AGRICULTURAL RESEARCH AND EXTENSION: SOME PROPOSALS

FOR THE FUTURE

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Striking anomalies exist within the agricultural sector in Southern Africa. Just as there is a need to correct resource and income disparities and to underwrite change with security, so measures must be consciously adopted to bring the official agricultural establishment into the service of the peasant.

The success of agricultural research is easily apparent in the role it has played in the growth of the large commercial agricultural sector in Southern Africa. Indeed, throughout the world science has mainly served the larger farms and the plantation economies. It has not yet developed a strong sense of constituency amongst small farmers except in exceptional cases where cash crops have been actively promoted. Throughout the Third World there has been an official push to develop a strong agricultural research and extension network. The growth of the international agricultural research centres system, supported by private foundations and increasingly by United Nations agencies and Governments, has lent considerable momentum to the development of national agricultural research and extension systems. Continued support for the international and national networks is underwritten by research into the investment efficiency of such activities. Agricultural research productivity has been measured in numerous studies covering a number of developed and third world countries. The observed annual rates of return typically fall within the 30% to 60% range. It is hard to imagine that any other investment in either private or public sector would produce more favourable rates of return than those from agricultural research. In other words, there has been an underinvestment in agricultural research and extension services in most countries, both developed and underdeveloped. This is in contrast to the thrust of much of the literature on public economics. That literature directs attention to areas of overinvestment and decreasing efficiency in the supply of bureaucratic services. Agricultural research appears to be a strong exception to the general theory.

High rates of return to agricultural research in third world countries pose a dilemma for the policy maker. It suggests that a vastly increased funding of agricultural research would produce large benefits. Yet the same time a substantial body of evidence exists which suggests that only a small proportion of peasant producers have adopted scientific innovations and that those who have were mostly the relatively well-placed. Smaller farmers and landless labourers have been left behind in the countryside. Is this a function of poorly developed agricultural research and extension services, or is it an outcome of a more general malaise in which policies and programmes do not reach the small and the poor? Growing frustration with the efficacy of official development projects and programmes in all countries in the third world suggests that there is a structural hindrance to the flow of knowledge and investment. For instance, a detailed examination and evaluation of 36 rural development projects in Africa and Latin America concluded that project success depended largely on whether farmers were involved in decision making during implementation of the project and whether they committed their own labour and/or cash to the activity. The report urged that projects be designed more carefully in response

1. V.W. Ruttan, 'Bureaucratic Productivity: The Case of Agricultural Research' in Public Choice, volume 35, issue 5, pp.529-545. See especially Table 1.

to these criteria and that this in turn would require more time and knowledge of local conditions than aid agencies normally deemed necessary. It is recommended that aid agencies should either adopt a more locally based organic development approach or support smaller institutions that would be able to operate on this basis.

In the late 1960s, a general disappointment with the top-down development theories arose and was given more concrete impetus following the entry of other disciplines, notably geography and ecology, into the field. The series of crises of the late 1970s lent urgency to the issue: the energy crisis, the rapid growth in systems of production that were dependent upon non-renewable fossil fuels; the incidence of largely man-made ecological disasters such as the drought in the Sahel and the fuel-wood and desertification scares that were formally acknowledged and the more widespread concern that the potential promised by the green revolution had revealed problems inherent in the institutional systems which governed the countryside as well as in the strategies used to promote the technology.

It is possible today to assess the potential for the growth of what is often termed ethno-science, the study of indigenous knowledge systems, and to set that promise and the method it demands against the conventional position held by agricultural research and extension. We shall argue that the ethno-science system offers the means whereby it may be possible to attain high returns to investment in agricultural research by combining local knowledge and initiative with new materials and understandings derived from modern science. If that can be achieved then it should be reasonable to expect that agricultural science, working in the service of peasant producers, can lead to rapid production increases together with the maintenance of stable ecological systems and a furthering of equity.

The promise of ethnoscience is based on the demand that development planners must take into account the accumulated knowledge and the traditional skills and technology of the people amongst whom they work. This position is in contra-distinction to that which has arisen in Western science from its origins in a logical positivist mode wherein knowledge is held to arise at the centre, in the policy or planning office or in the laboratory, and is disseminated outwards to clients. In the case of peasant farmers the client is regarded as a clean slate on which to write recommendations. The belief that knowledge originates at the centre is reinforced by a hierarchical structure with research scientists placed at the top and agricultural extension workers at the bottom. The classical agricultural extension model that results is a set of assumptions, principles, and organisational structures for diffusing agricultural research to farm audiences.

The model, as developed in the United States, emphasises the outward flow of communication for the 'extension' of knowledge from scientifically trained extension agents to clientele who share at least a minimal scientific education. The working of the 'classical' extension model in the United States is further modulated by the degree of pragmatism evident in the culture, by the economy's past ability to support simplified, externally supported agricultural ecosystems, and by the fact that farmer groups often hire and therefore control extension agents. With the growth of the industrial farming venture, scientists have become both company servants as well as farm managers. The relationship between research and development is close and reinforces the role of pragmatism.

In Third World countries farmers seldom enjoy a modicum of science education and few have the resources and confidence in the necessary institutional and


technical support to emulate the American way. Colonial attitudes amongst administrators and scientists have often served to weaken the farmers' ability to organise around a problem. Moreover, in some cases the dominant scientific establishment represents a marriage between a logical positivist philosophy and a ruling cultural group. India offers a clear cut example. Cultural and educational leadership has traditionally been vested in the Brahmin caste. The marriage of western science and Brahmin values has resulted in a reinforcement of the proclivity of scientists in the establishment to pronounce farmer activities. It is also reflected in India's planning. In her five year and annual plans India has presumed that documents issued at the centre can determine what farmers in their millions will decide to do. In short, Indian planning denies the decision making and autonomous nature of her farmers. The same pattern is true of practically all Third world countries though it differs in degree. One authoritative report describes extension agents as 'one-way messengers' and adds that their task is seen to be limited to 'passing along' to farmers 'a package of recommended practices which experts at a high level have decided will fit the farmers' needs and opportunities'.

The process under the classical extension model is illustrated in Figure 1. Knowledge originates in the first box and is disseminated or extended to the second box in which is housed the clientele. In the formulation box A is an entirely independent variable. This leads to the deduction that if a recommendation which is generated in box A fails to take hold in farmers' fields in box B, then clearly there is something wrong either in the process of transmission or with the farmers themselves. The failure of the earlier development models and agricultural programmes has led to attempts to improve the feedback of information from the field to 'decision makers'. The 'agro-economic constraints network' employed by IRRI and the CYMMIT monitoring programmes are recent examples of serious attempts to improve the flow of communication between boxes A and B, Figure II. They suffer the critical limitation they remain 'within the overall philosophical position that knowledge is to be transmitted from research to farmers'. It results in a dichotomy between scientists and farmers, a 'them and us' syndrome, in which the farmer is confined to a passive role and the data that is communicated back to the scientist is of a type prejudged to be important by those scientists. It ties down skilled manpower in activities which might equally efficiently or more beneficially be carried out by the farmers themselves.

Quite dramatic differences arise between the specialist interest of modern scientists and the more general understanding of peasant farmers: an agricultural extension system must be designed to moderate the differences. Specialisation in modern science has meant that increasingly scientists in the field have particular knowledge about a single crop or indeed about a single aspect of that crop. This contrasts with the universe of understanding held by peasants in which they place empirical knowledge gained about a plant and its utility. Two examples will suffice.

The first is the juxtaposition of the science based monoculture cropping which has been a standard aim and recommendation of modern science in the
tropics during this century, and African agricultural systems. Monoculture derives from a world view in which society is conceived as an entity apart from nature, and in which society is able to manipulate its environment in the pursuit of its own ends. The epitome of this approach is the success gained with the high-yielding variety seeds. The key to the success of the high yielding programme is the provision of an artificially created and highly simplified ecosystem supported by non-biological inputs. The mixed or 'dirty' fields of the typical tropical cultivator are based on a far more complex understanding of plants and their associations combined with the farmer's pursuit to minimize risk while increasing returns to labour inputs. This contrasts directly with the scientist's objective which is invariably to increase the yield of a single crop from a given piece of land. Mixed fields are inherently more stable than an ecosystem the adher is peasant farmers to attain a high degree of autonomy. A secondary conflict is that the modern scientist's view of multi-cropping tends to be limited to sequential cropping of any one field, often made possible only by investment in irrigation. In the inter-cropping system of peasant farmers a series of harvests are extracted from one piece of land over a period of time. Belshaw has observed research and policy development in East Africa and has reported on the recommendations that scientists and policy makers have put forward during the last decade. The gist of which is that the agricultural science and extension establishment should begin to work with farmers on the improvement of their inter-cropping systems. Despite this, no recommended practices involving inter-cropping techniques have been issued to the agricultural extension services in East Africa. He concludes that this can be explained by the inappropriate criteria applied in the experimental research programme. Measurement has concentrated on yield per unit area whereas farmers using inter-cropping techniques aim to achieve a number of functions which can be summarised thus:

Farmers aim to:
1) raise total farm output,
2) reduce the variance in output levels,
3) reduce labour inputs per unit of product,
4) ensure a conveniently placed, timely and varied supply of fresh foods,
5) avoid or reduce cash outlays on farm inputs such as fertilizer,
6) To Belshaw's list may be added the maintenance of the eco-system.

Belshaw argues that a concept of multi-disciplinary research of farmer systems has not yet been adopted by the agricultural science establishment. Such an approach would take account of the fundamental human needs of rural farmers and their families as well as the interests of future generations. He argues that the material components of the farm system - energy flows, plants, animals, technology, or whatever - enter as only secondary considerations in the farmers' valuation of alternatives to the improvement of human welfare.

fitted more directly into extension practice can be regarded as a longer term attempt to educate the scientific establishment, to improve the flow and pictures of the field between B and A. Figure II. There remains a need to look at the structure of the formal relations between farmers and scientists.

The second example of the conflict of interests between scientists and farmers has arisen in the management of India’s forests. The Indian Forest Service, only the second official forest service in modern times, was founded in the 1860s as a reaction to the over-exploitation of valuable timber and to the threat that posed to state revenues. A century of primary concern for valuable timber has been spent at variance with the needs of an increasingly impoverished peasantry. Trained foresters have a limited knowledge of forest species and crop uses. This contrasts with the considerable knowledge of flora held by villagers, especially the tribal inhabitants of the forested central uplands and the inhabitants of the Himalayan foothills, two groups who lost control over common (forest) lands under British land settlement in the nineteenth century. This led to a situation in which foresters policed the forests against incursions by people largely dependent upon access to the same land. As a result, the vital and relevant knowledge systems of the peasantry lie buried under layers of mutual suspicion and corruption. A new programme, Community Forestry, aims to place peasants in the position of shareholders and managers over forest tracts and to replace the police role of the forester with a professional support role. It is expected that multi-storey forestry, the exploitation, with the help of modern industrial research and processing, of hundreds of plant types, and local value-adding activities will bring high returns to labour and to land: the opposite of the degenerative cycle that has been in operation since the 1860s.

Indigenous knowledge has been held to be inherently mystical and irrational. In recent years a school has developed which regards indigenous knowledge as primarily ‘utilitarian’: in other words, that peasants do not pursue knowledge for its own sake. As Howeg points out, by labelling indigenous knowledge utilitarian it denies it an abstract or intellectual dimension and thereby effectively excludes it from consideration as having potential for independent development and growth. The utilitarian school simply replays the either-or dichotomy between rational and irrational thought with a view that contradicts abstract and intellectual dimensions with simple utility. A way out of the dilemma is provided by Levi-Strauss. He has held that ‘the thirst for objective knowledge is one of the most neglected aspects of the thought of the people we call primitive. Even if it is rarely directed towards facts of the same level as those with which modern science is concerned it implies comparable intellectual application and methods of observation. In both cases the universe is an object of thought at least as much as indeed a means of satisfying needs.

Current understanding of and theorising about knowledge — its source, generation, measurement, quantity or quality — is a Gordian knot that holds philosophers, anthropologists and psychologists among others in a stranglehold. The very complexity of its nurturance, transmission and expression enable cognitive systems to evade attempts by social scientists to confirm or to define them. Research this century, nonetheless, has exploded numerous myths about cognition.

The present context does not allow for a detailed analysis of current views of systems of knowledge held across cultures, classes, provinces... We can but draw upon a number of premises put forward by leading authorities to our affirmation that the individual and communal realisation of

for the benefit of farmers in agricultural development. The premises that follow do help in setting the qualities an agricultural research and extension system should accord in its formal design.

Jean Piaget: Every individual recreates knowledge. Knowledge is reconstructed by each generation. There is no thought that is not tied to activity. There is no thought that does not emanate from interaction between an individual and a community or environment.

Paulo Freire: There is important generative vitality within a community.

Gregory Bateson: Mind is immanent in the larger system—man plus environment.

Karl Popper: Conjecture or hypothesis must come before observation or perception.

All learning is a mediation (it may be a refutation) of prior knowledge.

Lévi-Strauss: Primitive man does seek objective knowledge.

Mao Tsetung: Knowledge originates in perception of the objective, external world through direct human physical experience.

The world can be seen as a series of problems which are the occasion for both theory and action (similar to and influenced by John Dewey, the American pragmatist).

These premises can be summarised, without great injury, as follows:

Thought can be nurtured, especially through exploration and experimentation (activity plus a variety of objects). It requires, however, the possibility for spontaneous activity in the social and physical environment.

The hold that logical positivism has held over science has recently been shaken, noticeably by the work of Karl Popper. Knowledge has no longer to be held to be the monopoly of the central or higher orders of society. Rather knowledge is seen to progress from the willingness of man to forego what Thomas Kuhn called 'normal science', or the dull community to existing theories, and to seek advance by the continual overthrowing of established understanding. In short, that knowledge emanates from the use of broad theories, that is, theories that are general and hence operationally useful but which are also liable to be disproved. It is precisely the willingness to countenance faults which advances knowledge. In operational terms, learning takes place at the periphery of society where theory is tested, found wanting and revised in numerous situations. The approach serves to unleash positive processes of change over relatively short time periods and in finite, identifiable areas of action. Improvements occur by the continual adjustment of mechanisms, procedures and measures as reactions to field experience. Central to the learning and planning process is the acknowledgement of large areas of concern over which individuals and communities must be free to express themselves.

A less remnant philosophy governing the working of science and planning does promise to grant to peasants recognition that they are thinking men with


knowledge and experience. A recognition that modern science and indigenous knowledge systems are indeed both ethno-sciences would help to deflate the rhetorical humbug of "modernisation" theory or its socialist-technocratic equivalent.19

The Organisation of Agricultural Research and Extension

In an ideal society groups of small farmers would employ their own scientists, provide them with facilities and set them field problems upon which to work, recognizing that agricultural research has been and surely will remain a good investment. The mechanics of an extension system governed by small farmers were mirrored in the practical nature of Chinese and Israeli experience. Both countries have made striking progress by adapting basic knowledge to local conditions. In China there is now a need to replenish basic knowledge, a correction China is pursuing with the international agricultural research institutes.20 Israel has adopted an intensely practical research programme aimed at the problems at hand. As a small country, Israel regarded pure research as an activity she could not immediately afford, preferring instead to draw upon the enormous store of knowledge held in other countries.21 In both China and Israel the presence of organised rural communities has provided farmers with a political and an institutional counter to central agencies and with mechanisms for group initiative and action.

Southern Africa is characterised by a dual system of agricultural research and extension with a preponderant philosophy and organisational capacity working in close support of large commercial farming. It is possible today for well endowed and usefully modulated local research institutions to develop politically and financially well supported international and rational research networks at little cost. Joint comparative trials, the exchange of actual arrangements are possible, are sought and should be encouraged. Local research should be characterised by adaptive work, by the identification of field problems, by farm management studies, and by a concern for local knowledge systems. Its hallmark should be its ability to respond to farmer demands and to act as a counter to much of the science practised on behalf of small farmers in distant fields and laboratories.

The organisation of agricultural research and extension should address the tendency, long operative, whereby the agents of extension are translated into scientists who use their so-called scientific knowledge to demand superior status and to maintain their farmer clients in a dependent relationship. This value system, as with colonial administrative attitudes, debases local self-regard and throttles the likelihood of self-help and the generation of new knowledge. As one illustration, Howes and Chambers report that Mali pastoralists "are said to have accepted the dependent status which has been thrust upon them (through and IDA project), and now believe that their major hope of salvation lies with the World Bank'.22

Three correctives to the conventional hierarchical agricultural research and extension system appear to be needed:

1. Small farmers should be organised and equipped so that they can play a governing role over a part of the agricultural research and extension establishment.

ii. Extension and research personnel should be knitted together so that field issues permeate research programmes and absence of responsibility towards farmers can be established.

iii. Government should be removed from responsibility for daily affairs so that it can acquire a more detached, more professional approach to the analysis of obstacles to rural development.

iv. Rural institutions must be allowed to challenge the large body of monopoly practices which exist and which are paraded behind what are in fact inappropriate standards of production, processing and marketing; standards which are themselves at odds with historical and contemporary facts.

The organisation of the Extension Service

The basic principles to be established are:

i. Extension workers are well trained and partake in regular programme planning with fellow workers, senior staff and research scientists;

ii. Extension workers derive their status amongst colleagues and research staff from the fact that they are answerable first to a particular farm community.

iii. Extension workers follow strict routines in terms of field visits so that the farmers and superiors know where they are on any morning or afternoon;

iv. Extension workers operate primarily through a few selected farmers, in each locality each season;

v. Extension workers and the selected farmers receive regular support and training from crop specialists and research scientists.

Figure IV on the following page illustrates the administrative relationships proposed.

Extension workers have to hold minimum qualifications set by government. But they are hired, and can be fired, by the CLCs or the CSOs. The normal development would be joint CSO and CLC selection with hiring by the CLC of one or more extension workers. As the CSO grows, with a number of member CLCs, so the CSO might appoint a senior extension officer to strengthen liaison, training and supervision functions. Accountability is thus clearly to the community. Government must avoid involvement in salaries and service conditions. Personnel reports by the secretary of the hiring body, the CLC or CSO, and by the Regional Agricultural Officer will be completed annually, made available to members of the hiring body and placed for review on the agenda of the respective Regional Advisory Board which would recommend salary increases and promotions to the hiring body.

Each extension worker will work with about eight selected farmers for a whole or a half day once a fortnight, i.e. three to four days a week. Selected farmers will each be chosen by the farmers themselves, all members of a CLC, according to criteria agreed by the District Agricultural Officer and the CSO. This will allow for selection within categories of crop grown, size of farm, labour composition, capital employed etc. Criteria can be altered from season to season, as can the period of selection, to accommodate particular requirements. Normally the period would be for one or two years. On the fifth day, the extension workers will conduct a half day demonstration or training programme, ideally within the operating periodic market (see chapter and spend half a day in the office.)
Some may object that no compulsory proposal is recommended to ensure that communities hire extension workers. Any compulsory move, even though backed by government budgets to GLCs, would include the danger that government would be drawn into questions of emoluments etc. In the system proposed, the joint payment of fixed daily stipends to Selected Farmers plus the planning and training programmes means that there is a strong incentive for communities to join the research and extension network - membership of which begins with the community hire of a suitably qualified extension worker.

Selected Farmers have to agree to act on behalf of their neighbours, primarily by reporting field problems to the extension worker, and to undertake from one to two days per week as part-time workers of the extension service. Selected Farmers' duties include the running and overseeing of demonstration plots on their own and neighbours' fields, attendance at the monthly meeting at the Regional Agricultural Office and at bi-annual short courses. A standard daily wage for Selected Farmers is fixed jointly by local government and the CSOs in the area. Payment is by the GLCs to whom the Selected Farmers belong.

The structure of the extension service is as follows. Each Agricultural Officer would supervise and organise the support for roughly twenty extension workers. That means that each Agricultural Officer handles an extension system that has four levels with forty as the largest factor between levels: 1,208,140 (Officer, extension workers, Selected Farmers, neighbouring farmers) or 6,400 farmers. The present, and hopelessly deficient, norm for developing countries is 8,000 farmers per extension agent. Here the figure for farmers per extension worker is only 320. In fact more favourable than the norm for developed countries which is one extension agent per 400 farmers. Of course, mathematical relationships tell only a part of the story. The point in making the comparison is that the proposed system accepts the premise of high returns and sees itself as capable of generating significant improvements in communication, in the utility of research and, through training and field experience, in human capital and group operational knowledge. Its management is poised about the duality of farmer control of extension workers and Agriculture Dept. supervision of the extension system. The balance is held in check by mutual farmer and Agriculture Department planning of extension goals and programmes and by collegial rather than hierarchical relationships within the professional research and extension structure.

As organised communities of farmers gain experience and confidence, so a fifth level can be interposed: that of a senior extension worker hired by the CSO and acting as a Deputy Agricultural Officer. If one agricultural region comprised of four CSOs, that would give a system composed as follows: 1,440,1840, i.e. with 4 Deputy Agricultural Officers each in charge of 10 extension workers, or one Agricultural Officer per 12,800 farmers. In other words, adjustment in the ratio is possible between levels whilst keeping a favourable ratio of extension agents to farmers. In fact, Selected Farmers and natural leaders of farmer groups should properly be regarded as agents: The system is flexible and no one ratio is sacrosanct. In time, as has happened elsewhere, greater specialist crop interest and reliance upon commercial (fertiliser etc) representatives will alter the role and the intensity of a once symmetrical system.

At the Regional Office, the Agricultural Officer heads a team of subject matter specialists: not all of whom need be full-time members. The team operates as a management group, initially through the mechanism of a one day

monthly meeting of all extension workers and selected farmers in the region. At the same meeting technical staff of the CSOs, senior staff of the Agricultural Department and representatives of agricultural colleges and research institutions should be present to ensure that information, co-ordination and policy purposes are fulfilled. During a part of the same day, short courses to upgrade knowledge or to reinforce field programmes should be conducted.

At other times of the year a similar grouping of personnel would meet to help finalise land use, production planning, community budget exercises and farm plans under the jurisdiction of a CSO or even a CLC.24

The success of extension activities depends on a strong sense of accountability to the client (farmers), and on all participants keeping abreast of field problems, policy options and knowledge. The system proposed goes as far as any system can to secure accountability to farmers and a central focus on field problems. Intensive in-service training and objective evaluation studies can help to realise the latter. Two-week long courses twice a year for all levels of staff should be the policy. Training programmes should be the responsibility of the Agricultural University or College, guided by a Training Committee composed of the Director of Agriculture, the Head of the Extension Service, the University or College principal(s), the Head of the Planning Department, a representative of the CSOs, a representative of the banking sector and, at most, two independent nominees of the government. Selected farmers should attend separate week-long courses. For the last day and a half of the course the extension workers should join to enable analysis and discussion, and to facilitate exercises in evaluation and forward planning.

Extension workers, who operate on their own a great deal, need continuous reinforcement. Regular schedules of work with selected farmers and their neighbours make it possible for the Agricultural Officer and his subject matter specialists to join him in the field on pre-arranged or surprise visits. Each other week, alternating with the longer monthly visit, the extension workers should meet with the regional staff. This in-house meeting, without farmers and members of other institutions, provides extension workers with a chance to update their activities, to check themselves and their methods, and for the whole programme to be scrutinised by professionals enjoying collegial relations. The lodge of extension workers' security and accountability with client farmer groups who hire them, rather than in the hierarchy of the Agriculture Department is important for it helps to achieve collegial relations between largely autonomous professional persons working within one mutually supporting system.

In far too many countries differing entry qualifications and rigid seniority codes in the agricultural extension service have combined to stifle open working so that the only communication is in orders passed down. One result has been that crop production, fertilizer consumption and other fictitious 'targets' have been set by the planners and senior technicians to grad the extension system into life. The fact that farmers alone make such decisions has been ignored. In a target extension system the extension worker has been converted into a false performer. He has pushed technical proposals that he knew his seniors favoured even when that caused him to deny his own and the farmer's knowledge of local conditions and preferences. The converse of the coin was that he concocted reports to his superiors claiming successes in meeting targets laid down all the result of loyalty, born of security and promotion concerns, to a false system.

24. CLC: Community Land Company. A concept of communal land ownership which is explained in detail in a forthcoming book by Dr. Reynolds.
demonstrations arise out of mutual arrangements in which the farmers and their organisations, principally the extension workers, the CLSs and the CSOs, set the goals. The extension system helps to provide initial paper tests of the goals by bringing research and market knowledge to bear and by analysis conducted in open sessions. Once the programmes are adopted, their implementation comprises an open test of the inherent technical production and market hypotheses contained. Until proved otherwise and corrections made, farmers, their organisations and the support system managed by the Agricultural Department can be presumed to be working towards the achievement of common goals. A further strength is that no grand once-for-all or faddish technical or crop preference can be imposed across the land by utopian or despotic officials. Rather, there should be a series of concurrent tests, the results of which hold wholly only in particular localities but the principles of which can be extrapolated and tested elsewhere.

The benefits of a dual-cum-mutual system can be expected to operate at several levels; levels which should emerge in a sequence as confidence and mutual understanding grows. At first, as Richards has observed, 'an idea borrowed from the people, developed by the agronomist and returned to the people, is much more likely to be adopted than something alien to the culture'. That leaves farmers in a passive role and allows the system to continue to deny farmer ability to create knowledge. At that level, as Kusum Nair so eloquently showed, individuality will surface for there is nothing predictable about persons use of resources. Indeed, as argued earlier, farmers do seek objective knowledge and many will be conducting their own experiments.

Farmer knowledge and man's inherent quest for a greater ability to order knowledge can be drawn upon in the early work of CLC formation and the beginnings of agricultural extension assistance. Farmer knowledge of micro-environments can be used in the preparation of soil maps, local groups can be organised into monitoring teams over environmental degradation and as the field personnel of crop reporting systems, and farmers can provide 'useful guidelines to expected productivity in the absence of scientific tests' (as with indigenous milk yields under existing and 'improved management' pastures). All such activities offer savings in terms of time, trained personnel and cost. They also contain elements of local determination, group functioning and of mutual working with professional staff. Chapman has noted that farmers may prove to be comparable or even superior at conceptualising a local problem than scientists.

Because industrialised agricultural systems take time to arise, are beset by cost and environmental questions and hence offer no panacea, 'new' directions in modern agriculture now share many features of the traditional systems that scientists and developers once sought to replace. The mutuality of the system proposed is designed to allow a milieu that facilitates the construction of novelties in agricultural science and in community functioning and use of resources, for it is out of a common search for novel solutions that farmer and scientist will find each other.

30. See next page.
In another sense, novelty and mutual discovery requires the development of a meta-language to bridge farmer and scientist perceptions. Paulo Freire's experiments with the use of semantics and with the determination of generative themes in community life provides a validation of its possibility and utility. That does not mean that no progress can be made without following Freire's procedures closely. Dialogue and farmer control are cornerstones of the system proposed. Attitudes and behaviour inimicable to a dialectic process should be constrained because the relationship of technique to culture and to prior understanding is intended to operate as a communal governor over the system. Nonetheless, Freire's illumination of the requirements for dialogue are valuable and provide useful training material and a basis for concurrent research. The transactions expected in the system proposed are held to be the result of a structure designed for dialogue. A government managed and controlled extension service, as is common in most developing countries, tends to lead to a situation in which employment is regarded as a club for life. Well led and well disciplined, and extension might achieve wonders. However, it is seldom well equipped or trained, victories are too few and personal ends dominate within a wooden concern for conformity and security. Agricultural graduates in too many countries seek, even expect, to be employed as extension staff in the Agriculture Department. Very few ever practice as farmers or as entrepreneurs in crop processing and marketing. Consequently the Agricultural University becomes open to capture by the Agriculture Department simply because the latter is its only client as well as its governmental master. This vicious circle is completed when University staff are appointed almost solely from Departmental ranks, making the research, training and extension systems increasingly inbred and unresponsive to new needs, opportunities or leadership.

In the farmer-controlled government managed system proposed, the choice and governance of staff is split; and the University enjoys client relations with government, as part of a service structure, and with diverse and autonomous communities. The University Board should be able to use the duality of the system to maintain its autonomy and to build up other client relations: organised crop interests as dairy co-operatives, sugar associations, etc., and women's and young farmers' groups.

What is an Optimum Level of Investment in Agricultural Research and Extension?

Knowledge, participation and experience are all factors in economic growth. The agricultural research and extension system proposed is designed to advance each factor and their interplay within and between farmer groups, extension workers and scientists. W.A. Lewis has argued that, 'one of the main deficiencies of underdeveloped countries is their failure to spend adequately upon research and upon the development of new processes and materials appropriate to their circumstances'. He points out that, unlike developed countries where entrepreneurs fund a great deal of research, in under-developed countries the funding of research is largely a prosaic function of government, 'and ought to be one of their major fields of activity'.

In the system proposed, government's role is one of initial fueler and then financial securer of a growing agricultural and extension effort that provides room for community and for crop interests to become major financial

32. W.A. Lewis, 'The Theory of Economic Growth'
33. Ibid.
supporters of research out of their own self-interest. In other words, the decision to push investment above a basic norm set by government up to the point where returns are optimised for each crop and activity is best judged and executed by farmers operating through an increasingly confident and varied institutional setting.

Lewis points out that in the USA expenditure on agricultural research is just under 0.5% of the net value of agricultural output and that in industry in the western world expenditure on research and development is just under 1% of the income generated. Proportional figures between rich and poor countries translate into very different cash amounts. One estimate puts the annual expenditure on agricultural research in rich countries at US $120-150 per farm family and in poor countries at a mere US $21. In southern Africa where structural adjustments and a backlog of research and of extension require to be financed, it would seem that governments could not err on the extravagant side if they set out to create a system that cost at least 0.5% of agricultural output or, whichever is greater, the equivalent of US $30 per peasant farm family.

Allied to the budget for agricultural research and extension, governments should bend their undoubtedly large and growing education budget towards the production of large numbers of well qualified agricultural scientists, technicians and related social scientists. In most countries this largely ignored field appears to be extremely profitable.

The ability of national scientists to draw upon international research is itself partly dependent upon their confidence in their own training and work methods. Foreign training, joint national and foreign graduate programmes aimed at strengthening local institutions, and scientist exchange programmes are important elements. As important is the status accorded agriculture and the countryside within the nation. A bias of prestige school and university level scholarships towards 'agriculture', as the Rockefeller Foundation helped to institute in in Mexico, can be useful; certainly it can produce a leadership sympathetic to the needs of agriculture. Real status will only come when the countryside, suitably organised and financially fueled, develops itself in dialogue with government as the underwriter of change. Investment in the type of agricultural research and extension system proposed can be expected to pay rich dividends in production, in farmer and community knowledge and cohesion, and in the capacity for rural self-renewal.

Figure V completes the progression in correctives used or proposed to alter the uni-directional character of the classic extension model (Figs. I - II). It summarises the relationships between scientists and farmers which have improved the agricultural research and extension system.

34. ibid., p.175.
35. J. Power, op. cit.
It should read together with Figure IV since it is derived from the organisation principles, principles which it in turn informs.

Fig. V. The Proposed Agricultural Extension Model

There is a wide discrepancy between the ratio of extension workers to farmers, proposed, 320, and existing ratios. For instance, in Zimbabwe, the goal is one extension worker per 1 000 peasant farmers; a goal that will take some time to achieve. In southern Africa, the purer commercial farming regions can be expected to carry extension and research costs more directly whilst remaining the object of extension work by fertilizer and other input enterprises. In the remainder of each country, the system proposed provides organised communities with much of the initial finance required upon which to make decisions to hire extension workers and thereby to tap and to influence agricultural research.

The close supervision of extension workers in the field, the demonstrable success sought in the intimate and regular working of extension workers with a few selected farmers, and reinforcement through mutual planning and through training programmes should not be dissolved to accommodate the wishes of communities seeking an inexpensive relationship. The model must be based on the premise that research pays and that costs can increasingly be passed over to communities and farmer organisations. That being so, budget provisions to CLCs under the National Rural Budget should adequately fund communities' initial hire of extension workers to set up the system correctly. This can be done in the expectation that CLCs will be formed over a period of several years so that the demand for official budgetary support will be spread over time and decrease with experience.
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