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Farming systems research and development
Africa, developing countries, sustainable institutions, colonial legacy, post-independence period, green revolution, agricultural research, training and extension, development strategies, sustainable development, development agencies, CGIAR, NARS, World Bank, ISNAR

EICHER, C.K.

Sustainable institutions for African agricultural development.

ISNAR Working Paper No. 19; Int. Service for Nat. Agric. Research, P.O.B. 93375, 2509 AJ, The Hague, Netherlands; 1989, 32 pp.

This paper presents some thoughts on the development of sustainable institutions for African agricultural development. The focus is on strengthening the three core institutions - research, training, and extension - that form the institutional base of African agriculture. Primary attention is devoted to strengthening national agricultural research systems (NARS), and secondary attention, to training and extension.
The performance and sustainability of agricultural institutions is examined over two 30-year periods: the colonial period from 1930 to 1959 and post-independence from 1960 to 1988. This historical assessment raises some longer-term issues to ponder on strengthening African institutions over the coming 30 years, 1990 to 2020. Finally, some of the implications are explored for African states, donors, the CGIAR, and ISNAR.
The thesis of this paper is that after a third of a century of independence, many African states are several generations behind Asia and Latin America in terms of their stage of scientific, political, and institutional maturity. A few countries in Africa are probably one or two centuries behind Latin America and Asia. This is a sensitive topic that was shunned in the 1960s and 1970s and is only slowly starting to be discussed openly.
It is hypothesized that the stage of institutional maturity of individual African states will play a critical role in determining the type, amount, and sequence of foreign aid that can be absorbed with integrity. But most donors normally ignore the stage of institutional maturity of individual African states and prepare a continent-wide strategy to strengthen institutions such as a national agricultural research system or a national extension service.
The stage of institutional maturity of African countries relative to Asia and Latin America is beginning to receive attention from researchers. While much of the comparative scholarship on Africa and Asia centers on drawing insights from Asia's development experience for Africa, there are few studies which deepen the knowledge base.
African family structures and economic and religious attitudes towards fertility severely limit the ability of African states to implement forceful family planning programs.

A recent study of 25 World Bank-financed agricultural development projects in East Asia, Latin America, and Africa points to substantial differences in the sustainability of agricultural projects by continent. Instead of evaluating projects immediately after project completion, the projects implemented between 1969 and 1980 were studied between 1980 and 1984. The surprising finding was that all of the 10 projects in Latin America and Asia were considered economically sustainable, while only two of the 15 projects in Africa were economically sustainable. The findings point to differential sustainability rates between Africa and Latin America and Asia and suggest that projects for Africa may have to be designed differently than those in Asia and Latin America.
This paper is one of ISNAR's working papers.
The ISNAR working papers are intended as flexible instruments for sharing analysis and information about relevant organization and management problems of the agricultural research systems in developing countries.
In the course of its activities - direct assistance to national agricultural research systems, training, and research - ISNAR generates a broad range of information and materials which eventually become the formal products of its publication program.
The series is intended mainly for diffusion of materials produced by ISNAR staff, but it is also available for the publication of documents produced by other institutions, should they wish to take advantage of the opportunity.

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Farming systems research and development
Africa, developing countries, study, sustainable development, institutional framework, planning policy, rural development strategy, monitoring and evaluation, management, marketing, credit, financing, land tenure, rural infrastructure, education and training, local organisations, NGO's

BEMBRIDGE, T.J.

A proposed institutional framework for successful rural development in less developed areas of Southern Africa.

Development Southern Africa, 5, 1988, pp. 23-39

This paper makes suggestions as to how institutions and organisations might function for successful rural development in less developed countries of Southern Africa.
Whatever aspects of institutional change are important for successful rural development, political power will inevitably be a determining issue. A strong national planning and development organisation to facilitate co-ordination between government departments, parastatal and other organisations is essential. Coupled with this is the need for a national policy for action, with supporting services and adequate financial support.
The critical question to be answered is: What form of institutional set-up and organisation is best likely to achieve rural development objectives and how should institutions and organisations be promoted effectively? It would seem that, first of all, there is a need for politicians and their advisory bureaucrats to have a conscious determination to carry out the necessary rural reforms.
A review of the desired institutional and organisational situation against the present situation in Southern Africa leads to the conclusion that the following are the main elements required for successful rural development programmes:
- a national policy and strategy for action for rural development, together with supporting national and regional services and adequate financial support
- a strong national-level planning and development organisations to facilitate co-ordination between departments, parastatal and other organisations
- a decentralised effective administrative organisation at the regional and local level to co-ordinate the activities of departments, the private sector and other organisations operating in the various target areas.
- participation of rural communities in the planning and implementation of rural development projects through village and district level organisations, interest groups and other forms of group organisations
- introduction of rural development projects initially on a small-scale, with the idea of replication on a national scale.

The form of rural development institutions has to be adapted to both the social and economic requirements of rural communities. Organisations and institutions need to be viewed as a dynamic concept involving continuous decision making, planning and evaluation . Success depends primarily upon rapid expansion of opportunities for productive employment both within and outside agriculture, as well as provision of basic needs on a participatory basis.
Government will have to take the responsibility of reaching the poorer rural communities. They have to be committed to providing managerial expertise and delegating authority, and they must be aware of the needs of rural people. To do this, institutions and administration need to be streamlined to provide logistical and technical support and training. In the long term, local development affairs, calling on government departments only when they need them. In the short term, there is a need for outside intervention and support to enable staff to gain experience and self-reliance in managing its own rural development programmes.
Suggestions have been put forward for decentralised, co-ordinated and effective administrative organisations at village, district and regional level, with particular emphasis laid on village-level participation in rural development programmes.
There should be an autonomous institution for the promotion of input supplies and marketing, consistent government financing, rural infrastructure and rural service centres, all of which are essential for successful rural development. It is important that the activities of the private sector be co-ordinated at various levels as part of the national rural development effort. A politically acceptable land tenure code with appropriate legislative and judicial support needs to be built in to a rural development strategy.
It is essential that there be appropriate co-ordination of research and extension through proper institutional mechanisms, so that it becomes an integral part of rural development planning.
The purpose of this paper is to stimulate further dialogue.

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Farming systems research and development
Review, sustainable development, economy, environment, natural resources

PEARCE, D.

An economic perspective on sustainable development.

Journal of SID: Development 1989, 2/3, pp. 17-20

In this paper the author outlines the roles of sustainability in terms of both economic and environmental costs.
Sustainability is the total stock of all forms of wealth that must not be depleted. It is consistent with this view that environmental wealth is depleted as long as that depletion is compensated for by a building up of the other forms of wealth, human and capital wealth.
Sustainable development means getting the accounting systems to reflect, as far as possible, the shadow prices of the environment.
Any economic system that treats environmental systems as free goods will overuse them. Environmental degradation is a symptom of "market failure". Man must invest the proceeds of any resource depreciation to ensure fairness to the future.
But many environmental assets do not have man-made substitutes.
The fact on non-substitutionability should lead to be even more cautious in running down environmental capital.
A further variation on non-substitutionability is that one cannot replace an extinct species. Much environmental capital has the feature of being irreversible: once lost it cannot be regained.
Sustainable development must mean compensating the future for any environmental losses by replacing those losses with similar assets.
The economic implications of sustainable development points to several major steps that need to be taken in practice:
- Changing the national accounting system
There is already a significant amount of effort going into the modification of the way in which one measures economic progress.
Gross National Product (GNP) is misleading in this respect.
Gross National Product (GNP) essentially measures the value of marketed output. It ignores the environment. A more correct measure of GNP would net out the kinds of "defensive" expenditures incurred to combat pollution.
Any environmental damage that occurs should be valued and deducted from GNP.
A feasible alternative is to publish a separate set of resource accounts which show, in non-monetary units, just what is happening to the resources in a given country.
The main change is the need to show how changes in environmental variables are linked to changes in the economy. This at least avoids the error of managing the economy as if economy and environment are unrelated.
- Correcting prices

The prices of natural resources should reflect their full value.
The price of a resource is obviously linked to the cost of its extraction or harvest. The market mechanism will ensure that these costs are reflected in prices. But resource extraction and harvesting can also impose costs on others.
Prices should not just reflect the extraction and harvesting costs, but also the environmental costs.
The lost future benefit from unsustainable management is called a user cost. There must be a user cost involved in all extraction of an exhaustible resource. There is also a user cost attached to the non-sustainable use of a renewable resource.
The rule for the "proper" pricing of natural resources is those prices should reflect extraction costs plus environmental costs plus user costs.
The production of goods and services necessarily uses up environmental services which are treated as if they were free, those prices are not correct prices. The adjustment required is consistent with the "polluter pays principle" - i.e. making the polluter pay for the costs of environmental clean-up or for the environmental damage done by the production of the good in question. This can be done by imposing a charge on the good for its pollution content. The charge will be partly passed on to the consumer in the form of higher prices.
This may seem to be making the consumer rather than the polluter pay. But it is exactly what should happen. The consumer, after all, is the ultimate polluter, he signals to the producer what he wants and should therefore pay the full costs of its production.
- Project appraisal:
Development projects will inevitably degrade some environmental assets even when environmental effects are properly priced. But allowing that degradation is not consistent with holding the stock of environmental assets constant over time. Thus it is necessary to alter the portfolio of investments to ensure that there are offsetting investments in the environment.
Putting sustainable development into practice means altering the way we measure economic progress. It also means altering the way one allocates resources within the economy. The price mechanism is a very powerful allocator of resources because it relies on people acting in their own self-interest.
But "getting prices right" is only part of the story. Monitoring the environment to see how it is changing and investing in the environment to ensure that the stock of environmental assets is not reduced overall is fundamental to achieving sustainable development.
Concluding the author argues that putting sustainable development into practice means finding changing mechanisms for increasing economic progress and resources within the economy.

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Farming systems research and development
Study, accountability, agricultural development, research resources, society goals

NORMAN, D.W.

Accountability: a dilemma in farming systems research.

Culture and Agriculture No. 38, 1989, pp. 2-7

In this article the dilemma of accountability in farming systems research is dealt with.
The author considers three areas in which this dilemma of accountability manifests itself. These areas, which are not mutually exclusive but are separated to simplify discussion, are the following:
- Multiple clients for results of farming systems research.
- Limited availability of resources for research.
- Incorporating societal goals into farming systems research.

Close links exist between credibility and accountability. Where there is credibility, there is accountability. However, the three areas specified above complicate the task of achieving credibility and thus make issue of accountability more significant.
The development, dissemination, and adoption of relevant improved technologies and the development of relevant policy/support programs are obviously two equally important complementary approaches to improving the productivity.
There are four groups of actors who are critically important in contributing to the process of agricultural development. Productive, interactive linkages between planners, researchers (on-station and on-farm), extension and development staff, and farmers are very important. Nevertheless in many developing countries, until recently, the one-way, top-down pattern was most common. The situation in many countries is that the link to the farmer (top-down) is still stronger than that from the farmer (bottom-up).
There are a number of reasons why some of these linkages are fragile. It is apparent that farming systems work can act as a broker in helping to forge linkages among the groups of actors. In other words, it facilitates a process and does not produce a product. Therein lies the problem of accountability as some of the clients (e.g., donor agencies) demand a more tangible outcome.
A growing problem in many developing countries is the lack of adequate resources necessary for conducting research. Consequently, there is a need to maximize return from the allocation of such resources. Discussion of this topic is based on the actors specified earlier: experiment station researchers, extension workers, and farmers.
The primary objective of farming systems research is to improve the well-being of individual farming families by increasing the overall productivity of the farming system. This is done in the context of both private and societal goals, given the constraints

and potentials imposed by the determinants of the existing farming system. There has been much less success in incorporating society goals. The reasons for this are discussed in this paper.
Accountability has been hindered because it is virtually impossible to quantify conclusively the contributions of farming systems research to small farmer development. The following reasons have been cited:
- The complementary nature of station-based research and farming systems research.
- The fact that adoption of technologies depends on a wide range of circumstances, e.g., the performance of support systems.
- The fact that the farming systems approach encompasses both technology change and institutional change, results of which can take 10-25 years to materialize.

Even in the absence of such quantitative benefit-cost ratios, farming systems work is becoming a regular component of research programs in many different countries.
Farming systems research is here to stay, although its viability will depend on the credibility it achieves and the related issue of accountability.

814 91 - 2/112

Farming systems research and development
Review, diversification, small-scale farming, resource allocation, agricultural production, farm outputs, economics, factor relationships, product relationships, price ratios, DSE

ROLA, L.R.

Economics of small-scale diversification farming.

Proc. of the Int. Training Course on Sustainable Agriculture and On-farm Experimentation, SEARCA, Los Baños Laguna, Philippines; 1988, pp. 107-123

This paper aims to provide or review the basic economic principles that are often used in allocating resources in agricultural production, including the determination of the number and type of farm outputs to be produced, i.e., diversified.
The biological and economic dangers of monoculture production have long been recognized by many agricultural development experts and agricultural economists.
Diversification is obviously one of the best alternatives to monoculture production. With diversification, fallbacks are automatically created. It also reduces the risk of the whole farm enterprise as it is spread over different lines of operation, thus minimizing losses in times of crises.
While agricultural diversification offers a lot of economic options and market incentives, implementing an actual diversification program, specially in small-scale operations, is not as easy as it sounds. In a fairly large geographical location, diversification has serious implications on technical support services, farm management, postharvest, processing, production organization, credit, marketing, attitudes of people already used to monoculture production, and other factors associated with producing and marketing several crops instead of one.
On farm level, the objective of agricultural production economics is to aid the farmers in determining the best use of their resources so as to maximize or optimize profits or other ends. On the national level, it aims to bring about the most efficient use of agricultural capital, land, labor, and management resources in a manner that will improve the people's welfare and the national economy.
Production of farm commodities involves three fundamental relationships:
- Factor-product relationships (also called input-output relationships).
  These determine the amount and nature of yield or product forthcoming as various quantities of labor, feed, fertilizer, or other factors of production are used on the farm.
- Factor-factor relationships.
  These determine what proportions different resources or factors of production may be combined in producing a given output.

- Product-product relationships.
  These relationships are closely interrelated and cannot be separated from each other.

The relationships are discussed in this paper.
Parallel to the physical relationships, there are three basic price ratios which the farmer has to take into account when organizing his production:
- The factor-product price ratio determines the optimal level of intensity (i.e., the amount of input per acre, per animal, or per farm that produces the most profitable output).
- The factor-factor price ratio determines the optimal factor combination (i.e., the proportion in which different resources or factors of production should be combined when aiming at minimizing the costs of a given output).
- The product-product price determines the optimal combination of enterprises (i.e., the kind and composition of commodities that should be produced when aiming at maximizing the value of output from given resource).

Examples of the three basic price ratios are dealt with in this paper.
Concluding, the author states that price ratios are the major choice indicators when determining the economic organization of a farm with respect to intensity, factor combination, and combination of enterprises. A subsistence farmer who does not produce for the market has other principles of choice indicators. He may, for example, aim at maximizing food supply for the family with respect to him and the family's labor force. As soon as he enters the market, he has to take prices into consideration. He may then have a blend of choice indicators which are partly related to his subsistence production and partly to production for the market. Farmers' reaction to price incentives is not often understood because of lack of knowledge of the economics of subsistence production.
Even in market-oriented agriculture, farmers' behavior is often misunderstood because prices are considered as absolute data and not in their relationship to each other. This may lead to considerable mistakes when designing an agricultural development project. The projected production pattern (i.e., crop rotation, intensity, and degree of mechanization) will only be followed by the farmers if it is in line with respective price ratios. Usually, there is no absolute best technology, method, or production but only a relatively best one according to the economic conditions.

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Farming systems research and development
Asia, Malaysia, review, economic analysis, on-farm research, on-farm trials, livestock, integrated systems, sheep, cattle, oil palm, Winrock, IDRC

KIM LAI, T.

On-farm research in Malaysia: illustration of economic analysis.

Proc. of On-Farm Animal Research/Extension and its Economic Analysis, Los Baños, Laguna, Philippines, 1987, pp. 86-90

The objectives of this paper are to highlight past on-farm work in Malaysia and to give some illustrations of economic analysis of on-farm livestock.
Malaysian agriculture comprises two major and distinct sectors: the estate or plantation sector and the smallholding sector.
For better acceptance of technologies by farmers, the needs of the decision makers (small farmers, commercial and semicommercial producers, backyard producers) should be identified. A related problem is that the technology developed was oriented to single-commodity farms; therefore, less impact was achieved in the productivity of the multicommodity farms that are prevalent in this country.
This has led to a new approach where the emphasis is on the development of technology that encompasses the total farm - the varied mix of crops and livestock on a given farm or a group of farms.
The Rubber Research Institute of Malaysia has also conducted studies on the integration of livestock, particularly goats and sheep, on rubber plantations. Farming systems research ensures that the design of technology takes into consideration the economic and social values of the farmer.
Farming system research in Malaysia was based on four main production systems: paddy, rubber, coconut, and orchard.
Previous on-farm trials have concentrated on the technical component and neglected the economic aspects of the technology.
A number of analytical tools are available for quantifying the economic benefits of new technologies, ranging from the simpler gross margin analysis to the more complex approaches such as production function analysis, linear programming, and simulation, which require considerable skill and computer support. This paper discusses in detail only the gross margin analysis.
Gross margin analysis consists of identifying and then allocating all income and expenses to the individual enterprises that generated the income and incurred the expenses. The result is similar to an income statement. This analysis can be used for farms with single or multiple enterprises. For farms with multiple enterprises, the common costs (overhead costs) must be allocated among the various enterprises. Gross margin analysis makes it possible to compare the detailed results of different enterprises on one farm. It allows a particular enterprise's results to be

compared with those of other farmers to help find possible technical weaknesses. For the purpose of illustration, gross margin analysis will be used in two scenarios of on-farm livestock trials. The same approach is used to determine the economic returns of cattle fattening under feedlot conditions using cocoa-based rations.
As shown in the illustrations, gross margin analysis can be a useful tool in demonstrating the effectiveness of the technology.

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Farming systems research and development
Study, developing countries, Asia, Africa, Europe, economics of counterpart training, technical cooperation, training effects, GTZ, DSE, BMZ

CARLS, J. et al.

Effects and economics of counterpart training in technical cooperation.

IKO Verlag, Frankfurt ISBN 3-88939-000-5, 1991, 177p + Annex

The Deutsche Gesellschaft für Technische Zusammenarbeit GmbH - GTZ - has recently evaluated five projects with the aim of comparing the costs of counterpart training with the effects achieved in the project, the country and for the counterpart concerned. The study was to ensure that training for counterparts is given due consideration in future project planning. In addition, the study should consider the extent to which training contributes to the sustainability of Technical Cooperation.
The training of counterparts as part of adult education aims to overcome bottlenecks in specialized fields and to achieve defined project purposes.
Reference has been made to five GTZ projects as case studies:
- Vegetable Growing Project in the Algarve, Portugal
- Plant Protection Project in the Philippines
- Plant Protection Project in the Niger
- Forestry Project in Kaghan Valley, Pakistan
- Forestry Project in Korea

Data were collected predominantly on the spot in the projects. The study centres on interviews of counterparts who have received training. The candidates were interviewed in introductory, in depth and final talks.
In detail the following aspects are dealt with in this study:
- Selection criteria for counterpart training
- Share of women in training schemes
- Satisfaction of the counterparts with training
- Increased income after training
- Work situation after training
- Professional situation after training
- Effects of training for the project
- Effects of training for the country
- Economic efficiency of training for counterparts

The majority of the counterparts is satisfied (49 percent) to extremely satisfied (36 percent), and 14 percent are more or less satisfied with training. In all the projects studied, the counterparts felt that training enhanced their status and led to greater responsibility. It extended their competences and increased their independence. In addition to these qualitative criteria, quantitative, measurable indicators, such as higher incomes and promotion were mentioned in connection with training.

In practical project work, these effects are expressed in greater independence and ability to make decisions, greater willingness to cooperate and increasing ability to make constructive criticism.
The effects of counterpart training for the countries mentioned can be summarized as follows:
- The training of counterparts in the **Korean Forestry Project** is classed extremely positively compared with other projects. Training makes a substantial contribution to safeguarding the project's long-term success, particularly because of the wide influence achieved in the country.
- In the **Pakistani Forestry Project** there are considerable administrative difficulties and a shortage of adequately qualified counterparts for training. That is why counterpart training has been limited in the past and there is a considerable shortage of qualified counterparts in some fields.
- Great importance is attached to training in the **Philippine Plant Protection Project.** Practically all the counterparts in the project had received training. The provision of Philippine personnel for training may be described as adequate. Training can therefore be regarded as a successful project component. The uncertain political situation and the reorganization of the project executing agency have had a negative influence. Therefore, restrictions will have to be made to safeguard the project results in the long run.
- The background conditions for the **Plant Protection Project in the Niger** may be described as marginal. The number of staff and the qualifications of counterparts for long-term training was inadequate for several years. Thus, predominantly short-term schemes were conceived for project interests.
- Great attention has been paid to the training of project staff in the **Portuguese Vegetable Growing Project.** Numerous short-term measures have been implemented. The current effect of training is assessed as "good". However, a number of young staff members are employed on limited-term contracts without future prospects. Therefore, the long-term success of the project is only secured to a limited degree.

The determination of the costs and benefit of counterpart training encounters both methodical problems and those of quantification. In addition to these limitations of quantitative analysis, it is important to stress that qualitative effects for counterpart training, such as cultural aspects, etc. cannot be taken into account. The present analysis shows various ways of measuring the benefit of counterpart training.

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Farming systems research and development
Review, proceedings, book, Africa, Asia, developing countries, agricultural extension, policy issues, system practices

RIVERA, W.M. and S. SCHRAM

Agricultural extension world-wide: issues, practices and emerging priorities.

Publ. of Croom Helm, New York, USA, 1987, 304 p., price USD 39.95

This book consists of a collection of papers presented by a number of well-known experts in the field of international agriculture at a colloquium series organized at the Center for International Education at the University of Maryland in 1985-86. The papers are organized into three sections: issues, practices and emerging priorities. Although the coverage is primarily limited to Africa and Asia, the perspectives offered should benefit developing countries in other parts of the world as well.
The point of view articulated through most of the papers is that agricultural extension, though an integral component of agricultural development, must be linked to other factors (supportive policy framework, relevant research, adequate financial support etc.) if it is to make a significant impact on raising the standard of living of people in rural communities.
The first section highlights a number of policy issues that impact on extension. A significant point that comes to the fore in many of the discussions is that the success of extension depends, to a large extent on the overall development strategies pursued by developing countries. If such strategies are not consciously geared to benefit agriculture in general, and agricultural extension in particular, it is hardly likely that extension would achieve much in the long run. Other specific issues discussed include the question of public versus private extension systems, issues of centralized versus decentralized planning strategies, issues relating to appropriate incentives for farmers and agents, and the role of women as agriculturists.
Regarding system practices, a number of varying perspectives on agricultural extension system effectiveness are presented.
In this book, the importance of linkages between extension and other areas of agricultural development is a recurrent theme. Four key factors are identified: an agricultural research network with linkages to extension; credit and input supply systems; farmer incentive structures; and effective use of government staff. The research-extension-farmer link is, of course, critical and a number of mechanisms to achieve this effectively are explored. Other important linkages are also discussed namely, political linkages, system linkages, scientific-technical linkages and the linkage between the agricultural education systems of formal education and pre-service training with the nonformal agricultural extension system.

As might be expected from a collection of edited papers, there is overlap among some papers while, in others, the discussion spans a broad range of topics. There is some variation, too, in the level of comprehensiveness with which the various topics are handled by the authors. However, work done by the editors helps considerably. An introduction provides an overview of the chapters while an epilogue does an excellent job of pulling together the arguments presented by the authors on the various topics and filling in the gaps where necessary.
Overall, though, this volume is quite an important piece of work and it should be required reading for agricultural policy makers as well as serious students of agricultural extension. While field practitioners may find the style a bit difficult, the effort spent in understanding these issues presented will serve them in good stead as they try to unravel some of the problems they encounter in the field.
Abstract by J. Seepersad, shortened

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Farming systems research and development
Africa, Ciskei, Transkei, KwaZulu, study, agricultural extension, efficiency, effectiveness, staff management, organisation, service conditions, farmer attitude, extension aids, in-service training

BEMBRIDGE, T.J.

Agricultural extension in the less developed areas of Southern Africa.

Agric. Adm. & Extension, 27, 1987, pp. 245-265

This paper is based upon empirical data from surveys of the Ciskeian, Transkeian and KwaZulu extension services. Previous extension efforts in Southern Africa are briefly discussed. The main focus of the paper is on the characteristics of extension workers, the effectiveness of the extension organisation and the system of linkages between farmers, research and extension in establishing and perpetuating the flow of knowledge between the various sub-systems. General suggestions are made for improving the research and extension system.
The singular lack of success on the part of extension services in less developed areas of Southern Africa is shown in available agricultural production statistics. Studies of the human potential in less developed areas of Southern Africa suggest that approximately 60 per cent of de facto heads of households are likely to be responsive to extension communication to improve agricultural production.
Although some progress has been made in the development of the rural infrastructure through 'betterment planning', operational policies for agricultural development and credit and marketing facilities are generally lacking. Capital formation is slow, most farming units are non-viable and farming income is derived chiefly from non-farm sources. The land tenure system militates against individual initiative. Various studies show that approximately 40 per cent of the people in rural areas are caught up in the vicious cycle of poverty. There is also clear evidence of a deteriorating agricultural environment. It is against this background that the problems and prospects for agricultural research and extension in the less developed areas of Southern Africa are reviewed.
A postal questionnaire concerning background (extension) information and quantitative communication inputs was sent to all 710 extension staff in the three States studied. Interviews were held with a stratified random sample of 209 (28 per cent) of the various grades of extension workers in each region. These interviews were concerned with assessing qualitative communication inputs, information sources, knowledge, perception, attitudes, aptitude and performance. In addition, 60 field visits were made to a random sample of 83 field officers taken from each Region, with the object of assessing facilities and functional efficiency.
The effectiveness and efficiency of extension services depend on the structure and overall management of the organisation itself,

as well as on the personal, social, socio-psychological and communication characteristics of extension staff.
Findings show that extension services have operated in a haphazard manner, with neither priorities specified nor plans drawn up and implemented. There were considerable deficiencies in the quality of staff, technical support, communication methods, administration and management at all levels. There were deficiencies in levels of technical and extension knowledge and the general morale and status of extension workers leaves much to be desired.
A relatively low percentage, mainly progressive farmers, were contacted by extension workers. Only a small percentage of farmers adopted recommended technology which was not always suited to the needs of farmers. Suggestions are made for improving the situation through development of more appropriate technological packages, greater farmer involvement in extension and research, improved training, management, communication, evaluation procedures and supporting services.
This study has shown that the educational task and function of extension education in the three areas studied has not been fulfilled. The functioning of the classical 'inter-system model' of generation and diffusion of knowledge and interaction between research, extension services and farmers in the less developed areas of Southern Africa has many deficiencies and impediments of which the following are of major importance:
Returns on investment in agricultural extension and research will be great, provided there is political commitment and the extension and agricultural development strategies are well planned, managed and relevant to local conditions.

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Farming systems research and development
Africa, Nigeria, study, evaluation, training management, extension supervision, extension management

ADEKOYA, A.

Management training programme in extension supervision and management in Nigeria.

Trop. Agric. (Trinidad), 67, 1990, pp. 345-349

This paper evaluates the extension supervision and management training programme as offered to agricultural managers, extension managers and cooperative organization managers in Nigeria.
While the purpose of this paper is not to justify or query the amount of loans expended in the establishment of the Agricultural and Rural Management Training Institute (ARMTI), it does propose to evaluate the extension supervision and management training programme as offered to agricultural managers, extension personnel and cooperative organization managers by the Institute. Effort is to be made to evaluate the content and effectiveness of the training programme using the educational impact model. This model proposes that when participants at a course use the materials learned in the training sessions for solving practical problems, they are demonstrating that their training has had the highest impact.
The desire to improve productivity on Nigerian farms has culminated in the establishment of an Agriculture and Rural Management Training Institute in Ilorin, Nigeria.
Programmes of the institute will be devoted to the managerial training of personnel in the upper levels of supervision and management of agricultural enterprises, with major attention given to the needs of experienced managers rather than the inexperienced.
The purpose of management training in agriculture is three-fold: (1) to provide vital tools for analysing management practices that may be beneficial to increased productivity on the farms; (2) to make it possible for farmers, farm managers and extension personnel to gain specialized familiarity with management styles in business that will benefit agribusiness in general; and (3) to develop a new calibre of managers who are knowledgeable in the art of planning, controlling, activating, evaluating and monitoring of agricultural development projects.
The management training programme in extension supervision and management can be considered a success, in view of its popularity among extension personnel and cooperative managers in Nigeria. Further, the growing number of participants at the course 1-yearly is a plus for the Institute's faculty and administration members. In addition, the general conclusion of this evaluation is that the programme has helped to develop professionalism among farm managers, extension training personnel and agricultural development project coordinators. The immediate and long-range

benefits of the programme far outweigh the limitations. By providing an opportunity for the in-serve training of extension supervisors and managers at the various agricultural development projects and programmes, the programme continues to be a source of manpower development for continued service and increased performance. Through the training programmes, many participants have acquired supervisory and managerial skills essential for carrying out other responsibilities within their organization.

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Farming systems research and development
Review, book, tropics, sustainable agriculture, agricultural development, natural resources, agronomic practices, socio-cultural aspects, socio-economics, cropping systems

BEETS, W.C.

Raising and sustaining productivity of smallholder farming systems in the tropics.

AgBé-Publishing, P.O.B. 9125, 1800 G.C. Alkmaar, Netherlands, ISBN 974 85676 13, 1990, 729 p.

This book is the result of 22 years of fieldwork, and eight years of formulation.
The book, which follows a multidisciplinary approach, advocates constant consideration of the farmer's point of view and development within existing systems, rather than a wide-spread adoption of western-style systems which depend heavily on non-renewable energy, good infrastructure and institutions. Another philosophy guiding this work is that self-sufficiency and reliance are preferred to dependence on external inputs.
The author gives a comprehensive and up-to-date survey of the factors that play a role in increasing the productivity of tropical farming systems. It gives guidance on how to cope with present problems and future difficulties which may arise from the adoption of new technologies.
The author gives specific regional examples in addition to his general models, and explores the relationship between man and his environment, between economic and technical aspects, and between short-term and long-term considerations. He draws heavily on project experience in Africa and Asia and compares this with conditions in other tropical countries.
The book mainly deals with farming systems dominated by annual food crops. Grazing systems are mentioned, but only when they involve smallholders, or when the animal husbandry activities are fully integrated into food crop activities. Considering the importance of draught animals in many crop-based systems, some attention is paid to the husbandry of such animals, particularly fodder and grazing aspects.
The book is organized in two parts (A + B).
Part A, which constitutes the background and framework for the subject, consists of five Chapters. Chapter 1 introduces the subject and also summarizes the book. The other four chapters of part A deal with the various components of the systems and other matters related to farming systems and their development. The subjects are grouped into technical and socio-economic aspects. Chapter 3 discusses the history and recent development of farming systems.
Part B forms the core of the book. It starts with a description of the seven farming systems selected (Chapter 6). The discussion is largely descriptive and in some parts there is an historical

approach. Chapter 7 follows the same approach in discussing 23 groups of ways and means to raise or sustain productivity, or interventions in the development process. In Chapter 6 and 7 change and development aspects are discussed.
The three Chapters of Part B relate to the background and framework given in Part A.
Finally, major farming systems concepts and technical terms are defined in appendixes.
The purpose of this book is to provide a coherent conceptful framework that will help professionals of different backgrounds in their work.
The overall objective is to give an up-to-date, comprehensive review of all factors that play a role in raising the productivity of tropical farming systems.
This publication will be useful to all those involved in agricultural development, to students, research workers and professionals, and to government officials at every level of policy making and implementation.
The book is easily read and is appropriate for practitioners and scientific audiences. All chapters are well documented and the conclusions drawn are verified by the text, graphs and tables.
The book is therefore highly recommended for all interested and engaged in Third World activities in general and farming systems in special.

821 91 - 2/119

Farming systems research and development
Review, North America, Europe, sustainable agriculture, soil improvement, fertilization, crop rotation, appropriate tillage, stock rating, disease and pest control, economic aspects, marketing, labour requirements, financial implications

MACRAE, R.J. et al.

Farm-scale agronomic and economic conversion from conventional to sustainable agriculture.

Academic Press Inc., Quebec, Canada; Ecological Agriculture Projects Research Paper No. 9, 1989

Sustainable agriculture is receiving increasing attention in North America and Europe because of four main factors: increasing concern about degradation of the agricultural resource base, low commodity prices that have sent many producers looking for low-input alternatives to cut costs, consumer concern for food quality, and a perception that the quality of rural life is deteriorating.
The authors state that of particular importance is working with natural soil processes. Sustainable agriculture systems are designed to use existing soil nutrient and water cycles, and naturally occurring energy flows for food production. Moreover, such systems aim to produce food that is both nutritious and without products that harm human health. In practice, such systems have tended to avoid the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives, instead relying upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, and mineral-bearing rocks to maintain soil fertility and productivity, and on natural biological and cultural controls for insects, weeds, and other pests.
Approaches, philosophies and strategies of sustainable agriculture are discussed in detail in this paper.
Furthermore the following aspects are dealt with:
- Length of the conversion period
- Key elements in developing and action plan
  . Soil improvement
  . Organic matter management
  . Supplemental fertilization
  . Manure and slurry management
  . Crop rotation
  . Appropriate tillage
- Agronomic changes
  . Stocking rate adjustments
- Economic considerations
  . Marketing possibilities
  . Labor requirements
  . Yield projections and financial implications

- Conversion without animals
- Implications of widespread conversion

The authors conclude that recent research results confirm what experienced farmers have been saying for some time: conversion from conventional to sustainable production practices is possible in a reasonably short period of time. Financial risks can be minimized if the converting farmer plans ahead, identifies markets for products, converts the farm in stages, and gradually cuts expenditures on off-farm inputs. Developing cropping systems that balance the financial and biological needs of the farm will also reduce the chances of farm failure.
Although the general principles of conversion are reasonably clear, there remain many gaps knowledge. In many regions, there are still few farmers who have experienced a conversion and few researchers interested in the process.
These information gaps should not discourage farmers from making the transition, except for those already in severe financial difficulty. Although some have failed in their attempts to convert, many have done so successfully, without great hardship, and have few doubts about the wisdom of their decision. They have found the benefits of converting to go far beyond the purely economic. Their skills and their appreciation of their environment have been enhanced; the health of their soil, animals, and families has improved; and many have a peace of mind that was absent when producing conventionally.

822 91 - 2/120

Farming systems research and development
Asia, Syria, mixed farming, farm classification, farming systems analysis, economic impact analysis, GTZ, ICARDA

MÄRZ, U.

Farm classification and impact analysis of mixed farming systems in Northern Syria.

Wissenschaftsverlag Vauk, Kiel, F.R.G., Farming Systems and Resource Economics in the Tropics Vol. 7, ISBN 3-8175-0060-2, 1990, 194 pp. + Annexes

This research was carried out in cooperation with on-going studies on "intensification of small ruminant production in rainfed cropping systems" of the Farm Resource Management Program and the Pasture, Forage and Livestock Program, at the International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo.
In order to investigate the impact of improved techniques on the economic performance and organisation of small farms in the Breda-Bueda study area, a two step approach was chosen. First a multivariate characterisation and analysis of farms from the Breda-Bueda area was carried out. Using market data and experimental results, stochastic programming models were set up for specific farm types. These models were used to analyse the impact of the tested improved techniques on the farm income, the farm organisation and stability. This approach allows the selection of those improved strategies which show the highest development potential for a specific farm class, the highest expected farm income by minimising the variability of it.
The cluster analysis, carried out on the basis of 18 weekly correlated but highly variable farm characteristics and using the cosine similarity index together with the average linkage agglomeration procedure, produced five distinct farm classes. The five farm classes are of unequal size and farm class 1 accounts for about 27%, farm class 2 for about 34%, farm class 3 for about 4%, farm class 4 for about 22% and farm class 5 for about 12% of the total farm population. These farm classes are significantly different at the 90% level, in many farm and farm management characteristics. Farm class 1 can be characterised as an extensive farming system with strong market orientation; farm class 5 as an intensive farming system with a strong subsistence orientation, farm classes 2 and 4 as the transition stages from farm classes 1 to 5. Farm class 3 summarises irrigation farms.
The following conclusions have been drawn:

The existing farming systems in the study area are characterised by a low but highly stable farm income, so that the risk of falling below the subsistence level is marginal.
However the development potential is very low. The introduction of any of the tested improved techniques does not seem to be

appropriate for improving farm types with continuous barley system. Research in that field should therefore be stopped.
Minor improved techniques, like the intensification of the feeding regime of pregnant ewes do not influence the farm income nor the organisation significantly. Research in that field should not be given a high priority.
In most cases, the main effect of applying fertilizer to barley is an increase in the variation of the farm income. It is, however, not clear whether fertilizer applications lead to a higher income or not; possibly due to the unreliable empirical estimates of the barley yields and their variability. Fertilizer trials should be continued for a few more years at a low priority level as on-farm trials in the study area, with some randomly selected farms of the barley-fallow and the barley/wheat-fallow cropping system.
Major effects on the farm income as well as on the farm organisation can be expected due to the introduction of a legume crop which replaces the fallow. The data base for analysing the impact of the introduction of a legume crop on a specific farm type's organisation is weak and was replaced in the models by assumptions. Research in the field of cropping systems based on forages should be continued at a high priority level as on-farm trials in order to fill major information gaps, to modify the presented models and to work out extension packages.
Author's summary, shortened.

823 91 - 2 /121

Farming systems research and development
Review, book, sustainable agriculture, external inputs, ecology, economy, soil erosion, water pollution, desertification, integrated systems, agricultural policy

EDWARDS, C.A. et al.

Sustainable agricultural systems.

Publ. of Soil and Water Conservation Society, 7515 Northeast Ankeny Road, Ankeny, Iowa 50021-9764, USA; ISBN 0-935734-21-X, price USD 40.00 plus postage

The sustainability of modern agricultural systems has become a topic of concern among farmers, researchers, and policy makers worldwide. A great deal of agriculture today depends on high inputs of commercial fertilizers and pesticides. While such practices have undoubtedly increased productivity and efficiency, the resulting long-term ecological and economic impact is cause for worry.
Severe soil erosion is common in some regions of the world, as is water pollution, desertification and threats to human health. There is an urgent need for research and education on farming systems that can increase productivity and profits without having adverse effects on the environment and ultimately on our future survival.
This book takes a look at how the adoption of sustainable farming methods is being pursued in many parts of the world and provides insights into research and education needs. It covers the history of sustainable agriculture, practical applications, the importance of integrative farming methods, the use of sustainable agricultural systems in the tropics, ecological impacts, and current developments in the area of policy and regulation.
Abstract by Sidney B. Westley

824 91 - 2/122

Farming systems research and development
Review, agricultural research, sustainable development, integrated framework, agricultural production, economics, ecology, institutions, research stages, CIP, IIED, SIDA

RHOADES, R.E.

Evolution of agricultural research and development since 1950: toward an integrated framework.

Gatekeeper Series No. SA 12; IIED, 3 Endsleigh Street, London WC1H ODD, UK, 1989, 19 p.

The purpose of this article is to take a broader historical view of shifting emphasis in agricultural research and development since the 1950s.
The recent shift away from Farming Systems Research (FSR) should be seen in this context. Only ten years ago, proponents of FSR were criticising its predecessors in much the same way that FSR is being criticised today.
Objectivity is quickly lost in such push and pull debates and the long-term view is clouded.
In agricultural research, there is a move toward a more comprehensive view of the complex problems at hand, with each stage absorbing and synthesising valuable new insights. Beginning with the events of the 1950s and the Green Revolution of the late 1960s, the author traces changes down to the newest emphasis on sustainability, and then project into the near future.
Developing country farmers are a central element throughout this process and the paper focusses on how they are perceived by the scientific and development community over time.
Four overlapping stages of awareness and perception of problems can be identified:
- production stage (1950-1975)
- economic stage (1975-1985)
- ecological stage (1985-1995) and
- institutional stage (1995-).

Each period is characterised by different goals and mix of disciplines, and each period leaves its mark and legacy on the period that emerges later.
Each stage has been characterised as well by its own popular movement: the production stage by the famous Green Revolution, the economic stage by Farming Systems Research, today by Sustainability and tomorrow by institutional effectiveness. Likewise, at each stage new blood in terms of disciplines is added to the research and development process. The evolution of a broader interdisciplinary perspective has occurred with the result that the understanding of agriculture and food has become deeper. Historically, farmers have always had to cope with these four forces while surviving on the land. Researchers, donors, and policy makers, however, are only now beginning to understand the complexity of micro-macro linkages in Third World agriculture.

The author concludes that the risk in addressing too many issues is that scientists in the International Agricultural Research Centers and national programmes become too diffused to be effective. However, if one keeps in mind the four threads in setting research agendas, formulating policy, and determining funding priorities, a balanced approach to agricultural R&D can be achieved. In rough sketches, this evolution reflects the sequential development of the sciences, beginning with biology and ending with sociology. These four stages or dimensions of agricultural research are elements of a single whole, not mutually exclusive parts, and the fact that the whole is more than the sum of the parts is a major reason for interdisciplinary research. Production and the role of plant and animal scientists are no less important today than they were in 1965. Economics is just as important as it was in 1975, if not more so. The same can be said of other disciplines added along the way. Our tendency to write off the efforts and impacts of disciplines other than our favoured ones serves no purpose except to aggrandise the importance of one's own area of interest. It is easy to be critical of plant breeding or conventional agricultural economics, but in fact today's young agricultural scientists stand on their shoulders, looking toward the future. Research and project managers must be careful that institutions and individuals do not become frozen in any stage, e.g. production or economics, refusing to become open to the enriching process of interdisciplinarity. The interdisciplinarity table has become crowded, almost to the point of being unmanageable, but at the same time the understanding of agricultural R&D is moving beyond expecting simple solutions for inherently complex problems.

III INTEGRATED SYSTEMS

825 91 - 3/88

Integrated systems
Review, developing countries, sustainable development, integrated approach, development constraints, environment, politics, economics, institutions, technology, organizations, participation, natural resource base, management strategies, NGO's, DESFIL, USAID

GOW, D.

Beyond the project: the quest for sustainability in the Third World.

DESFIL Working Paper in association with Earth Satellite Corporation, Washington D.C., USA, 1988, 29 p. + bibliography

The use of the word "integrated" in conventional development circles has been taboo for some time, principally because of its close association with integrated rural development (IRD), the dominant paradigm in rural development in the 1970s. Under IRD, a project area was defined by its physical environment, such as the limits of a watershed, by the degree of homogeneity of its productive systems, by its administrative or political boundaries, or by some combination of these. This definition was characterized by its emphasis on the interrelatedness and complementarity of the various project components - social, economic, and infrastructural.
But IRD fell into disrepute because it failed to deliver what it had promised. Several reasons have been given, such as the technical-fix syndrome referred to earlier, a lack of coordination among collaborating institutions, and the inherent conservative bias of such an approach.
But what is missing is, first, an admission of the complexity of the problems faced and the strategy proposed and, second, any realization of the time factor involved, or acceptance that development - integrated, regional, sustainable, or whatever - is a continuous process that evolves in the course of several decades. No one now really questions the need for a multifaceted approach that will integrate several important components, involving several disciplines from both the social and the natural sciences.
A recent review of the experience of US AID with IRD makes a clear distinction between integrated rural development as a strategy and the ways in which the strategy is implemented. One alternative is to implement a large, comprehensive, multisectorial project that proves difficult to manage and encounters insurmountable coordination problems. The second alternative is to design single-activity projects that are independently managed and require minimal coordination. They are planned as components of an overall rural development strategy that are intended to be basic ingredients of a continuing program. In a recent review of World

Bank experience in Latin America, a similar conclusion is reached, recommending an umbrella program covering a large number of smaller, independent projects as a better approach.
There are different definitions of the term "sustainable development".
There are various schools of thought. The first regards sustainability as food sufficiency: agriculture, guided by conventional cost-benefit analysis, is primarily an instrument for feeding the world.
Sustaining the natural resource base is secondary. If the introduction of new technology intensifies erosion of the soil, the price in lost fertility and loss of soil may be compensated for by increased yields. This is strictly a short-term view.
A second school regards agricultural sustainability as primarily an ecological question. An agricultural system that depletes, pollutes, or disrupts the ecological balance of natural resource systems needlessly cannot be sustained and should be replaced by one that is adapted to the long-term biophysical constraints. A critical measure of agricultural sustainability is the capacity of renewable agricultural resources, such as arable lands, pastures, and forests, for sustained yield. Instead of taking population as a given, this school tends to espouse policies that limit population to levels that can be sustained by a finite physical environment.
Closely related to this stewardship school is agroecology, which, like sustainability, has come to mean many things.
The word loosely incorporates ideas about an environmentally and socially sensitive approach to agriculture, which is focused not only on production, but also on the ecological sustainability of the production system. It has roots in the agricultural sciences, in the environmental movement, in ecology, and in the ecological analysis of indigenous farming systems.
Development includes a long-term concern for the future, and the principal objective of development initiatives should be to generate self-sustaining improvements in human capability and well-being. But closely allied are the following development objectives, which give sustainability a more human, potentially more durable:

- **Capacity.** This has both micro and macro aspects, which involve changes in the individual, the community, and the nation - to include the capacity to develop political and social institutions that will be responsible for production and allocation of resources.
- **Equity.** On the one hand. Long-term economic development is stimulated by increasing the human resources of a country and by equalizing the ability to consume. On the other, to ensure greater equality in access and benefits is of value in itself.
- **Empowerment.** If powerlessness is to be addressed directly, then the poor must have some political leverage in order to correct grossly unfair decisions regarding the allocation of development resources and distribution of the ensuing benefits.

But however sustainable development is defined, two interrelated issues, energy and population, must be taken into consideration in this context.

The primary constraints that inhibit the achievement of sustainable development can be grouped into the following five categories:

- Political, economic, and financial factors;
- Environmental and natural resource factors;
- Technological factors;
- Institutional factors; and
- Organizational factors.

Concluding, the author of this paper states that there is a body of knowledge that can help the Third World and the development community work toward sustainable development and to arrive at some common understanding of what we mean by sustainable development, of what the principal constraints are, and of ways in which they can be overcome. Equally important, are the political will and the personal commitment to act on this knowledge.

826 91 - 3/89

Integrated systems
Review, sustainable agriculture, soil quality, ecological efficiency, agroecosystem stability, diversity, development criteria, research education, agricultural development policies, international programs, WRI

DOVER M.J. and L.M. TALBOT

An action plan for sustainable agriculture.

In: To Feed the Earth: Agroecology for Sustainable Development; World Resources Institute, Washington D.C., 1987, pp. 61-71

In this paper the concepts of sustainable agriculture and a general strategy are discussed.
The time has come for a global assessment of agriculture's sustainability. Clearly the issues are different in developed and developing countries, and they also differ among areas within those two groups. But the unifying element is the set of ecological concepts discussed here. A region-by-region "agroecological audit" should be conducted, covering energy efficiency, soil conservation and regeneration, nutrient sources and uses, preservation of genetic diversity, stability of yields, water use and hydrology, off-farm contamination, effects on natural areas, and similar topics.
For detailed assessments of farming practices and resources, the International Agricultural Research Centers that have already begun programs in farming systems research and related studies could contribute significantly.
The agroecological audit would see how countries and regions really can provide food on a sustained basis relying principally on indigenous resources for fertility and pest management.
The purpose of the audit would be to identify principal problem areas by region, in terms of both productivity and sustainability, and to provide a basis for developing coordinated, comprehensive research programs and policy changes to meet those needs. The audit could be duplicated at the national level, either in concert with or following upon the global assessment. Bilateral and multilateral assistance organizations should provide funds for these national audits to be carried out. In this way, the resources, constraints, and problems of agriculture can be addressed systematically, incorporating both production and environmental considerations in one integrated program. Without such an overall assessment, it may be difficult to convince decision-makers of the need for research and development in sustainable agriculture.
To assure that ecological principles are followed in agricultural development, assistance organizations need to establish measurable criteria for judging proposed projects. The conditions for sustainable agriculture are discussed on a set of criteria:
- Replenishment of soil nutrients removed by crops;
- Maintenance of the soil's physical condition;

- Constant or increasing humus level in the soil;
- No build up of weeds, pests, or diseases;
- No increase in soil acidity or toxic elements;
- Control of soil erosion;
- Minimization of off-farm contamination of the environment;
- Maintenance of adequate habitat for wildlife; and
- Conservation of genetic resources.

Project proposals should be required to show how these criteria will be met. If a project requires purchasing such inputs as fertilizers and pesticides, means for minimizing their environmental effects should be spelled out. Assessments of the reliability of supply and stability of agrochemical prices should be conducted prior to funding. How indigenous resources can be substituted for imported industrial inputs should be explicitly considered. Proposals should also be detailed as to how the project will be monitored to make sure that the above criteria are being met and should include a budget for conducting the monitoring.
As research and development progress in both high-input and low-input agriculture, comparative studies of the various agroecosystem designs should be carried out to determine their strengths and short-comings vis-à-vis long-term productivity and sustainability. The research must be conducted under many environmental and sociological settings where the new agroecosystem design are likely to be implemented, including productive lowland areas and marginally productive upland regions.
Detailed knowledge of the specific characteristics of the farm site is essential to effective system design and management. Understanding local needs and demand for products can lead to crop mixes that assure marketability throughout the year. And experience with variations in labour supply and demand can contribute to farm systems that provide employment and avoid labour shortfalls at critical periods.
Environmental considerations should also be included in the basic macroeconomic analyses and planning operations of the development-assistance agencies.
With continuing population increases and rising food demand, an ecological approach can begin to redress the environmental deterioration that both industrial agriculture and misplaced traditional agriculture have brought about.
Policy-makers must be willing to take hold of the ecological approach and make it heir own.
A new appreciation of natural systems' ability to utilize their environments efficiently and in equilibrium with available resources is needed.

91 - 3/90

827

Integrated systems
Review, sustainable agriculture, agricultural systems, concepts, definitions

GENG, S. et al.

Sustainable agricultural systems: concepts and definitions.

J. Agronomy & Crop Science, 165, 1990, pp. 73-85

In this paper the authors attempt to generate some discussion of concepts and definitions of sustainable agriculture and also present some arguments for setting priorities in research.
The specific objectives of this paper are to present the public's changing perspective about agricultural systems and to define some useful terminology to describe agricultural systems, to give a definition of sustainable agriculture, and to present some important research issues for developing sustainable agricultural systems, and to suggest the priorities of certain research areas.
Many definitions have been attempted of the term sustainable agriculture and related terms such as "organic farming," "low-input farming," and "alternative agriculture." With the recent growth in research and education in this area, a clearer understanding of both the concepts and the research priorities is critical to scientific progress.
In part, the disagreement on definitions and priorities is a function of the concept, because part of the purpose of research and inquiry is to find out what agricultural practices are sustainable for the long term. While many people agree that practices that have less adverse environmental impact are probably more sustainable, it is not immediately clear that all organic or reduced-input practices necessarily fall in this category, or that those that do are all profitable enough to ensure economic sustainability.
Inputs of an agricultural system are classified as components and activities. A component is either a resource or a technology. The activities are the management of resources and the application of technology in the production process. The outputs of a production process will include both the targeted product and the environmental impact. When these terms are used to describe an agricultural system graphically, the dynamic aspects of the system can easily be illustrated and problems associated with the system can be properly identified. Sustainable agriculture is recognized as conveying certain objectives or delineating certain requirements of an agricultural system, in terms of both the input and output of the system.
These objectives are:
- producing necessary quantity of high quality food and fiber;
- profitable to the grower;
- conserving nonrenewable resources; and
- harmonious with biological; physical and social environments.

These objectives have long-term implications and attempt to secure the future viability of agriculture. Therefore they embrace the concept of sustainability. The difficultly of constructing such a system is that not all the objectives are compatible; compromise or trade-offs among the objectives are often necessary in developing a workable sustainable system. Progress and improvement can always be made through research, but no perfect system can realistically be constructed. General research issues in sustainable agriculture are discussed. Priorities in developing appropriate technology based on sound biological principles and laws of physics and mechanics for pest and weed control are suggested.

91 - 3/91

828

Integrated systems
Review, developing countries, livestock, production strategies, economics, environment

PRESTON, T.R.

Future strategies for livestock production in tropical Third World countries.

AMBIO, 19, 1990, pp. 390-393

The last five years have witnessed a marked change in the economic and political pressures to which livestock production is subjected.
Farming systems throughout the world are threatened by the increasing prices of fossil fuels (and the agrochemicals derived from them) due to decreasing reserves and political instability in the principal supplying countries; and the concern over the increasing atmospheric and terrestrial contamination, much of which can be traced to agricultural activities. There is increasing advocacy for free markets in agricultural products, greater discrimination by consumers, and mounting concern for animal welfare. The conduct of livestock production and the role of food products of animal origin have been influenced profoundly by these changes. As a consequence, livestock production strategies are changing and will continue to change in response to these pressures.
Foreign exchange shortages present an opportunity for developing new production systems using local resources which are less dependent on fossil-fuel derived inputs. Environmental pressures will force a decreasing role for fossil fuel and an increasing reliance on renewable biomass. Concern for animal welfare and natural food quality is leading to deintensification of production systems and incentives for organic agriculture. Tropical regions are in a strong position to take advantage of these changes, being richly endowed with natural resources in the form of solar energy, soil and water, and biological diversity. Correctly harnessed, these resources can form the basis of production systems which will confer a real competitive advantage to livestock production in these regions. An example of this latter approach is presented, designed specifically for tropical zones, the widespread adoption of which will help to close the production-utilization gap for carbon dioxide with a more than tenfold reduction in emission of methane per unit meat production, compared with traditional tropical systems based exclusively on cattle ranching. Such technologies are sustainable and especially appropriate for use on small-scale family farms in tropical regions. They create innovative research possibilities for use of nonconventional feed and animal resources.
In the present context, sustainable means that: natural ecosystems are enhanced rather than threatened; rural-based social structures are strengthened rather than fragmented; local resources are

preferred and there is minimal dependence on inputs not produced directly on the farm; production techniques are increasingly directed to the reduction of stress at both animal and human level.
Research against this background may appear far removed from what is currently being published in the scientific journals in the industrialized countries, although already there are signs of impending change. What should be recognized is that research into sustainable systems is a unique opportunity for scientists in developing countries to establish their own priorities, to study new and different resources, and in so doing to set the groundwork for a future competitive advantage rather than the present dependency.