

1060

92 - 2/144

Farming systems research and development
Review, book, projects, people, participation, experience, key
elements, development, ILO

OAKLEY, P.

**PROJECTS WITH PEOPLE: THE PRACTICE OF PARTICIPATION IN RURAL
DEVELOPMENT.**

Publ. of the Intern. Labour Office (ILO), CH-1211 Geneva 22,
Switzerland; ISBN 92-2-107282-7, 284 pp., paperback, 32.50 Swiss
francs

Experience - as the author points out - has shown the importance
of involving rural people in decisions concerning their own
development. His book presents a convincing case for encouraging
participative processes, not as a manageable element of a project,
but as the fundamental dynamic of the project itself. He stresses
that participatory development must be consciously based on
people, their needs, their analysis of issues and their decisions.
It must trust that people, whatever the condition of their poverty
and oppression, can progressively transform their environment with
the help of, but not dominated by, external agents.

The author provides us with descriptions of some experiences in
participative efforts which show - in his judgement - successes
and failures, but also different concepts of the nature of
participation, and the gap between participation as an objective
and its actual implementation. Although he also provides useful
insights into key elements concerning the practice of
participation, and suggests possible methods and activities, he
fails to address this gap directly.

Participation of rural people in development projects is not a
smooth simple process where people speak freely and honestly about
their problems and the alternatives they visualise, where
decisions are taken regardless of local problems, of loyalties,
differences and silences. Conflicts are an everyday issue, and
they help forge the process in a more "participative" but messy
way. This means that one cannot speak naively of "the village" or
"the rural poor", as if they were a homogeneous category, as the
author often slips into doing.

The author assumes that by incorporating the felt needs of the
people, by encouraging their participation, these projects will be
incorporate. However, this is not an automatic process. One
wonders why participation is hardly ever conceptualised the other
way around: to include the participation of the outsider in the
projects of the local people.

Abstract by M.V. Martinez, shortened.

1061

92 - 2/145

Farming systems research and development
Review, book, Latin America, agriculture, technological
innovations, debt crisis, public sector, research, private sector,
biotechnological revolution, IICA

JANVRY, A. DE et al.

TECHNOLOGICAL INNOVATIONS IN LATIN AMERICAN AGRICULTURE.

Program Papers Series No. 4 of the Inter-American Institute for
Coop. on Agriculture (IICA), San José, Costa Rica; ISSN 0046-0028;
1987, 86 pp + appendices

This paper discusses some of the issues in the field of
biotechnology within the context of the debt crisis in Latin
America and its effects on the region's agricultural sectors. In
analyzing the issues, the authors highlight their effects on the
behaviour of the region's technological systems. More important,
they also point out their implications in terms of the
agricultural technology policy options open to Latin American
countries at this time.

This report is written to identify a feasible strategy that
attributes to agriculture a key role in the reactivation of the
Latin American economies and, to technical change, a key role as
an important source of growth and of dynamic comparative
advantages.

The paper is organized as follows:

- Technological discontinuities: Adjustment to the crisis and
biotechnology
- Latin American agriculture in the context of the debt crisis
- Technological change in Latin American agriculture
- Public sector research
- Role and performance of the private sector
- The biotechnological revolution
- Implications for agricultural technology in Latin America

In more detail the paper starts by reviewing in Part 2 the
implications of the debt crisis for Latin American agriculture,
most particularly for market prices and government expenditures.
The authors then analyze in Part 3 the past patterns of the rate
and bias of technological change, contrasting the periods before
and since the beginning of the debt crisis. In Part 4, they look
at the organization of public sector research and how it has been
affected by the crisis. Part 5 is devoted to the role of several
agents in the private sector in the generation, transfer, and
diffusion of technological change. This includes input suppliers
on the side of backward linkages, agroindustries on the side of
forward linkages, and producers' associations. Finally, in Part 6
the authors identify several major features of the biotechnology
revolution and discuss how they create both opportunities for and
threats to Latin American agriculture. Finally the paper concludes
in Part 7 with a number of important policy implications.

Concluding, there is little question that biotechnology will transform agriculture in the next 30 years.

Because biotechnology will speed up the technological treadmill, increase production, and put downward pressure on prices, peasants will become increasingly marginal producers without assistance.

Biotechnology will not solve the social problems of Latin American agriculture; unless considerable effort is given to mitigating its impact, it will clearly worsen inequality, flowing only to those who can afford to adopt it.

For technology to play its role and contribute effectively to agricultural development and economic growth, action is required in terms of policy design as well as funding, organization and management of the technological process.

1062

Farming systems research and development
Review, reference book, agricultural compendium, tropics,
subtropics

EUROCONSULT

AGRICULTURAL COMPENDIUM - FOR RURAL DEVELOPMENT IN THE TROPICS AND SUBTROPICS.

Elsevier Science Publishers, Amsterdam, The Netherlands; 1989, 740 pp.; USD 65.75, Dfl 125.00

When it first appeared in 1981 the Agricultural compendium was widely welcomed as a very comprehensive and authoritative reference book on every aspect of agriculture in the tropics and sub-tropics. It was an interdisciplinary work, directed not to the specialist but rather to field workers, with limited local resources, who needed to collate information in several different fields. It assumed a university or college background.

A second edition with minor revisions appeared in 1985, but in this third edition the work has now been thoroughly revised and updated, much new material added, and published in a larger format. A sign of the times, some graphical material is now presented as formulae, acknowledging the almost universal availability of pocket calculators.

Although the revision is comprehensive, the most important revisions are in the chapters relating to climate; soil and land classification; water control; land improvement; crop production; animal nutrition and fisheries; and sociology.

This is an entirely Dutch enterprise, commissioned by the Ministry of Agriculture and Fisheries; produced and edited by EUROCONSULT of Arnhem; and with advisers drawn from institutions in the Netherlands, largely Wageningen Agricultural University. All concerned are to be congratulated on producing an internationally indispensable reference book.

Abstract by T.I. Williams

1063

92 - 2/147

Farming systems research and development Review, book, guidelines, rural development projects, target groups, critical elements, process approach, project design, decision making, project components

FAO

GUIDELINES FOR DESIGNING DEVELOPMENT PROJECTS TO BENEFIT THE RURAL POOR.

Food and Agriculture Organisation of the United Nations (FAO), Rome, Italy; 1986, 76 pp. + annex

The overriding objective of development initiatives is to generate self-sustaining improvement in human capabilities and welfare. This task has proved difficult, especially when development investments are to benefit economically, socially, and politically disadvantaged people in rural areas, as mandated by the World Conference on Agrarian Reform and Rural Development (WCARRD). Empirical evidence proves that rural development projects with high degrees of organization and participation at the local level are more successful in accomplishing their objectives than those that lack these characteristics. Therefore, the participation of the rural poor in project design and implementation, as well as in monitoring and evaluation, has been given substantial scope in these guidelines.

These guidelines are not meant to provide an universally applicable blueprint for poverty-oriented rural development projects.

These guidelines are directed at the design of rural development projects.

These guidelines have been prepared to help implement the WCARRD policy framework and Programme of Action. For that reason, individuals will find them particularly useful in countries where governments are already committed to the WCARRD Programme of Action.

The primary WCARRD goal is to improve the standard of living and the quality of life of the rural poor in a self-sustaining manner. This entails generating improvements in human capability and well-being, without nurturing dependence on external assistance. The WCARRD policy framework recognizes that long-term economic progress will not occur without the full involvement and commitment of the rural poor themselves. They constitute a major resource for development.

The need for this manual is demonstrated by evaluations of agricultural and rural development projects. These evaluations show the frequent failure of project designs to identify the intended beneficiaries adequately or to adapt project activities to local conditions. The designs also often lack either realistic implementation plans or adequate monitoring and evaluation systems. These design problems usually result in serious

implementation problems and a failure to achieve the desired long-term benefits.

In this sense, these guidelines are a complement to the "UNDP Guidelines on Project Formulation" which give less attention to people's participation, target group identification, alleviation of rural poverty, and the process approach.

This manual is organized as follows:

- Purposes of the guidelines
- Defining rural development projects
- Applying these design guidelines to different types of projects
- Identifying the target groups
- Critical elements in projects that benefit the rural poor
- The "process approach" to project design and development
- Functions of a good project design
- The steps to follow
- Specifying project objectives
- Specifying project components
- Determining project management and organizational arrangements
- Structuring the project design
- Phasing project interventions
- Relating project analysis to key feasibility issues
- Preparing a realistic implementation plan
- Designing a monitoring and evaluation system

These guidelines are most relevant for projects that intervene directly to help rural people in specific geographic areas. These range from sector-specific projects, such as the testing of new seed varieties, to large-scale multi-sector projects.

1064

92 - 2/148

Farming systems research and development
USA, case study, participatory education, grassroots development,
regional development strategy, rural economic crisis, alternative
strategy, IIED

GAVENTA, J. and H. LEWIS

**PARTICIPATORY EDUCATION AND GRASSROOTS DEVELOPMENT: THE CASE OF
RURAL APPALACHIA.**

Gatekeeper Series No. 25; IIED, 3 Endsleigh Street, London WC1H
ODD, UK, 1991, 13 p.

The failure of the traditional trickle-down methods of development
is now well documented. Though better recognized in Third World
countries, it is also central to the steady erosion of livelihoods
in rural, resource-poor regions of the industrialized countries.
Perhaps nowhere is it more evident than in rural Appalachian
communities of the United States of America.

The Appalachian region refers to the mountainous region in the
middle eastern part of the United States, stretching from as far
north as western New York state, and running through parts of
Pennsylvania, West Virginia, Kentucky, Tennessee, Virginia down to
Alabama and Mississippi. Historically, the region has contained
some of the poorest socio-economic conditions of any region in the
country. It is one of the least developed in the United States in
factors including agriculture, unemployment, housing,
urbanization, poverty, economic diversity, etc.

The economic crisis in the region poses a crisis for traditional
economic development policy. Historically, the development model
for the region has been based on creating a favourable 'business
climate', which in turn could be used to lure industry into the
region. In the name of maintaining the business climate, workers
received low-wages, and communities provided tax and other
concessions to industry. Based upon a traditional understanding of
'trickle down' economics, the assumption was that what was good
for business was good for communities and local livelihoods. To
some extent, within its own definitions of success, the 'business
climates' model of development worked. Thousands of industrial
plants came to the region. The overall standard of living grew.

A number of methods were used which were similar to those employed
in participatory research and extension approaches such as Rapid
Rural Appraisal, Rapid Assessment Procedures, and Farmer
Participatory Research. A central point was the emphasis upon the
development of peoples' knowledge, and peoples' research and
analysis as an important part of the process of beginning to
reverse the pattern of dependence upon external economic forces.
These methods include those described below:

- Oral histories
- Community surveys
- Community mapping and drawings
- Decision-makers interviews

- Videos and readings
- Brainstorming and feasibility studies
- Cultural components

The definition of successful development expands to include
criterion broader than jobs and income, but also community
participation, democratic participation and dignity. Community
development - economic, cultural and social - flowers when people
value themselves and their neighbours, and begin to work together
in common endeavours.

As important as these may be, these case studies and the
experience suggest a broader view, especially if one is interested
in participatory development. In the latter approach, the
development of 'infrastructure' includes human development, an
education for creativity, regaining and understanding popular
knowledge and history, democratic decision-making, and
consciousness of religious and political symbols. With this
investment, people can become better equipped to rebuild their own
communities and economies.

1065

92 - 2/149

Farming systems research and development
Review, book, rural development, participatory methods,
development practice, community development, cultural impact,
grassroot movements, future directions

BURBIDGE, J.

**APPROACHES THAT WORK IN RURAL DEVELOPMENT: EMERGING TRENDS,
PARTICIPATORY METHODS AND LOCAL INITIATIVES.**

IIRD Series No. 3; K.G. Saur Verlag, München, F.R.G.; ISBN 3-598-
21043-4; 1988, 414 pp.

The approach in this volume is a dialogue between local initiatives in development practice and emerging trends in the wider development community. In Part I, the focus is on broad development trends. One of the most prominent of these is the increasing importance being attached to the role of non-governmental organizations in development and the need to enhance their institutional capacity. Another is the desire to find ways for all, to talk, plan and work together.

Part II describes the processes or methods whereby various approaches to rural development have led to successful results. The intention here is to share some of the more of recent development experiences, from a variety of perspectives and a number of different countries.

These include participatory planning and problem solving, people-centered evaluation, training of trainers and innovative conferencing.

In Part III, the emphasis is on what is happening at the grassroots and its impact on the development process. There is an increasing acknowledgement that the grassroots is the basic building block for effective and lasting development. Not only is there an awareness of the need to strengthen indigenous institutions but village-based initiatives themselves are calling for more attention and support. This key area from the perspective of the individual, small-scale projects, organizations and networks is examined.

The concluding chapter weaves together some of the insights contained in the three parts of the book and points to new directions for the future of development. The last part of the book contains appendices which list activities, programmes and resource materials that have been used in the third phase of the project.

An additional feature of this volume is the publication of interviews with six participants in India 1984. These six profiles acknowledge the critical contribution such people make to the entire development process.

Abstract from ATSAF-Circular

1066

92 - 2/150

Farming systems research and development
Africa, Ethiopia, review, workshop, participatory rapid rural
appraisal, natural resource management, peasant association, IIED

SCOONES, I. and J. Mc.CRACKEN

**PARTICIPATORY RAPID RURAL APPRAISAL IN WOLLO: PEASANT ASSOCIATION
PLANNING FOR NATURAL RESOURCE MANAGEMENT.**

Publ. of the Int. Institute for Environment and Development
(IIED), London, UK, 1989, 86 pp.

This report is the result of a Rapid Rural Appraisal (RRA) exercise carried out in Ethiopian Red Cross Upper Mille and Cheleka Catchments Project (UMCC-DPP) in Wollo Province. The concern for the protection and management of natural resources in Wollo is central to the Ethiopian government's strategy in the highland areas. The Ethiopian Highland Reclamation study that was carried out following the 1984/5 famine claimed that vast areas of the highlands will be lost for cultivation and grazing due to accelerated soil erosion.

This report is divided into nine sections. Following an introduction to RRA methods and the approach taken in the training workshop, the information derived from the RRA Peasant Associations (PAs) is presented. A general profile of each PA is given followed by a summary of attitudes of different groups within the PA to issues of natural resource management, water, health, etc. This information, derived from the use of a range of RRA techniques, is then used to generate a list of problems and opportunities in the PA. These give rise to a series of 'Best Bets' for development which are formulated in a preliminary way and then taken back to the community, tested and revised in a series of group discussions. The finalized 'Best Bets' then are the basis for further practical action - from policy review, to research to project implementation. Within nine days of field and workshop work the RRA teams, in consultation with a range of groups within the community, came up with a series of practical options for future action. These are presented in the report and are supported by information derived for the environmental, agricultural and attitudinal profiles of the PAs.

The final sections of the report provide a comparison of outputs between the two PAs, a list of recommendations for immediate follow-up and a review and evaluation of the training workshop by the participants.

The final session of the workshop was used to discuss what the participants felt they had learned and achieved as well as the problems and limitations they had encountered in the work. Finally they discussed what the next steps should be in applying the RRA approach elsewhere.

There was general agreement among the participants that they had learned much from the exercise and had been able to fulfill many of the objectives which they had set themselves on the first day.

1067

92 - 2/151

Farming systems research and development
Asia, Sri Lanka, study, farmers' knowledge, agricultural
practices, high-yielding varieties, seed treatments, chemical
fertilizer, pests, diseases, weed control, yield

WIJERATNE, M.

**FARMERS' KNOWLEDGE OF AGRICULTURAL PRACTICES: A SRI LANKAN
EXPERIENCE.**

Beiträge trop. Landw., Vet. med., 29, H3, 1991, pp. 283-287

This study investigates farmers' knowledge level for selected agricultural practices in order to understand how the dissemination process works under field conditions.

The study was carried out in one of the southern districts of Sri Lanka which comes under the low country wet zone.

The case materials were obtained through participation in different formal sessions established in the reformed extension system and conducting indepth personal interviews with extension officials as well as with farmers. The farmers were selected randomly; the sample contained 100 of them.

The agricultural practices were grouped as follows:

- high-yielding rice varieties (HYVs)
- pre-seed treatments
- plant establishment practices
- chemical fertilizer applications
- pests, diseases, and toxic conditions
- weed control
- weights and measures.

The Training and Visit (T&V) System of Agricultural Extension was introduced to developing countries since the mid-seventies, especially to strengthen the knowledge of the dissemination process.

The route from research to farmer involves several steps, especially on the route through the extension sub-system and farmer sub-system. In the latter part of the dissemination process, the message transmitted to the professional extension agent through the bureaucratic organizational structure and is handed over by him to a set of untrained communicators for further dissemination at the village level. It is evident that message distortion takes place in the process, often through levelling, adding, highlighting and modifying, in addition to the total loss of the knowledge or information.

It can be concluded that generally farmers were unable to gain sufficient knowledge for the innovations which are complex for their technical competence. On the other hand, some of the innovations are very costly. Hence, farmers do not show much interest to utilize such innovations in their fields. As a result, they do not demand knowledge. The findings indicate that farmers have a medium level of overall knowledge on rice cultivation, so

that there is a potential for further advancement of knowledge at the utilizer level.

The extension system has made efforts to advance farmers' knowledge mainly by launching training programmes for extension workers and extending the knowledge to a selected number of farmers by making time-bound regular extension visits. It is evident that the extension approach is effective for simple and low-cost innovations. For complex recommendations, alternative extension methods should be applied depending on the field situations. Further, recommendations must be cost-effective at the utilizer level and care has to be taken to provide the other elements of the development mix.

1068

92 - 2/152

Farming systems research and development
Africa, Zambia, study, rural development project, project effects,
sustainability, cultivation systems, work oxen, commodity supply,
cooperative development, self reliance, associations, beekeepers,
craftsmen, institutions, SLE

RAUCH, T. et al.

**THE SUSTAINABILITY OF THE IMPACT OF THE INTEGRATED RURAL
DEVELOPMENT PROGRAMME (IRDP) ZAMBIA/NW-PROVINCE.**

Schriftenreihe des FB Internationale Agrarentwicklung of the
Techn. Univ. of Berlin Nr. 116, Berlin, ISBN 3-924333-70-X; 1988,
257 pp + annex

This report is the result of a three-month survey carried out by a
study team from the Centre of Advanced Training in Agricultural
Development (CATAD) of the Technical University of Berlin.
The study was conducted on request of and in close cooperation
with the Integrated Rural Development Programme/North Western
Province in Zambia.

The book is organized as follows:

- Chapter I: Impact of the IRDP on non-participants and
reasons for non-participation
- Chapter II: Sustained cultivation systems
- Chapter III: Sustainability of joint utilization of work oxen
- Chapter IV: Supply of relish
- Chapter V: Commodity supply
- Chapter VI: Cooperative development
- Chapter VII: Village self-reliance
- Chapter VIII: Associations of beekeepers and craftsmen
- Chapter IX: Observations on institutional sustainability
- Chapter X: Summarizing conclusions

The Integrated Rural Development Programme (IRDP) in Zambia's
North-Western Province was inaugurated in 1977. Its major goal has
been to improve the living conditions of the majority of the
small-scale producers (farmers, bee-keepers, craftsmen) mainly by
increasing their productivity and production. The approach has
focused on providing these small-scale producers with access to
inputs, credit and markets and to institutionalize such a mass-
oriented service system after it has proved to be feasible and
attractive for the target groups.

The aspects of sustainability analyzed in the study are so
manifold that it is not easy to extract generalizing conclusions
on the sustainability of the IRDP.

Meanwhile the major targets in terms of number of participants and
production have been achieved. More than half of the rural
households are actively involved. The services have been handed
over to local agencies.

The IRDP has managed to make the masses of the small-scale
producers the decisive factor for the regional economy (they are

providing 80% of the supply, using most of the fertile land and
investing their manpower in their own production activities),
which can hardly be neglected anymore.

The small-scale producers are, to a certain degree, in a position
to identify problems on the farm and village level on their own
and to undertake problem-solving action (as far as they are
provided with the necessary minimum of external support). They
depend on institutions for certain means of production and for
access to external markets, but they do not as much depend on
support in terms of motivation, mobilization, organizational
promotion and advice.

Concluding, the efforts of the IRDP to safeguard sustainability
through introducing more adjusted cultivation patterns and new
organizational structures have been too ambitious. The recommended
intercropping packages are too sophisticated. The attempts to
promote organizations which do represent the interests of the
poorer sections would require massive interventions into social
processes on the village level which are beyond the scope of a
regional project covering 55 wards with more than 10,000
participating small-scale producers.

The IRDP's interventions directed towards the sustainability of
its impact on the village level should be limited to a support of
the people's own attempts by improving the information flow. This
can be done without creating new, artificial structures by using
the existing communication channels.

III INTEGRATED SYSTEMS

1069

92 - 3/119

Integrated Systems

Latin America, Colombia, study, tropical deforestation, livestock production, cattle, small livestock, biomass production systems

MURGUEITIO, E.

INTENSIVE SUSTAINABLE LIVESTOCK PRODUCTION: AN ALTERNATIVE TO TROPICAL DEFORESTATION.

AMBIO, 19, 1990, pp. 397-400.

Extensive cattle grazing is the principal production system employed by the colonizers of rain forests and has been, and still is, encouraged by most state agencies for rural development and agrarian reform, even though scientific research has demonstrated clearly the failure of this system in most tropical ecosystems. When cattle-grazing systems are the main activity of resource-poor farmers with insufficient capital and minimal access to credit, returns are usually insufficient to support the minimal needs of the family. The consequence is that the land is sold, usually to the rich landholders, who, through economies of scale, can continue with the extensive grazing systems; and the resource-poor farmer turns once again to the forest and the destructive process continues.

To solve the problem of tropical forest destruction demands a strategy which is of necessity complex, if the remaining tropical forest areas with their ecological riches and biological diversity are to be preserved.

An intensive livestock production model, based on the concept of using highly efficient energy- and nitrogen-fixing plants, promises to offer an appropriate technological solution to the problem of providing an alternative to extensive cattle-grazing systems.

An appropriate strategy is the rational use of the natural resources of the tropics, namely:

- solar energy captured by highly efficient crops through the processes of photosynthesis; and
- the genetic diversity of the nitrogen-fixing plants present in the forest flora.

In recent years, several Latin American countries, have directed research and development activities towards validating the hypothesis that sugarcane can be the basis of intensive animal production systems, thus assuming the role played by the cereal grains in the temperate countries. In a complementary way, it is increasingly being recognized that nitrogen-fixing trees and shrubs (leguminous and non-leguminous) can provide much of the protein needed to balance the carbohydrates from the sugarcane. The model has the additional benefit of providing a comparative advantage for the resource-poor farmer with limited land area. The

model employs fractionation of both the sugarcane and the forage trees to provide suitable diets for monogastric and ruminant animals in an integrated operation, which is proving to be technically, economically and ecologically sustainable.

The model developed in Colombia employs complementary livestock species (pigs and sheep) managed in confinement. Productivity is a function of sugarcane yield which depends on soil fertility, water availability and variety. For the world average yield of 50 tonnes per ha per year, total liveweight production per year from pigs and sheep can be 1500 kg per year. With appropriate management, sugarcane can yield up to 180 tonnes per ha per year, which will give 8000 kg liveweight per hectare per year.

During the last three years, this model has been subjected to continuous testing and adaption to Colombian conditions with extremely promising results. The crops used in the model (sugarcane and forage trees) are perennial, thus soil erosion is contained.

Implementing these models on a massive scale will result in a substantial reduction of the area required to support a resource-poor farmer. At the same time, existing grazing areas can be transformed into more productive units with obvious advantages in terms of job creation and economic stimulus to rural development.

A weakness of the system is the lack of certainty as to the best way to provide the protein input. Recent developments in this area are encouraging. And even at the present stage of development, the results are much more superior, in economic, sociological and ecological terms, than traditional grazing systems.

1070

92 - 3/120

Integrated systems
Africa, Nigeria, humid tropics, study, snail utilization,
traditional medicine, cultural values

AGBELUSI, E.A. and B.N. EJIDIKE

UTILIZATION OF THE AFRICAN GIANT LAND SNAIL IN THE HUMID AREA OF NIGERIA.

Trop. Agric. (Trinidad), 69, 1, 1992, pp. 88-92

This paper examined the utilization of the giant land snail among the people of Ondo State in Nigeria. The study was carried out in ten of the 17 local government areas in Ondo State of Nigeria. A questionnaire was used to obtain data on the pattern of utilization of this animal.

The climate is tropical with two distinct seasons, the wet season and a dry season. The vegetation of Ondo State ranges from mangrove swamp at the coast to derived savanna towards the northern boundary.

The African giant land snail is the largest among the terrestrial Gastropoda living in Africa. This snail species is found mostly in the high forest zone. A mature adult weights approximately 750 g and the foot, which constitutes the edible part, is about 30% of the live weight.

Snail meat is highly relished and considered a delicacy for the peasant population living in the rural area of the forest zone of West Africa, especially in Nigeria and Ghana. Apart from its nutritive value, it is also used in traditional medicine.

The results indicate that snails are used primarily as meat by the rural and urban people. This may be due to a downward trend in the economy of the nation which places frozen fish and chicken out of reach of the common citizen, so that wild animals are the primary source of protein.

Although some groups of people have taboo, religious and other reasons for not eating snails, the numbers are quite insignificant when compared with those who relish snail meat and consider it to be a delicacy.

Alternative uses for giant land snails do exist. The land snails are very important in traditional medicine throughout the areas. Various parts of this animal are utilized in preparing medicine for curing numerous ailments. When mixed with other ingredients, the fluid from giant land snails cured headache and malaria. This fluid also improved blood clotting on a fresh wound. The shells of giant land snails when smoked/burnt to a colourless condition are ground and mixed with other ingredients in preparing a medicine for pregnant women during labour and as fertility drug for women experiencing difficulty with conception.

The importance of giant land snails is also reflected in cultural values. Snails are one of the ingredients used in making a sacrifice to Ogun (the god of iron).

Snail shells, which are regarded as the trophy of the animal, are used as decorative objects, especially when painted with different colours.

Some rural people also store traditional medicine in giant land snail shells and some make use of the shells as an abrasive for washing utensils and brushing teeth.

Snails also provide employment for some people in the rural area. Owing to a high demand for this animal, some of the rural dwellers are now full-time or part-time gatherers of snails.

These results revealed that the snails were important not only as a source of animal protein to the population but also an important ingredient in their traditional medicine.

1071

92 - 3/121

Integrated systems
Survey, developing countries, industrialized countries, livestock
production, small-holders, development policies, environmental
pollution, animals, extension, education

GUDAHL, D.

IMPORTANT ISSUES OF SMALL-HOLDER LIVESTOCK SECTOR WORLDWIDE.

Sustainable Agriculture, 3, 1, 1991, p. 5

Heifer Project International listed a comparison of important
issues of the livestock world around the world.

Developing national and international policies which stress the
importance that small scale farmer play in agriculture and
environmental balance is important. Often, economies of scale are
applied to agricultural situations leading to production
efficiency at the expense of the environment, animal health and
welfare of small farmers. Greater value must be placed on animals
and crops raised by small scale producers to avoid monopolization
of agriculture, increase agricultural diversity and keep rural
populations viable.

The overriding issue listed was how are animals fed and cared for.
In non-industrialized countries, the concern for animals is more
along the lines of how does one keep an animal fed during the lean
months.

Farmer based technology such as agroforestry techniques, fodder
banks, development of vegetative erosion control barriers,
utilization of crop wastes, increased planting of leguminous trees
and pasture crops are techniques that are readily adaptable.
Farmers easily see how livestock and the land benefit from
establishment of year-round reliable feed sources.

The most successful operations in non-industrialized countries are
those that utilize livestock as waste converters. Ruminants, with
their ability to digest cellulose, are especially suited to this
task. Animals can be useful in using those things that are waste
or inedible for humans and convert it into human food.

Finally a system that involves people, land, plants and animals is
the paradigm for animal agricultural development for the 90s.

1072

92 - 3/122

Integrated systems
Review, book, developing countries, arid zone, semi-arid zone,
tropics, small ruminant production, sheep, goats, breeding,
nutrition, management, feeds, FAO

TIMON, V.M. and J.P. HANRAHAN

SMALL RUMINANT PRODUCTION IN DEVELOPING COUNTRIES.

FAO Animal Production and Health Paper No. 58, FAO, Rome, ISBN 92-
5-102343-3, 1985, price DM 33,-

FAO organized an Expert Consultation on Small Ruminant Production
in Sofia, July 8/12, 1985. The papers published in these
proceedings represent the technical contributions and discussions
at the meeting. Separate to these discussions the consultation
addressed some of the broader issues of importance to the
advancement of small ruminant production, particularly in the
developing countries, and at the end of the meeting agreed a set
of recommendations.

Twenty papers were presented and discussed in the consultation and
are reproduced in these proceedings. Strategies in breeding and
breed development, nutrition and management, the development and
utilization of indigenous grasses, shrubs and forest feeds for the
production of sheep and goats, in arid, semi-arid and tropical
conditions.

Small ruminants such as sheep and goats have adaptive capacities
to survive and produce in difficult environments be they arid,
high altitude or extremely cold. Generally, small ruminants are
efficient converters of forage feeds whether they are farmed in
temperate, arid or semi-tropical conditions. Perhaps their
greatest advantage relative to large ruminants is their low cost,
small size, their suitability to small holdings and in many of the
developing countries, their triple purpose use for meat, milk and
fibre.

There is a steady increase in sheep and goat numbers; sheep
numbers are in excess of one billion head and goat numbers
globally are now approaching half a billion head.

Increasing numbers is not enough. The fundamental issues are
increased efficiency of production, biological efficiency,
structural/organizational efficiency or more effective use of
basic feed resources.

The recommendations are set down under the following broad
headings:

- Research and development in small ruminant production.

In view of the very significant contribution of small ruminants
to the economy and livelihood of peoples in almost every country
around the world, and particularly in the developing countries,
the consultation strongly recommends that much greater priority
and much larger investment should be made by national and
international institutions in the promotion of small ruminant
production.

- Coordination - linkages.

The consultation recommends that there is need for much more effective coordination and closer linkages between institutions involved in small ruminant production throughout the world and in particular involving research and development centres in the developing world.

- Support services/infrastructure.

The expert group considered the likely success of development in small ruminant production and recommends that an adequately planned infrastructure and support services must form an integral part of all development programmes in small ruminant production.

- Genetics and breed improvement.

Very serious consideration should be given to the choice of species (and/or mixture of species) and the choice of breed in the very first stages of planning the development of small ruminant production. Adaptation of breed to local environment should be a key element in breed choice and breed development strategies. This means paying particular attention to indigenous breeds.

The consultation considered that many of the developments in the technologies of reproduction in small ruminants are not and will not be relevant to small ruminant production in the developing countries until levels of nutrition and management are substantially increased, and market prices dictate more cost effective results.

1073

92 - 3/123

Integrated systems

Review, book, microlivestock, animals, economics, future, microbreeds, poultry, rabbits, rodents, deer, antelope, lizards, bees

BOSTID

MICROLIVESTOCK LITTLE-KNOWN SMALL ANIMALS WITH A PROMISING ECONOMIC FUTURE.

Publ. of the Board on Science and Technology for International Development (BOSTID), Nat. Research Council; Nat. Academy Press, Washington, D.C., ISBN 0-309-04437-5; 1991, 370 p. + annexes

The purpose of this report is to raise awareness of the potential of small livestock species and to stimulate their introduction into animal research and economic development programs. It is geared particularly towards benefiting developing countries.

'Microlivestock' is a term suggested for species that are inherently small, such as rabbits and poultry, as well as for breeds of cattle, sheep, goats and pigs that are less than about half the size of the most common breeds. These miniature animals seem to have a promising future.

The book was prepared after an intensive survey of more than 300 animal scientists in 80 countries. They suggested more than 150 species for inclusion. The staff then drafted chapters on about 40 species and these drafts were reviewed by more than 400 researchers worldwide.

This study covers many species, but it by no means exhausts all the microlivestock possibilities.

As well as dwarf breeds of cattle, sheep and goats, the book covers more unusual species that can be farmed profitably including deer, the giant rat, coypu and guinea pig are dealt with.

Each potentially useful breed is analyzed and useful information set out under headings, including appearance, husbandry, behaviour and uses.

The muscovy duck, for example, is shown to have several advantages over the domestic duck, in that it is a good forager, is not so susceptible to disease and produces a lean carcass.

Not much space was allocated to the inclusion of aquatic food sources or edible insects, snails, worms, turtles, birds or bats, highly regarded food sources in some regions.

A warning was issued about the introduction of certain species, especially rodents, into regions where they do not exist. Such schemes can, obviously, have dramatic negative consequences.

This report is addressed to government administrators, technical-assistance personnel, and researchers in agriculture, nutrition, and related disciplines who are concerned with helping developing countries achieve a more efficient and balanced exploitation of their biological resources.

The book is easy to read, and with little technical language, the book will be particularly useful in those areas where good grazing is in short supply.

This is an extremely interesting book and is highly recommended for all those engaged in livestock production.

The Board on Science and Technology for International Development (BOSTID) of the Office of International Affairs addresses a range of issues arising from the ways in which science and technology in developing countries can stimulate and complement the complex processes of social and economic development. It oversees a broad program of bilateral workshops with scientific organizations in developing countries and conducts special studies.

This report was prepared by an ad hoc advisory panel of the Advisory Committee on Technology Innovation, Board on Science and Technology for International Development.

1074

92 - 3/124

Integrated systems
Review, book, Africa, subhumid zone, arid zone, Nigeria, Sudan, Kenya, Botswana, livestock production, projects, multilateral agencies, NGO's, animal health, range management, livestock feed, restocking systems, ODI

OXBY, C.

ASSISTING AFRICAN LIVESTOCK KEEPERS.

Overseas Development Institute (ODI), Regents College, Inner Circle Regent's Park, London NW1-4NS, UK; ISBN 085003-143-5, 1991, 61 pp., UK £5.95

'Assisting African livestock keepers' is a collection of four papers which were originally published in the Overseas Development Institute (ODI) Pastoral development network. They refer to a range of subjects within pastoral development; animal health, animal feed, range management, and post-drought recovery. All emphasize the need for the participation of livestock-keepers in project management. They describe projects in Nigeria, Sudan, Kenya and Botswana which cover both subhumid and semi-arid regions. The development institutions involved range from large multilateral agencies to a small Sudanese NGO.

The first paper, on animal health, describes an example of an increasingly popular approach to the delivery of veterinary services, namely the training of herder specialists. The project was a notable success in terms of the number of livestock vaccinated. The second paper is about range management and lists the conclusions to be drawn, and the problems that arose, during six years of work in Botswana on establishing fenced grazing areas radiating out from a central water point. Improvement of livestock feed in the subhumid zone of Nigeria is the subject of the third paper. It describes the achievements and problems faced during the course of a research project set up to involve livestock keepers in fencing off a small plot of land near their homestead and in supplementing the natural pastures therein with a forage legume for use during the dry season. The fourth paper is an evaluation of four restocking projects set up in various parts of Kenya.

1075

92 - 3/125

Integrated systems
Review, book, Europe, deer farming, research, development,
practical aspects, theory, nutrition, health, selection, breeding,
farming systems, marketing, economy

REINKEN, G.

DEER FARMING.

Farming Press Books, Ipswich, UK, ISBN 0-85236-206-4; 1990; £15.95

In the quest for alternative forms of livestock production to sheep and cattle in northern Europe, deer farming has been strongly advocated. It is environmentally friendly with low inputs of fertilizers and pesticides and farmed venison is a lean and natural meat with a distinctive flavour desired by consumers. It has also an advantage over other proposed alternatives in that there is a strong body of scientific knowledge on the biology of deer and a resource of information on farming techniques which has been collected in the last 20 years.

This book draws on such research and development work carried out between 1970 and 1985 in Germany and elsewhere and describes how to farm fallow deer in Germany, covering both theoretical and practical aspects in a comprehensive manner. Nutrition, health, selection and breeding, farming systems, marketing and economics are convincingly dealt with. This translation from the German into English is generally of a good standard. While the book offers a valuable insight into the state of the deer farming industry and agriculture in West Germany in the mid-1980s, it could have had a broader appeal if some of the detail only relevant to German conditions had been omitted in the English edition.

The major strength of the book is its wealth of information on fallow deer and their farming which will be valuable to scientists, lecturers, advisers and consultants in many European countries. Although reference is made to the farming of other species, such as the red deer, where information on the fallow deer is lacking, there clearly exists a need for a companion volume on the farming of the red deer under European conditions. This book sets a high standard for future publications on deer farming which will no doubt appear as the potential of deer farming as an alternative livestock enterprise is realized.

Abstract by J.A. Milne

1076

92 - 3/126

Integrated systems
Study, developing countries, Africa, Asia, Latin America, sheep,
goat, economic constraints, feed shortages, trade, policies,
capital, flock size, risks, labour, FAO

GUTIERREZ-A., N.

ECONOMIC CONSTRAINTS ON SHEEP AND GOAT PRODUCTION IN DEVELOPING COUNTRIES.

In: FAO Animal Production and Health Paper No. 58, FAO, Rome, Italy; 1985, pp. 138-147

This paper discusses some economic factors that have affected the efficiency of production, documents selected cases, and offers some solutions to the problems.

Sheep and goats are important livestock species in developing countries.

Fifty-three percent of the total small-ruminant population in the developing countries is found in Asia, particularly in India and Pakistan, 33% in Africa, and 14% in Latin America.

The total product from small ruminants increased in developing countries because their numbers increased.

Sheep and goats are important in development because of their ability to convert forages and crops and household residues into meat, fibre, skins and milk. The economic importance of each of the products varies between regions, especially in the developing countries.

Goats are hardy and well-adapted to harsh climates. Due to their grazing habits and physiological characteristics, they are able to browse on plants that would normally not be eaten by other livestock species. The presence of goats in mixed species grazing systems can lead to a more efficient use of the natural resource base and add flexibility to the management of livestock. This characteristic is especially desirable in fragile environments.

Sheep and goats contribute to a broad range of production systems. The most common production system throughout the developing countries involves either the extensive system with large herds and/or flocks grazing on arid and semi-arid rangelands or the intensive system with smaller herds and/or flocks kept in confinement, mostly in the humid tropics. Both systems are characterized by low input use.

Most of the world's sheep and goats are produced on mixed-species farms rather than in species-specific units.

Technological development studies of small-ruminant production as it relates to other farming systems have been limited. Therefore, the target, in terms of research, has to be integrated production systems rather than isolated sheep and goat components. By using a multidisciplinary research approach, the problem can be addressed in a realistic and practical way.

The problems of sheep and goat production can neither be efficiently nor successfully solved until research concentrates on

studying all of the related and interrelated components involved. For too long, research has focused on one discipline at a time, ignoring the developing country's culture, environment, educational level of its producers, and the availability and dependability of local technology transfer.

It is important to know that an increase in sheep and goat activity in an integrated system could increase the total productivity of a farm through more efficient labour and available resources and generate more income per unit of time.

If developing countries could increase herd productivity, they could increase production. To increase production in developing countries, existing constraints must be overcome.

1077

Integrated systems
Review, books, sheep, pigs, animal production, tropics,
subtropics, CTA

GATENBY, R. and HOLNESS, D.H.

SHEEP.

PIGS.

The Tropical Agriculturist Series; Macmillan and CTA, Sheep 0-333-52310-5; Pigs 0-333-52308-3; 1991, available from CTA, Postbus 380, 6700 A.J., Wageningen, The Netherlands

Sheep is the second volume in this series to be produced in the field of animal production: it follows the volume on 'Poultry'. The importance of sheep in tropical countries is often overlooked. They are, in fact, very important: over 600 million of them are to be found in the developing world. Sheep will thrive under conditions where either crops or other forms of livestock would not because the climate is too arid or the soil too poor.

However, they can be integrated well with both crops and other forms of animal production and, because of their relatively small size, they can provide a more convenient source of meat than cattle and they are often kept by farmers as a kind of insurance for quick sale or slaughter for festivities.

The third book in the series, 'Pigs', considers some of their advantages. The world trend is towards the consumption of more white, rather than red meat. Pigs produce meat without contributing to the deterioration of natural grazing lands.

This is of paramount importance in relation to the current desertification, soil erosion and loss of productive land in tropical and subtropical parts of the world. However, there are problems, particularly those associated with feed supplies; and inadequate control of disease may make intensive pig production unprofitable or even untenable. Religious considerations may make pig-keeping unacceptable, and the possibility of transfer of disease and parasites to the human population may make extensive pig production unwise.

This book considers these problems to see which systems of pig production are most acceptable in various regions of the tropics and which should be avoided. It approaches the subject from the point of view of both the commercial producer and of the village pig-keeper. As with all the books in The Tropical Agriculturist series, these are readable, informative and practical guides.
Abstract from SPORE

1078

92 - 3/128

Integrated systems
Africa, Rwanda, Kenya, Sudan, Nigeria, Ethiopia, Mali, sheep
production, traditional systems, farming systems development

WILSON, R.T.

STRATEGIES TO INCREASE SHEEP PRODUCTION IN EAST AFRICA.

In: FAO Animal Production and Health Paper 58; FAO, Rome, Italy;
pp. 118-123

Sheep in eastern Africa are managed in traditional systems. The end product is almost entirely meat, either for home consumption or to an internal or external market through sales. In parts of Sudan, sheep are also kept to provide milk.

In most traditional societies, first lambing occurs at 15-18 months when ewe weights are 80-85 per cent of mature size. Control of age at first breeding usually means delaying this and may result in first lambing not taking place until 2 years or older. Total lifetime production of young can be increased by encouraging first lambing at early ages.

The growth rate is an important factor in livestock productivity. In traditional systems, because of overstocking, genetic potential is rarely expressed. Growth rates vary from as little as 40 g per day in Kenya Masai sheep to as much as 70 g per day in Sudan Desert type from western Sudan.

As an example of the potential for increased growth under improved conditions of nutrition and management, the "Mouton de Case" sheep in West Africa achieves a growth rate of 117 g per day to 40 weeks of age compared with only 60 g for its range-reared contemporaries.

Management practices in many traditional societies are such that the best adapted sheep or those with superior genetic potential are not used as breeding stock. This is because of the cultural or religious requirements for large fat sheep for slaughter at social and sacrificial occasions.

Pre-weaning mortality has been shown to be an extremely important constraint on productivity of sheep. Levels of up to 30 or even 40 per cent losses before weaning are not uncommon.

The standard approach to improving the supposedly unproductive indigenous African sheep types has been to import exotic breeds, usually of European origin.

There have rarely been successful transfer of these breeds to traditional systems. In East Africa, successes have almost entirely been confined to those cases where modern management practices can be assured and high levels of veterinary and nutritional inputs maintained.

Identifying these practices and abilities and extending them to other owners would lead to overall improvement. A plan for improvement of a traditional flock with the minimum of outside and costly interventions is shown in this paper.

1079

92 - 3/129

Integrated systems
Pacific, Solomon Islands, pig production, compound feeds, pig
feeds

THORNE, P.J.

ALTERNATIVES TO IMPORTED COMPOUND FEEDS FOR GROWING PIGS IN SOLOMON ISLANDS.

Trop. Agric. (Trinidad), 69, 2, 1992, pp. 141-143

The developing island nations of the Pacific region are often at a disadvantage as locally available feed resources are limited and technical expertise to facilitate their use may be lacking. Importation of feeds into these countries greatly increases the pig farmer's cash outlay and, in many cases, can render intensive pig-keeping a rather marginal activity.

The small-scale pig farmer has markedly different requirements from those of the intensive pig producer. As an alternative to the use of compound feeds, it may be possible to supply locally-produced protein concentrates to pig farmers operating under village conditions. These can supplement the low nutrient-dense energy feeds (e.g. root crops, fresh coconuts) that are widely available and allow levels of production not greatly below those of intensive pig producers. Such systems, based on sweet potato and cassava as the principal energy source have been evaluated experimentally with encouraging results.

Therefore an experiment was carried out to consider the use of locally available raw materials in the diets of fast-growing pigs either as a complete compound feed or as a protein concentrate to supplement low nutrient-dense energy feeds.

Three dietary treatments were tested in the experiment. An imported pig-grower diet was compared with an equivalent compound diet of local origin and a semi-intensive system in which low nutrient-dense energy feeds (cassava and coconut) were supplemented with a 50% crude protein concentrate designed to be fed at approximately 20% of dry matter intake.

An imported compound pig grower diet resulted in slower growth ($P=0.075$) and poorer feed conversion ratio ($P=0.001$) than a similar diet compounded from locally available raw materials. The economic advantages of the local compound feed were marked ($P<0.001$) with cost per kg of liveweight gain being little over one third (SI\$1.36 vs SI\$3.11) of that observed with the imported feed. An alternative system employing a combination of a locally-produced protein concentrate and fresh cassava and coconut resulted in slightly poorer growth rates than the compound feeds but was still competitive in economic terms. The use of concentrate, cassava and coconut did, however, result in fatter carcasses in terms of back-fat measured at the mid-back ($P=0.005$) and the loin ($P=0.007$).

The true value of any livestock feed is only revealed when the economic advantages associated with its use are taken into

account. A feed which results in fast and efficient growth but at excessive cost may be just as unsuitable as a cheaper feed which satisfies few of the animal's requirements and results in poor growth rates. The most suitable feed will invariably lie between these two extremes.

From these results it seems likely that pig production using imported feed might become uneconomic if high labour and service costs are incurred.

The locally-produced compound diet which combined fast, efficient growth with low cost therefore resulted in the highest returns.

The costings discussed above are based on pigs produced for commercial sale. The economics of pig sales in or between villages are likely to differ somewhat because of generally lower and more variable prices. Under these conditions, the benefits of intensification by improved nutrition using purchased feedstuffs may not always materialize. Before recommending the use of purchased feeds to any farmer with a pig project, extension workers should consider what reliable markets are available for animal products.

Concluding, it can be said that raw materials are available in Solomon Islands which ought to allow local production of compound pig feeds with several potential advantages: feed costs are dramatically reduced when local ingredients are used; the quality of local feed ingredients is more easily assured than that of imported feeds as more local control is possible and import substitution is of general benefit to Solomon Islands' economic development.

Integrated systems
Asia, India, on-farm research, dairy animal, sustainable development, economic analysis, crossbred-cows, green fodder, fodder production, technology transfer

SINGH, C.B.

ECONOMIC ANALYSIS OF ON-FARM DAIRY ANIMAL RESEARCH AND ITS RELEVANCE TO DEVELOPMENT.

In Proc. of on-farm animal research/extension and its economic analysis; Winrock Int. Inst. for Agric. Development, Los Baños, Laguna, Philippines; 1987, pp. 45-52

An economic analysis of on-farm research trials conducted in India on crossbred cows and fodder crops on rural farms was done. Figures indicate a wide gap between availability of and need for milk in the country.

Low production and per capita availability of milk in the country are due to poor productivity of milk animals, which can be attributed to poor genetic potential, poor nutrition, widespread disease, and lack of organized marketing and credit facilities. The average annual milk yields of Indian cattle and buffalo are only 181 kg and 438 kg, respectively.

To improve animal productivity and increase milk production, concerted research and extension are needed.

Results showed the economic viability and superiority of crossbred cows over animals kept by the rural households. Three crossbred cows kept on an acre of irrigated land generated net and family labor incomes of Rs. 1,345 and Rs. 2,772 per cow per annum, respectively. A three plot system of fodder production on small farms gave an average yield of 61,803 kg green fodder which was sufficient to feed four adult crossbred cows in one year. This indicates that three crossbred cows can be maintained profitably on one acre if intensive fodder crop rotations are followed. Highest average yields were obtained from a multi-cut mixture of fodder crops like sweet sudan, cowpea, teosinte, sorghum and pearl millet sown in summer (5,316 kg/ha) and berseem + mustard in winter (7,835 kg/ha). The analysis revealed that on-farm trials can help small farmers in selecting fodder crops for economical milk production.

Dairy farming that uses high-yielding animals and scientific practices has great potential to increase income and employment levels; therefore, on-farm research trials are important for disseminating new innovations and technology to the farmers. One can conclude that the technology demonstrated through on-farm research trials was technically feasible and economically remunerative and it can uplift the poor of India.

1081

Integrated systems
Review, book, UK, New Zealand, grazing management, grasslands,
animal production, animal feed, low-input systems, herbage intake,
grazing methods, sward monitoring, enterprise planning

HODGSON, J.

GRAZING MANAGEMENT: SCIENCE INTO PRACTICE.

Publ. of Longman Group, UK; ISBN 0-582-45010-1; 1990; £11.95

This is the latest book in the series 'Longman Handbooks in Agriculture'. It is an opportune time for the book to be published as research has advanced knowledge of grazed grassland considerably in the past 15 years. The author has been at the forefront of these advances. In particular, the understanding of sward dynamics and the animal behavioural factors influencing intake have been clarified by research. This has enabled the limitations to animal production from grazed grassland to be implemented to increase output. Reductions in government financial support for agricultural food products in developed countries will accelerate the move to lower input systems of production, which for ruminant animals means a greater reliance on grazing.

There are 20 chapters liberally sprinkled with tables and figures. Ten chapters deal with the principles of grazing including the grazed sward, the grazing animal, factors affecting herbage intake, food conversion efficiency and output from grazing systems. The resources of plants, soils, fertilizers and supplements are covered in four chapters. The final six chapters are devoted to applications, including grazing methods, sward monitoring and control and enterprise planning.

The book is written to answer the question of how the science behind grazing can be used by management to increase output, rather than how grazing management can draw on science to assist it, that is, it is science-driven rather than management-driven. Great reliance is placed on research experience in the UK, although the penultimate chapter on 'Enterprise planning and feed budgeting' reflects the author's more recent New Zealand experience. Extensive grazing on hills or rangeland is not covered, nor are grazing and plant species diversity.

The book is stronger on the principles of grazing mainly with intensive grazing. Being strongly research-based, it is directed more at the enthusiastic learner than at the superficial reader. Nevertheless this is an up-to-date, comprehensive account of the principles of grazing management, written by a world expert, which should make an important contribution to teaching in agricultural and applied biology.

1082

Integrated systems
Review, research report, Africa, Sub-Saharan, case studies, fish farming

LAZARD, J. et al.

FISH-FARMING IN SUB-SAHARAN AFRICA: CASE STUDIES IN THE FRANCOPHONE COUNTRIES - PROPOSALS FOR FUTURE ACTION.

AGRIDOC Inst. BDPA SCETAGRI, 27 Rue Louis Vicat 75738, Paris cedex 15, France; ISBN 2 11-086732-9; price 120 ff

Fish farming is a long-standing and traditional activity in Asia, but it is relatively new to Africa, arriving only in the last half century or so. Its potential has yet to be developed: the annual tonnage of fish, approximately 10,000 t, accounts for only 0.1% of world production. But the increasing demand for fish, especially in urban areas, means that there is likely to be a boom in aquaculture.

African fish-farming can be classified into several categories. At the lowest end of the scale is "family" aquaculture: the peasant farmer will dig out a pond by hand, with the help of family members, to rear tilapia for his domestic consumption only. This practice is common in many francophone African countries and often receives considerable aid from international organizations or NGOs for the breeding of young fish, extension and training work, personnel, etc. However, the results are universally disappointing, the farmers are not motivated, yields are low and incomes poor.

The second category is small-scale commercial aquaculture, which is beginning to be a significant factor, especially close to cities. The difference between this and family fish-farming is that it is essentially business concern which necessitates buying in materials and marketing the produce. For this reason fish-farmers establish their businesses close to town in order to make use of the urban infrastructure and the marketing potential. FAO has developed a project of this type in Côte d'Ivoire, in the Bouaké and Daloa regions. About 50 farmers have dug out their own ponds and now breed their own young stock and rear them with the help of the project staff. Research has shown that it is these small or medium-scale ventures which seem to have the best chance of succeeding.

The characteristic of the third category, 'network' aquaculture, is that its different stages (hatcheries, fish-feed processing, fish production) are separated.

This system is well-suited to some areas, for example where there are lakes, lagoons or water courses. The lagoons of Côte d'Ivoire have rearing projects in enclosures and cages, and Niger has set up cage culture schemes in the river. It particularly suits some sectors of the population - for example it can provide an alternative living for fishermen when their traditional sources of income are insufficient, and city businessmen are able to invest

capital in the hope of significant returns. However, further research into the ideal environment for fish-rearing and into improving feed is still necessary.

The final category - 'industrial', large-scale aquaculture - is carried out in sizeable production units. It depends on high productivity and, for example, raceways, tanks or cages, which demand considerable capital outlay. Burkina Faso set up the Banfora Aquaculture project of intensive-system fish production with cages and raceways, but hatchery and feed problems forced it to close down in 1986. An industrial fish farm in Brazzaville (Congo) forecast tilapia production of 500 tonnes per annum in concrete raceways using water pumped up from the nearby river. This enterprise was also bedevilled by numerous technical problems which slowed production, and financial results were well down on the forecasts. At present this type of fish culture is extremely problematic in that the cost of production is still considerably higher than the sale price.

All these categories of fish-farming are surveyed in this report, which has just been published by the French Ministry of Cooperation. It analyses the current state-of-the-art and suggests some future directions. Particularly useful are the many case studies used to support the theories put forward by the authors, and the analysis of socio-economic factors, especially the market study comparing farmed and wild fish. Also described in this book is 30 years' experience of experimental research done in the field. It addresses the problems of the training need to improve the technical and professional skills of African aquaculturalists.

1083

92 - 3/133

Integrated systems

Review, book, tropics, integrated crop-livestock-fish farming, concept, research framework, education, institutional framework, ICLARM, UNDP

EDWARDS, P. et al.

RESEARCH AND EDUCATION FOR THE DEVELOPMENT OF INTEGRATED CROP-LIVESTOCK-FISH FARMING SYSTEMS IN THE TROPICS.

Publ. by ICLARM, MC P.O.B. 1501, Makati, Manila, Philippines; ISBN 971-1022-46-x; 1988, 47 p. + annexes

In this publication, an attempt is made to create a framework for a truly interdisciplinary approach to research and education in integrated farming - a fusion of agricultural and aquaculture sciences.

Hunting/gathering/fishing preceded the development of agriculture but are still of importance in many third-world countries, particularly with regard to fish. Indeed, the capture of wild fish, as opposed to aquaculture, is still the major source of fish in most third-world countries.

The crop, livestock and fish subsystems may function independently in certain farming systems, and their products be only additive. An output from one subsystem in an integrated farming system, which otherwise may have been wasted, becomes an input to another subsystem resulting in a greater efficiency of output of desired products from the land/water area under a farmer's control. There is synergism in integrated farming since the working together of the subsystems has a greater total effect than the sum of their individual effects.

That means the word integrated is derived from the Latin verb "integrare", which means to make whole, to complete by addition of parts, or to combine parts into a whole.

The main biological feature of an integrated farming system is byproduct recycling; but improved space utilization, in which two subsystems occupy part or all of the space required for one subsystem, may be an important aspect of increased productivity. A major socioeconomic benefit of integrated farming is that inputs to the various subsystems that comprise the farming system tend to be intra-farm, with a diminished reliance on inter-farm or agro-industrial inputs. Integrated farming systems also spread the risks associated with farming because of the increased diversity of produce. They also lead to a more balanced diet for the farming family that chooses to eat some of its own produce.

A schema is presented in this study of the possible evolutionary development of integrated farming systems to set the research framework recommended here in an appropriate context.

Aquaculture science is a relatively new field of study.

The attention normally remains narrowly focused on the fish and the aquatic environment rather than on the farmer and the whole farm.

The greatest scope for the development of integrated crop-livestock-fish farming systems is in the humid tropics. This is where the need is also greatest.

This climate allows tropical fish to grow year-round.

The integrated farming systems discussed in this study make use of tropical fish, particularly the omnivorous tilapia which has been hailed as the "aquatic chicken" of the future. Tilapias breed and grow year-round in the tropics.

Integration of aquaculture with agriculture is more developed in Asia than in any other region of the world. Integrated farming systems are presently used by only a very small minority of farmers in a few countries and have not progressed far in terms of productivity and efficiency from their traditional beginnings.

A vast potential still exists for many more of Asia's numerous and needy small-scale farmers to enjoy the benefits of integration of aquaculture into farming systems. To realize this potential requires a new research and education program, as is proposed in this publication.

For Africa, the potential for aquaculture and integrated farming development is far less certain.

For many African nations there are serious constraints to aquaculture and integrated farming development.

A holistic view of the farm is essential. Aquaculturists must learn to understand existing crop and crop-livestock farming systems and agricultural researchers the fish farming subsystem. The processes of research and education for the development of integrated farming systems are therefore closely interlinked. This calls for an innovative approach to bring aquaculture into the mainstream of agriculture.

A cautious approach to aquaculture development is needed; not a rush into development by transfer of foreign technologies. Such a cautious approach should best be undertaken in parallel with further research for the development of Asian integrated crop-fish and crop-livestock-fish systems for which reliable management guidelines are still lacking.

1084

92 - 3/134

Integrated systems
Asia, Philippines, study, goat/fish farming, culture periods, tilapia

LIBUANO, L.P.

GOATS/FISH INTEGRATED FARMING IN THE PHILIPPINES.

AMBIO, 19, 8, 1990, pp. 408-410

This paper presents preliminary findings from the two 120-day fish-culture periods in a 240-day goat rearing cycle in the Philippines.

There is a government program for an effective approach to improving the quality of life of the people, not only in the urban communities but also in the rural areas through the livelihood project. The project is a centerpiece program and seeks to boost livelihood opportunities nationwide. Goat raising has become one of the priorities of the program. The small size of goats, their early maturation, inquisitive feeding habits and low capital investment must be exploited to spur development of intensive goat production including the utilization of the manure in fish culture.

The present project was initiated to determine the maximum rate of goat-manure loading and stocking density of Nile tilapia (*Oreochromis niloticum*) per unit area of fishpond and design a goat/fish integrated farming system that could give the highest economic return, with manure as the only added nutrient source.

This study was conducted in twelve 200 m² fishponds. The goat houses had a floor area of 0.75 m x 1.5 m per goat and were built partially overhanging the surface of the pond.

An integrated farming system offers several potential advantages, i.e. increased productivity, greater income, improved cash flow, fuller employment, a better diet for the farmer and his family and the spread of both biological and economic risks, since two subsystems are involved as opposed to one in a single commodity farming system. This strategy, however, requires knowledge and management skills.

The major constraint for small-scale farmers involved in aquaculture is the shortage and high cost of pond fertilizer and commercial feeds for the fish.

In the Ilocos Region, Philippines, intensive goat raising is possible due to the high demand for chevron (goat meat) which is the main delicacy of the Ilocanos. Intensification is greatly limited by the problem of waste disposal. Many Ilocanos are engaged in small-scale aquaculture, but operations are hindered by the shortage and high cost of commercial feeds and fertilizer for their fish ponds. This goat/fish production trial described employ 0, 200, and 300 goats with fish-stocking densities of 10,000 and 20,000 of Nile tilapia (*Oreochromis niloticus*) per ha. The highest individual fish weight (78.05 g), in a 120-day fish-culture period, was recorded for the combination of 300 goats and 10,000

O. niloticus per ha, whereas the lowest gain (45.95 g) was obtained at the stocking density of 20,000 *O. niloticus* per ha without goat manure. The highest total fish yield of 1170 kg x ha⁻¹ was recorded for a combination of 20,000 *O. niloticus* and 300 goats per ha. Currently, the goat manure loading per ha is increasing to 400, 500, and 600 goats.

Concluding in the two trials conducted, the growth of tilapia increased with the rate of goat manure loading. This indicates that the fish feed produced in the ponds with goat manure is being efficiently utilized by the fish biomass. The analysis shows that the highest net return of Philippine dollars 129872 was obtained from the 300 to 20,000 combination followed by the 300 to 10,000 per hectare (PD 108952.50). If the present trend in some local markets prevails where large fish fetch significantly higher prices than small-size fish, the 300 goat to 10,000 fish per hectare combination would be more profitable.

Raising goats and developing a family-level fishpond for small-scale use could help to decrease protein malnutrition.

The integration of goat with tilapia production is a means of establishing a sustainable farming system aimed at maximizing productivity and minimizing operational costs. There is great potential for this production as the demand for milk and meat is high.

1085

92 - 3/135

Integrated systems
Africa, Rwanda, aquaculture, project, techniques, extension,
organization, farm structure, USAID

MOLNAR, J.J.

THE SUSTAINABILITY OF AQUACULTURE AS A FARM ENTERPRISE IN RWANDA.

J. of Applied Aquaculture, 1, (2), 1991, pp. 37-62

The objective of this article is to identify correlates of self-sufficient practice of fish culture by Rwandan farmers. It focuses on the degree to which fish farmers have achieved autonomous confidence in growing tilapia and on their relative willingness to forego dependence on government services.

Data were obtained from a sample of active Rwandan fish farmers randomly selected from project rolls.

Fish culture is one of many diverse efforts to increase food production and food security by producing a much-needed protein crop.

Although first introduced by Belgian colonialists in the 1950's, in the past decade fish culture has experienced a renaissance in Rwanda. Beginning in 1983, the Rwanda National Fish Culture Project has assisted farmers with the upgrading of their ponds and identified the Nile tilapia, *Oreochromis niloticus*, as a species suitable for the high-evaluation, cool-water environment. Average annual yield among project participants was raised from an initial annual of 300 kg/ha to 1,550 kg/ha.

The purpose of the USAID Rwanda Fish Culture Project was to assist the Ministry of Agriculture in the development of an Aquaculture Extension Service to provide technical assistance to Rwandan farmers. In its seven years of operation, the project has established four fish stations, trained over 60 extension agents, and helped establish over 1,150 private ponds. Aquacultural extension representatives assist farmers with pond construction, fish production, and related activities.

A tilapia production system has been implemented by farmers, utilizing readily-available inputs to grow fingerlings to market-sized fish. Nearly 20,000 farmers and family members are associated with the project.

Most respondents planned new ponds; most felt capable of doing without extension assistance; and very few reported conflicts with other enterprises. When extensionists visited more frequently, farmers attended to their ponds more frequently. Wealthier farmers were less happy with the technical assistance they received. Women gave the male extension representatives lower helpfulness ratings. The results showed the advanced degree to which farmers have grasped the technical aspects of fish culture and their relatively favorable perceptions of the extension assistance.

The survey responses suggest that farmers expect to continue growing fish. Many of the factors that affect the independent

practice of fish farming depend on the government and are beyond farmer control.

Several contextual factors not measured in this study affect the prospects of aquaculture in Rwanda, regardless of its ecological, socioeconomic, or nutritional merits. The commitment of the Rwandan government may shift to other priorities, not the least of which is threats to national security. Donor priorities about environmental and natural resource issues may induce reallocations of scarce internal funds. The financial condition of the country may disrupt the payment of salaries or fail to provide sufficient resources to recruit and train additional staff or replacements. The extension administration may fail to allocate sufficient travel funds for the moniteurs. Farmers have little way of knowing or understanding the larger national questions about the direction of agricultural policy or the status of foreign exchange and the need to redirect spending to produce export crops.

Production schemes that fail to gain the confidence and enthusiasm of farmers will generate neither food nor revenue. As a consequence, a central aspect of sustainability of fish culture is the extent to which the farmers understand and use the technology in their normal pattern of farming.

One threat to the evolution of fish culture in Rwanda is that improperly constructed ponds will undermine the success achieved by project participants. Ponds that are too small, leaky, or have continual water flows that waste nutrients and chill pond waters create negative examples that undermine the reputation of the enterprise.

To summarize, the Rwandan farm data showed only limited connections between the sustainability indicators and the variable sets identified. The results showed the advanced degree to which farmers have grasped the technical aspects of fish culture and their relatively favorable perceptions of extension assistance. An important next step in the evolution of aquaculture in Rwanda is to identify spontaneous emulators and provide the necessary corrective assistance to assure the proper realization of fish culture. It also will be important to understand why some farmers did not undertake aquaculture and others turned pond land to other uses.

1086

Integrated systems
Asia, Malaysia, aquaculture, prawns, crawfish, ponds, rice production, aquatic macrophytes, grass carp, water quality

GRANADOS, A.E. et al.

DOUBLE-CROPPING MALAYSIAN PRAWNS, *MACROBRACHIUM ROSENBERGII*, AND RED SWAMP CRAWFISH, *PROCAMBARUS CLARKII*.

J. of Applied Aquaculture, 1, (1), 1991, pp. 65-77

The objectives of this study were:

- to determine the effects of three crawfish stocking densities on survival, growth, and yield of prawns and crawfish cultured in a double-cropping scheme;
- to contrast survival, growth, and yield of prawns cultured with crawfish with those when prawns are cultured in a monoculture system; and
- to compare survival, growth, and yield of prawns fed a commercially formulated diet in the double-cropping system with those of prawns that are cultured in double-cropping systems that receive no formulated feed.

Prawns, *Macrobrachium rosenbergii*, and crawfish, *Procambarus clarkii*, were alternatively grown in ponds to determine if they were compatible and if total production could be increased. Brood crawfish were stocked into replicated ponds at rates of 0, 60, 120 or 180 kg/ha on 18 April. Water was removed to encourage burrowing. Following this, rice was planted as forage. Post-larval prawns (0.02 g) were stocked 3 July in all ponds at 17,500/ha. Prawns in half the ponds were fed and those in the other ponds were not. Ponds were drained from 7 to 11 October. Prawn production ranged from 157 to 248 kg/ha; survival ranged from 69% to 88%, and average size ranged from 11 to 17 g. There was no significant difference ($P > 0.05$) between fed and non-fed treatments. The ponds were reflooded and crawfish were harvested by trapping from 15 January to 15 May. The average yield of crawfish ranged from 746 to 1,266 kg/ha. Stocking rate had no effect on crawfish yields ($P > 0.25$). Total yield, with prawns and crawfish combined, ranged from 1,037 to 1,237 kg/ha. Overall, prawns and crawfish were compatible in rotation.

This study demonstrated that prawns and crawfish are compatible in pond production and that one crop of each can be produced annually in the same pond. To achieve this, pond management strategies had to be modified. For example, rice was planted as forage only in the shallow area of the pond, and a deep portion was left open for initial stocking of prawns. While the crawfish yield in ponds was acceptable (1,000 kg/ha), prawn yield was low due to small size at stocking (0.02 g), low stocking rate (17,500/ha), and short growout period (93 days).

The ongoing goal of most commercial prawn growers is to produce a large prawn (30 g+), but when prawns exceed approximately 17 g they begin to segregate into different size groups. Up to 17 g,

there is virtually no size distinction, even between males and females. Successful marketing of such small individuals would produce additional revenue.

Crawfish are normally not available during summer and early fall, but prawns can be harvested during this period. The ideal size of prawns for molting troughs is about 17 g. Thus, prawns could possibly fill both a biological niche (rotation with crawfish in ponds) and a market niche (soft shell). Preliminary research indicates that prawns can be molted in the same shedding tanks as crawfish, and this could allow year-round production of a soft-shell product. The implementation of this would require new management strategies. Crawfish may have to be cultivated differently by introducing a formulated diet instead of allowing them to feed on rice forage. This management strategy could also produce a larger, more valuable crawfish (33 or less per kg), especially for the European market. Additionally, stocking systems will have to be developed to produce a 17-g prawn during those months when crawfish are normally not available. This study suggests that production of 17-g prawns is possible. Future research should concentrate on stocking dates, stocking sizes, stocking rates per hectare, and length of grow-out period.

1087

92 - 3/137

Integrated systems

Asia, Malaysia, study, rice, fish, farming systems, resource utilization

AHYAUDIN, B.A.

RICE/FISH FARMING IN MALAYSIA: A RESOURCE OPTIMIZATION

AMBIO, 19, 8, 1990, pp. 404-407

This paper summarizes and discusses the ecology as well as rice/fish farming system as practiced in North Kerian, Perak, Malaysia.

In Malaysia, where arable land is limited, integrated farming systems are widely practiced to optimize land use. Integrated rice/capture-fish farming is an example and is an important source of freshwater fish.

Capture-fish farming is practiced in North Kerian, Perak, Malaysia, where wild fish are retained and grown in the rice fields and later harvested at the end of the rice-growing season. Sump ponds, dug at the lowest part of the rice fields, provide refuges for fish during periods of low water availability or quality and facilitate fish harvest.

Before the early 1970s, when single cropping of rice was practiced, the system was the major supplier of freshwater fish, especially snakeskin gouramy (*Trichogaster pectoralis*), catfish (*Clarias macrocephalus*), and snakehead (*Channa striata*). But when double cropping of rice began in the 1970s followed by the widespread use of herbicides and pesticides, fish harvest began to decline.

The system described here requires no biological and little economic input, and native fish are found to be both biologically and economically suitable. The system can utilize different specific habitats, the fish are tolerant to extreme physiochemical changes, and command good market prices. The different feeding habits of the predatory snakehead (*Channa striata*), omnivorous catfish (*Clarias macrocephalus*), insectivorous climbing perch (*Anabas testudineus*), and plantivorous-omnivorous gouramies (*Trichogaster pectoralis* and *T. trichopterus*) indicate possible yield improvements through rice/fish polyculture. Aquatic productivity of the prevailing ecosystem is low despite repeated seasonal fertilization. Productivity is probably low due to shading and competition with aquatic weeds and rice plants. Zooplankton is not readily available to the fish larvae and fingerlings because aquatic weeds provide easy refuge. This lack of food results in fish below marketable size. The short growing season resulting from double cropping, coupled with widespread use of herbicides and pesticides, also affects fish production.

The shorter growing due to double cropping of rice cannot be avoided since it is the policy of the government to increase rice yields. Increasing the system's productivity is the only way to increase fish yields.

Integration of other farming activities into the rice/fish-capture farming system are being tried in order to fully optimize land use. Extra income could be obtained by properly planting the large dikes surrounding sump ponds with valuable fruit trees such as coconuts (*Cocos nucifera*), bananas (*Musa* spp.) and mangoes (*Mangifera* spp.).

Farmers also planted the perimeter dikes with produce such as tapioca (*Manihot* spp.), squash (*Cucurbita* spp.), and sweet potato (*Ipomea batatas*) that can either be used at home or sold at the local market.

These and other activities are a recent addition to the traditional rice/fish-farming system and further investigations should be undertaken to determine their economic feasibility.

1088

Integrated systems
Review, fishfarms, farming, biotechnology, transgenic fish,
aquacultural genetics, feed conversion, environmental impact
BIOTECHNOLOGY AND DEVELOPMENT MONITOR

BIOTECHNOLOGY IN FISHFARMS: INTEGRATED FARMING OR TRANSGENIC FISH?

Biotechnology and Development Monitor No. 7, 1991, pp. 3-6

For many developing countries fish trade represents a significant source of hard currency. Although the developing countries' share in world fish exports remained stable at 45 per cent, net fish exports from developing countries doubled between 1985 and 1989 to US\$ 10,5 billion. Industrialized countries accounted for about 90 per cent of total fish imports in 1989. Aquaculture had already its share in the net export increase, and the application of biotechnology may boost fish exports even more.

Demand for fish is soaring worldwide. It appears unlikely that the increasing demand can be met through increased natural harvest. Aquaculture could help to meet increasing demand, and biotechnology can make a contribution to improve aquaculture yields.

In Asia, where the bulk of aquacultural products is produced, aquaculture has a long-standing tradition as an extensive low input production system, practiced by resource-poor farmers. Recent interest in aquaculture biotechnology in industrialized countries could have a positive spin-off for these systems. To be effectively applied to small-scale systems, aquacultural biotechnology methods should start from the more traditional technologies already in use. The efficiency and relevance of these technologies are impressive.

Organic agricultural wastes can be recycled as fish feed. Rice bran, for example, or the brown crust of rice which become available after rice polishing, possibly mixed with mustard or ground nut oil cake, is a very good feed for fish. Soybean cake and wine residues are also given as feed to carps, while grass carps are fed with chopped soft grass and vegetable tops. Wastes from livestock and poultry are recycled too, in some systems by dropping the manure directly into the ponds, thereby raising the production of algae, protozoa and zooplankton.

Mahua oil cake, a residue from oil extraction, is used in India to kill predators in the ponds before fingerlings are stocked. Mahua cake works as poison at the initial stage, but loses all its toxicity after 15-20 days and is then valuable as fertilizer. In Malaysia teaseed cake is used to kill predators.

For cleaning the ponds, duck weed is used in India. To increase alkalinity, banana stem cuttings are allowed to rot in the water. Planting of tamarind leaves and stems have the effect of decreasing alkalinity of pond waters. Lotus plants maintain oxygen balance in ponds.

Widely adopted in southeast Asia also, is polyculture. In this system, a compatible group of 3 to 6 non-predator fish species of

different feeding habits are introduced together in the same pond so that all types of food produced either at column, bottom or surface, are effectively consumed by fishes.

In order to be helpful, biotechnology should be integrated with these traditional methods. Newly introduced techniques must be comprehensible to farmers, and should use materials locally available.

Much of the current biotechnology research, however, seems to be directed at high input aquaculture production that requires, e.g. a well trained staff, pumps, tubewells and formulated feeds. To justify these costs, farmers need to produce high value products which often go for export, since in developing countries only the relatively wealthy can afford to eat their products. In poor communities, even the costs involved in building a small pond might be beyond financial reach of the farmer.

The impact of aquaculture on the environment varies by rate of intensity of the production system. According to ICLARM, even the more extensive aquaculture systems (where little or no feed or fertilizer inputs are used) may lead to the destruction of ecosystems, and pose health risks to workers from water borne diseases. Especially in integrated agriculture-aquaculture systems, toxic substances in livestock feeds (e.g. heavy metals, pesticides, or antibiotics) may accumulate in pond sediments and fish.

Intensive aquaculture systems, mainly reliant on external feed and fertilizer inputs, will have additional abusive effects because of pollution by effluents. Escapes of exotic modified, or genetically modified organisms on ecosystems may have an unpredictable impact as well.

Increased aquaculture productivity may lead to oversupply and declining world prices in specific markets. Shrimp trade is the most significant example. Shrimp trade amounts to over 20 per cent of world fishery trade, with more and more supplies coming from culture ventures. Main exporters are China, Taiwan, Thailand, Indonesia, and Malaysia. Shrimp breeding has recently also been taken up in India, Bangladesh, Sri Lanka, Ecuador, and Mexico. Prices are likely to remain weak in the future, as shrimp farming is expanding enormously throughout developing countries.

1089

Integrated systems
Review, book, semi-arid zones, case studies, agricultural engineering, crop production, tillage systems, dry farming, soil properties, soil erosion, management systems, tillage equipment, FAO

GODWIN, R.J.

AGRICULTURAL ENGINEERING IN THE DEVELOPMENT: TILLAGE FOR CROP PRODUCTION IN AREAS OF LOW RAINFALL.

FAO Agricultural Services Bulletin 83, FAO, Rome, Italy; ISBN 92-5-102542-8; 1990, 119 p. + annex

The objective of this publication is to provide perspectives and guidelines in the formulation of tillage strategies for the low rainfall areas, where dry-farming is practiced.

A better understanding is needed of the effects of tillage on the soil physical, chemical, and biological environments and how these environments are altered by various tillage practices.

Conservation tillage systems have been developed in a number of countries where dryland farming is practiced, but the scope of development considerably lags behind that for more humid regions.

There is little published material available concerning the efficiency of traditional dry farming systems that have been developed in Africa and Asia.

The primary objectives of tillage in any cropping system are to control weeds, enhance soil water storage and retention, reduce erosion, and to prepare a desirable seedbed.

The success of dry-farming depends heavily on the ability of the farmer to conserve water, and also to establish a suitable environment for seed germination, root growth, and control of soil erosion.

Dry-farming is practiced in the low rainfall or semiarid regions, where average annual precipitation is generally less than 500 mm.

Soils are often shallow, sandy, low in organic matter, and highly vulnerable to erosion when the surface is unprotected. During the wet season high intensity rains may result in severe runoff and erosion, and this is often followed by dry periods and severe wind erosion.

Tillage systems are generally referred to as reduced, minimum, or low tillage systems and zero till.

Conservation tillage is a term that is widely used to denote tillage systems that emphasize water conservation and erosion control.

The chapters carefully analyze:

- tillage effects on soil physical properties,
- organic matter dynamics,
- erosion,
- plant response,
- alternative tillage,
- planting equipment.

Conclusions and recommendations are drawn specifically to:

- tillage practice,
- water infiltration and conservation,
- erosion control,
- soil fertility,
- crop response,
- tillage implements,
- planting equipment.

An integrated approach is required to meet the tillage objectives for optimum seed preparation, weed control, erosion control, water conservation, and preservation of organic matter. This is a reference book to assist scientists and extension workers in explaining alternative tillage practices.

IV CROPPING SYSTEMS

1090

92 - 4/133

Cropping systems

Asia, review, lowland, green manure crops, rice, cropping systems, rainfed conditions, irrigation, food production, crop productivity, high-yielding varieties, fertilizer, nitrogen source, legumes

ABROL, I.P. and S.P. PALANIAPPAN

GREEN MANURE CROPS IN IRRIGATED AND RAINFED LOWLAND RICE-BASED CROPPING SYSTEMS IN SOUTH ASIA.

In: Proc. of a Symposium on Sustainable Agriculture, IRRI, Philippines, ISBN 97-104-189-8, 1988, pp. 72-82

Green manuring is the practice of incorporating in situ easily decomposable plant material either from crops grown specifically for organic fertilizer or plant materials brought from outside the field. In situ green manuring is done by turning under the entire plant, usually a leguminous crop. When brought from outside, the green matter may consist of leaves, twigs, and loppings from selected trees or bushes.

Increased food production must come primarily through increased crop productivity and increased cropping intensity. In India, food production has nearly doubled in the last two decades. This has been achieved through the adoption of high-yielding crop varieties, intensive cropping, and improved management practices, including improved fertilizer use.

Nearly one-third of the total N consumed in Indian farming is used for rice. Rice is grown over an area of about 40 million ha. A considerable fraction of the P and K fertilizer used is also for rice. Fertilizer production in India lags behind actual consumption, compelling large imports worth more than US\$ 1 billion annually. The increase in fertilizer prices combined with the low purchasing power of farmers is imposing serious limitations on increased crop production and calls for increased efforts to mobilize cheaper and alternative sources of nutrients.

The advent of high-yielding crop varieties in recent years caused organic manure use to decline in favor of mineral fertilizers. There is renewed interest in organic manure, largely because increasing costs of fertilizers, greater incidence of multiple nutrient deficiencies, and deterioration in physical soil properties are resulting in reduced yields.

Farmyard manure, compost, and green manure are the organic materials commonly used. Because the availability of farmyard manure and compost is limited, green manure offers greater potential as a feasible and cheaper substitute for fertilizer N. Green manuring techniques differ in rice-growing regions. The various techniques are described in this paper.

Research shows almost universal beneficial effects of green manuring on rice yields. Green manure can substitute for up to 60-100 kg fertilizer N/ha. Many studies have shown it can enhance the availability of native or applied P and of micronutrients. Green manuring hastens the reclamation of alkali soils, largely because increased CO₂-production during decomposition of the green manure crop enhances the solubility of lime.

An alternative to growing a crop exclusively for green manure is to grow a short-duration pulse (e.g., mungbean *Vigna radiata*, cowpea *V. sinensis*) for a green pod harvest and straw incorporation.

Although the value of green manuring for increasing rice production by supplying nutrients and maintaining soil productivity is well established, the practice has not been widely adopted by rice farmers.

Farmers are unable to appreciate the benefits of green manuring, since the benefits sometimes are not as spectacular as those observed from direct application of inorganic fertilizers.

Green manuring has a large potential to augment nutrient supplies. Improved experimentation is needed so that crop responses to green manuring can be quantified. The factors responsible for crop responses must be identified to develop sound scientific strategies for green manuring practices.

The patterns of nutrient release during green manure decomposition and the patterns of rice crop utilization need to be better understood. The long-term effects of green manuring on soil properties and crop responses need evaluation. Knowledge of the changes in soil physical properties would be particularly valuable. Organic matter decomposition sets up a chain of physiochemical events which alter the form and availability of several nutrient elements. Green manuring has a special place in problem soils of low fertility and those with alkali problems. Identification of species or strains that accumulate high N or biomass is another research area of importance.

1091

Cropping systems

Africa, Nigeria, humid tropics, lowlands, study, field trials, intercropping systems, maize, melon, yam, soil water content, soil temperature, root length, crop performance

GHUMAN, B.S. and R. LAL

COMPARATIVE EVALUATION OF SOME INTER-CROPPING SYSTEMS IN THE HUMID TROPICS OF SOUTHERN NIGERIA.

Journal of Sustainable Agriculture, 2, (2), 1991, pp. 59-73

The present study was conducted to investigate the effects of intercropping maize with a mixture of melon and yam on soil moisture, soil temperature, rooting characteristics, and productivity of intercrop on an Ultisol in the humid tropical region of southern Nigeria.

Although much attention has been given to intercropping over the last two decades, there has been little research done on the effects of intercropping on soil moisture and temperature, particularly so in mixtures with more than two component crops. Traditionally, farmers in southern Nigeria would grow five or more annual and perennial crops simultaneously.

Field experiments were conducted near Benin City, southern Nigeria.

Before the initiation of the present trial, field plots were under no tillage for 2 years and, therefore, the same system was followed for this investigation also. Three plots, each measuring 30 x 60 m, were marked for intercrop and nine plots, each measuring 8 x 30 m, for sole crops. The intercrop treatment comprised maize, melon and yam. Local cultivars of yam and melon, grown by farmers of the region, were grown for these experiments. Yam sets, weighing 200 to 250 g each, were planted at 1 x 1 m spacings. Melon was planted at 0.5 x 1 m spacings in the yam rows so that there were two melon plants between a pair of yam plants. Maize (cv. TZSR-W in 1987 and TZSR-Y in 1988) was planted between yam + melon rows at 0.3 x 1 m spacings. Planting of crops at a given spacing was carried out on the same day in the intercrop and monoculture plots. After planting, 400 kg ha⁻¹ of 15:15:15 NPK mixture fertilizer was carefully spread on the maize rows alone. One month later, the second dose of N (60 kg ha⁻¹) as calcium ammonium nitrate was side-dressed to maize after thinning to one plant per hill. About 2 months after germination, yam vines were supported with wooden stakes over 3 m long.

At 0.10 m depth, the soil was desiccated most under the intercrop compared with monocrops. The trend changed at 0.30 m depth where minimum soil water was under sole maize. At 0.01 m depth, maximum soil temperature in the intercrop was lower by 1-2°, 8-10° and 8-11°C in relation to monocultures of melon, yam and maize, respectively, depending on insolation load and soil moisture content. At 0.20 m depth, however, temperature differences between intercrop and monocrops were much smaller due to soil's damping

effect. Intercropping decreased plant height and leaf area index of maize as compared to monocropping. Maize root length density in the 0-5 cm layer under the row was lower in the intercrop than sole crop, but in the 10-20 cm layer this was reversed. The intercrop of maize, melon and yam produced 61 and 98% more food than monocrops in 1987 and 1988, respectively, as assessed by area x time equivalent ratio.

The intercrop was more productive in terms of food production per unit area than the monocultures as indicated by the values of LER. For example, intercropping produced 130 and 167% more food per unit land area than component monocultures in 1987 and 1988, respectively. LER does not take into account the growth periods of crops and is considered an inappropriate index for evaluating the potential productivity of a mixture consisting of crops of widely different maturity periods. The point is that if long duration crops (yams in the present study) had not been grown, two crops of shorter duration, e.g., maize or melon, could have been taken in a year. The ATER was 1.61 and 1.98 in 1987 and 1988, respectively. This index confirms the earlier conclusion drawn by LER that productivity of the intercrop was higher than monocultures per unit area but not as high as is indicated by LER.

1092

Cropping systems
Latin America, Colombia, study, intercropping, land-use
efficiency, cassava, maize, yam, yield performance

CIAT

INTERCROPPING IMPROVES LAND-USE EFFICIENCY.

CIAT Report, Cali, Colombia, 1989, pp. 15-17

Associated cropping reduces the chances of the farmer losing everything to pests, drought, or diseases. If one crop fails, the other may survive and will compensate for the loss or provide at least some food or earnings. Another advantage of intercropping is that it often makes more efficient and intensive use of available labour. Most researchers agree that unless socioeconomic conditions change radically during the next few years, small farmers will continue to practice intercropping.

One of the most common association used by small farmers in the tropics are systems involving maize and cassava. The farmers have discovered by trial and error that if they lose their maize they can fall back on their cassava. Cassava is well known as a hardy crop that can withstand very stressful conditions.

CIAT Cassava Program in conjunction with Colombia's national program were conducting research designed to make this practice better.

For farmers in the northern coastal plains of Colombia the most common problem is lack of land, caused by a combination of rural population growth and the traditional pattern of land inheritance. Constant division of available land has left north coast farmers with an average of 5-6 ha, about 50% of which is maintained in natural pastures or left fallow to restore soil fertility. With natural or chemical nutrients difficult to obtain, they must make as efficient use of the land as possible.

It was interesting to find that the local maize varieties competed more aggressively with cassava than the improved varieties. Grown under farmers' conditions, cassava yielded an average of 16 t/ha of roots in sole cropping and 11 t/ha in association with the improved varieties of maize. Yet, when cassava was grown with traditional maize varieties, it only yielded 8.8 t/ha. Improved maize varieties, on the other hand, yielded 2.6 t/ha in sole cropping and 2.0 t/ha in association. Traditional varieties yielded 1.5 t/ha in sole cropping and 1.3 t/ha in association. This indicates that the improved maize varieties not only yield higher in monocropping but also in intercropping, while cassava intercropped with these improved maize varieties also yielded more.

The intercrop produces a land-equivalent ratio of 1.4. That is, 40% more land would be necessary to obtain the same production as from sole cropping.