farmers' real circumstances. Equally, of course, it may lead to a conclusion that the developed technologies will never be adaptable to the needs of the target group until essential institutional changes are made. The needed institutional reforms may be minor - such as raising the borrowing limit for institutional credit - or major - such as wholesale land reform. Certainly, drawing conclusions about the need for revolutionary institutional reforms may present special problems for FSR workers employed by, or dealing with, governments whose political preferences (whether due to self-interest or cnidarian attributes) do not include even the discussion of such possibilities.

Aggregation from farm-scale models of the results of prospective technologies can help to identify potential marketing problems or problems in the supply of inputs. Thus, for example, output-increasing technologies may be expected to have a depressing effect on market prices of the commodities being produced. If demand is very inelastic, price falls may be so sharp as to compromise any hoped-for effects on incomes of poor farmers. Or aggregate input requirements of, for instance, fertiliser or credit, may exceed the current capacity of input supplying agencies, implying a need for improvement or expansion of these agencies if the uptake of the technology is to be unimpeded.

3.2 Up closer to an IARC program

It may be useful to add some brief remarks about socio-economic modelling in an FSR program. These remarks stem from the involvement of one of us (JBH), in an advisory capacity, in ICRISAT's Economics Program.

The models used were MP models, chiefly quadratic risk programming models (Ghodake and Hardaker 1981). They were based largely on the abundant stock of detailed farm-level data collected through ICRISAT's Village Level Studies - probably the best data base of its kind in the world. Without this data base the modelling task would have been much more difficult, perhaps impossible. Information on new technologies came mostly from the Centre's Farming Systems Research Program, including both on-farm and on-station trials.

The modelling task proved to be more time consuming and labour using than at first imagined. Initial work was held up by the lack of suitable computer hardware and software. The models developed were relatively

large, reflecting the complexity of the real systems being studied as well as the generous stock of available data. The result, however, was that model building and validation were not easy tasks. Similarly, the output generated from computer runs with the models was voluminous, creating some problems in interpreting the results. In retrospect, it might have been better to have traded off some precision in the formulation of the models used against gains from greater facility in use of smaller more 'rough and ready' representations.

In use, the models did provide some information of the kinds discussed above as being potentially available from modelling (e.g., Ghodake 1983, 1984; Ghodake and Kshirsagar n.d.). Feedback to research policy was not, perhaps, as strong as it might have been, for several reasons. First, there is no sharp division in modelling between the phases of (i) model verification and validation and (ii) model use. Consequently, results from modelling must always be viewed as provisional and interpreted with caution. It becomes easy, therefore, to dismiss results that do not happen to align with current thinking about research priorities. Moreover, any analysis of the effects of prospective technologies must inevitably incorporate some guesswork as to how that technology will perform in the hands of farmers. The results of testing technologies, even with farmer management, are likely to be superior in technical efficiency to what can be realistically expected if and when the technology is actually adopted. It is too easy for the enthusiasm of scientists for their 'brainchildren' to bias upwards the expectations of how given technologies will actually perform in practice.

The existence of this potential source of bias in FSR modelling points to one advantage of MP over budgeting that was exemplified in this

ICRISAT-based work. Mathematical programming involves formal representation of the constraints faced by farmers with the result that, even though the yield effects of some technologies were, in retrospect, overestimated in modelling, the constraints on the uptake of that technology were pinpointed. The chief package of technologies investigated using the models was based on the raised bed and furrow system, involving a specially designed animal-drawn cultivator. The programming studies revealed very clearly the impediments to widespread adoption of this technology arising from capital shortage of the target group of farmers.

4. Limitations of Modelling

The plethora of problems surrounding FSR in general and its socio-economic aspects in particular pose a difficulty in selecting a few that can be mentioned in this short essay (for an entertaining and frankly informative treatment, see Abalu 1983). Others (e.g., Anderson 1974, pp. 33-6) have documented some that persist but which are not addressed here (e.g., inadequate representation of uncertainty, insufficient verification and validation, inappropriate balance in the structure of models, deficient use of feedback from on-farm trials to model specification, etc.). Rather, three categories of a reduced, albeit idiosyncratic, set of problems are considered.

4.1 Technical problems

It is tempting to broach some of the awkward questions that modellers face such as selecting an appropriate type of model (e.g., normative vs. positive, simulation vs. programming), going for the 'right' level of

detail, disaggregation, decomposition, etc. but, having tackled some of these elsewhere (e.g., Anderson and Hardaker 1979), we choose not to do so now. A couple of oldies are, however, worthy of a further look. An issue that we have not yet addressed ourselves, but which Maxwell (1984) has raised, is the difficulty faced in FSR by the turmoil in the socio-economic environment - what Maxwell calls FSR with a moving target.

In this respect, a particularly intractable problem is that of achieving an 'appropriate balance' between data gathering, model building and model exploitation as well as vis-a-vis the other processes depicted in Figure 2. If too much time is devoted to these tasks, the system under study may have been significantly perturbed before useful results are obtained. This seems to be an issue that is much easier to pass judgment on retrospectively than it is to make good decisions about in the hurly burly of completing an FSR project. It is something that can be addressed in part through the modelling process itself (especially via sensitivity analysis, see Anderson 1974, pp. 20-3) but somewhat irrevocable data gathering decisions may already be in train by the time of such realisation. All this puts a premium on the early availability of at least a preliminary model of the FS before very costly data assembly is begun.

A general issue that might be classified as a technical difficulty is the 'remoteness' of some FS modellers from their target domains of farmers. This arises from many sources - culture, language, class and understandable lack of enthusiasm by FSRers to live in the reality of such domains. This is surely one of the unstated driving forces for rapid rural appraisal methods and other 'quickie' approaches to problem diagnosis. Much less frequent, at the other extreme, is the

anthropological approach whereby researchers lose themselves in a culture for several years, make millions of observations, but never emerge from the morass of information to get back into the cyclical processes of FSR.

The remoteness problem is reflected in imperfections of FS models, largely connected to missed subtleties in understanding and modelling of the systems, that may be critical for ultimate success in the work - see Abalu, Ogungbile and Fisher (1984) on the importance of securing farmers' cooperation. We do not have any quick cure for the problem (beyond the obvious). We would, however, caution practitioners that it may be better not to be in the business at all than to adopt methods out of keeping with the stated intentions of FSR that may well contribute to giving it an even worse reputation than it presently suffers, and not predispose successful crossings of the threshold of relevance.

4.2 Frequent omissions

While the philosophers of FSR pay due homage to the farmers and their decision-making roles in FS, in practice these are often somewhat played down in significance. Sometimes this is understandable, if not necessarily defensible. For instance, farmers' and their families' attitudes to work and leisure may meet little sympathy from an analyst who doesn't have to endure long hours of physical activity in trying conditions.

In other cases, the technology of encoding farmers' preferences and attitudes may constrain attempts to explicate them within socio-economic models. Methods of varying elegance and restrictiveness for depicting multiple attribute preference functions are exposited by Anderson, Dillon

and Hardaker (1977, Ch. 4) but, in terms of present-day FSR practice, the application of such formal methods is somewhere between the horse and buggy and the T-model Ford. If specialists can't or won't, disdain by others is probably justified.

To summarise, it is our belief, founded mostly on casual observation, that farmers' and their families' preferences are very poorly investigated, understood and represented by most FSR workers. We can understand this since, were we to be more active in the field ourselves, we would perhaps be guilty of this same sin. Notwithstanding the potential such omission has for misdirecting FSR work (including modelling) and perhaps condemning its results to irrelevancy, it pales into insignificance when compared with the next-mentioned omission.

A related serious omission is the correctly identified 'farmer'. There is a near-universal tendency to presume that, where there is one, a male head of farm household is 'the' farmer. Thus, for example, male-dominated extension services have been created to target these male heads, and researchers too often fall into the same trap of chauvinistically identifying farmers as male.

The imperative need to recognise the crucial role of female farmers arises from several considerations. Most obviously, in many regions and countries, emigration of men to work elsewhere has left virtually all farming in the hands of women. In other situations, whether by tradition or comparative advantage, economic activities in the rural sector are strongly gender-determined. For instance, as well as home responsibilities, women frequently have almost exclusive control (through management, decision making and labour) over fruit, vegetable and herb

production, small stock, fuelwood, etc. If FSR is not 'major-crop' biased, the farmer of relevance in many cases will be a woman (Jiggins 1984). Since the preferences of women are likely to be different from men, omission of the women's viewpoint is likely to lead to misspecified models.

A further related omission highlighted by Jiggins (1984) is consideration of activities beyond production per se. FSR is often claimed to be holistic in its view of the farm but how often do FSRers (and socio-economists especially) explicitly incorporate accounting of and review of technological adjustments to household activities within the FS such as trading and the processing and preparation of produce into food? Needless to say, such activities are frequently the responsibility of women. The boundary of the system that is modelled in FSR should be drawn to include these activities if serious biases are to be avoided!

4.3 Practice and humility

We hesitate to throw more stones lest our own glasshouse suffer damage too. If our critical remarks have any validity, however, it follows that FSR people, and certainly FS socioeconomic modellers, should diligently seek to be humble about what they've been up to, at least for the foreseeable future. We are still at the dawn of systematically learning from the farmers of traditional FS (Chambers 1983). An attitude of humility would be appropriate to the existing level of achievement and may engender less points-scoring criticism from reactionary conventional agricultural scientists who probably have nothing better to offer anyway.

5. The Way Forward

Relative to the further development of socio-economic modelling of farm systems, all we can be sure of is that the way forward lies ahead of us! As ever, however, there are pointers from past experience. Chief among these are the lessons to be gained from past mistakes and failures, the high cost and often inefficient mode of conducting FSR, and the poor consideration of social relevance often given in the establishment of FSR priorities between regions and countries.

Even at a time when some sponsors of FSR are showing signs of disenchantment with the approach, perhaps because of unrealistic expectations in the first place, practitioners must strive to learn more from their mistakes. There are many obstacles to formalising such learning through documentation of case histories. People have a natural preference for sharing their successes with peers and sponsors and there are related impediments against elaboration of failures. These impediments must be overcome if FSR is to make the rapid advances that might be anticipated commensurate with the now considerable investment in such work.

The apparent high costs of latter-day FSR (see, e.g., McIntire 1984) must be reduced to enhance its attractiveness and cost-effectiveness in the more impoverished parts of the world. Costs can be tackled at nearly every detail of the work and not least in modelling. The unit costs of digital computing, for instance, are continuing to fall rapidly, so that storage, retrieval and processing of data should be reducing in cost everywhere. The labour costs of FSR, particularly data collection, can be greatly reduced by having most of its research workers as nationals

working in national programs - see Martinez and Sain (1983) but also the remarks of Abalu (1983, p. 34) on hardships and incentives for national FSRers. Relatedly there is an urgent need for training these workers, with consequent demands on external resources and demonstration programs. But can 'it' be taught and, if so, how best and by whom? While there is no shortage of would-be pedagogues, do they know what to teach? Further, for cost effectiveness, there is a need for models to be developed as far as possible in modular and/or skeletal form that can be added to or subtracted from with maximal flexibility without being constrained by location specificity. In other words, models should be developed in adaptable form so as to be useful for general baseline studies and for specific locations.

A continuing trade-off between social relevance on the one hand and difficulty of execution and impact, on the other, makes resource allocation in FSR challenging. Credibility with those whose concern rests primarily with the poorest of the poor places urgent obligation for FSR to address these people's problems - no matter how remotely they are located, how desperate their circumstances or how depressed their ambition. Quite apart from the obvious challenges of this sort of work, it may be difficult to encourage national FSR personnel to go to the more troubled parts of their countries. At the other extreme, 'success' may be had much more easily among those who face better technological options and opportunities, even if they are likely to be more conveniently located. Such work may have value, however, for its demonstration effect and for the political support it may generate for the more socially relevant but more difficult work in adverse locations.

Socio-economics models should capture some of these trade-offs, so that resources can be allocated explicitly according to various social priorities. Thus, as at every other turn, models can and do play a valuable role in determining the way forward - a thought that encourages us to end with a gender-free simile (cf. Anderson and Dent 1971, p. 388): like a spouse, a FSR model takes some time to identify, takes even longer to comprehend, is surely complex but often instructive and, not exhaustively or exclusively, treated with cautious respect, can serve intentions admirably.

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