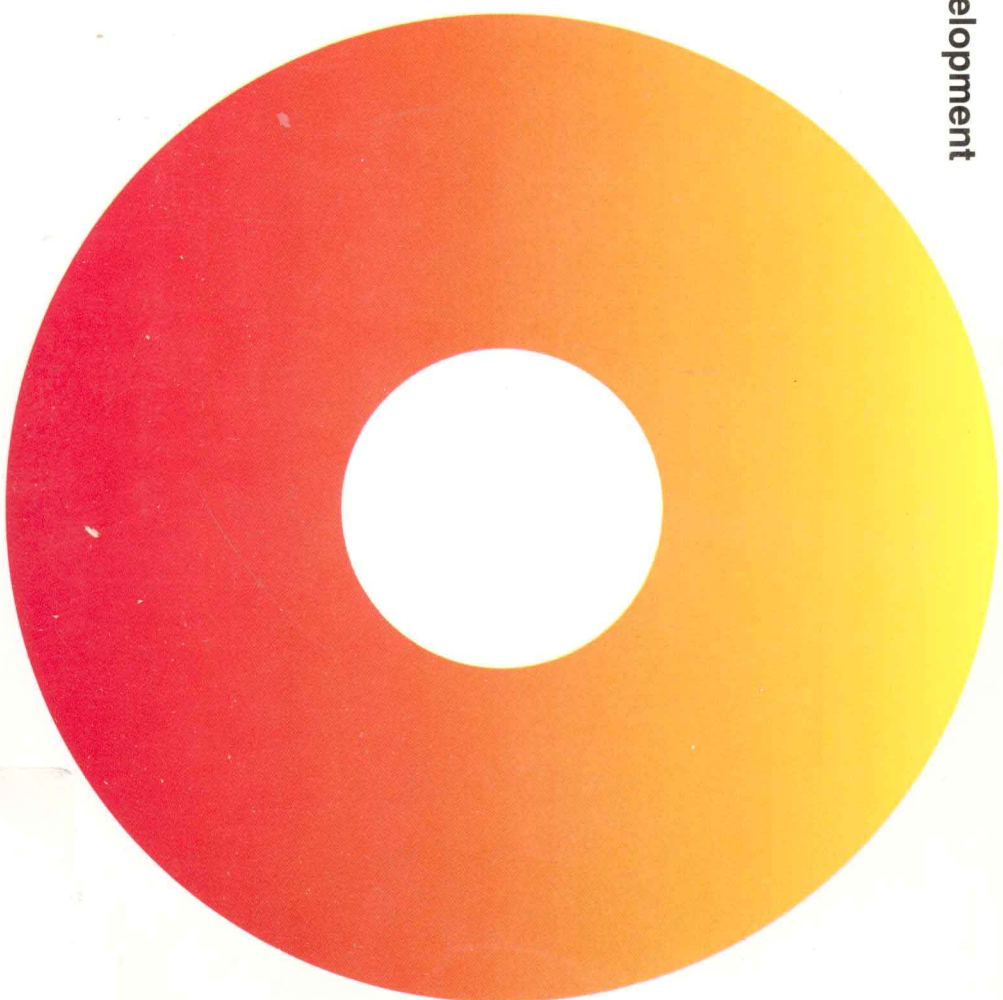


# **Food and Energy**

**Strategies for Sustainable Development**

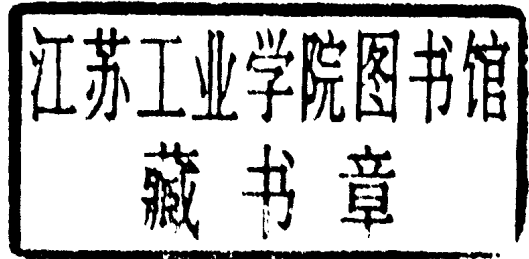
**Ignacy Sachs and Dana Silk**



# Food and Energy

## Strategies for Sustainable Development

Ignacy Sachs and Dana Silk



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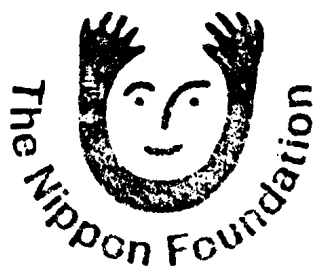
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SEMPAKU SHINKO BLDG., 1 15 16 TORANOMON  
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### **Note to the Reader from the UNU**

The Food-Energy Nexus Programme was launched in 1983 to fill the research gap that existed on the synergistic solutions to food and energy problems. The programme consisted of a two-pronged effort directed towards developing an analytical framework and planning methodology as well as stimulating the sharing of experiences between research teams working in Asia, Africa, and Latin America. It addressed such concrete issues as (i) a more efficient use of energy in the production, processing, and consumption of food; (ii) food-energy systems in diverse ecosystems; and (iii) household economy in both rural and urban settings and the role of women and children in the provision of food, fuel, and water. *Food and Energy: Strategies for Sustainable Development* sums up the research findings and their policy implications in comparative regional perspectives.

## **Preface**

This publication is based on the activities of the Food-Energy Nexus Programme (FEN) of the United Nations University (UNU) which took place between 1983 and 1988. As is the custom with the UNU, most of this research was done by researchers associated with various universities or research centres around the world. In this case, considerable work was done by researchers in third world countries in order to promote South-South co-operation in the fields studied.

We wish to express our gratitude to the many people who contributed in various ways to FEN and to acknowledge the institutional support of the Maison des Sciences de l'Homme in Paris. At the same time, we assume entire responsibility for any misinterpretations or omissions that may be apparent in the following chapters. For more detailed information, readers are referred to Appendices I and II, which reprint the descriptions of FEN programme activities and publications found in its final report.

We hope that this complementary analysis of FEN concepts will contribute to the preparatory process for the second United Nations Conference on the Environment and Development in 1992 by helping to identify future research, development, and implementation activities for the sustainable production of, and more equitable access to, the basic human needs of food and energy.

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## Introduction

For most people, the relation between food and energy problems first became evident as a result of the oil crisis in the early 1970s. While immediate attention was given by industrialized countries to ensuring adequate oil supplies to fuel their energy-intensive food systems, long-term concerns were raised about the plight of the rural and urban poor in third world countries with the realization that the high cost of energy and fertilizers would further limit the scope of the Green Revolution.

Beyond the oil price problem loomed the second energy crisis, with even greater social and ecological consequences for more than half of the world's population. In practically all third world countries the problems of getting food to eat began to be overshadowed by the problems of acquiring the energy needed to cook it. Apart from the financial sacrifices, there was a severe strain on time budgets, notably those of women and children, who spend increasingly long hours collecting fuelwood (Cecelski 1987). These problems are exacerbated by the seasonal imbalance in biomass supply and the vicious cycle of greater quantities of dung being used as fuel rather than as fertilizer for maintaining crop production.

These developments have already been amply documented, but much less research is available on the synergistic solutions to food and energy problems. The Food-Energy Nexus Programme (FEN) of the United Nations University (UNU) was thus created to help fill this gap through a two-pronged effort: to develop an analytical framework and planning methodology; and to stimulate the sharing of experiences between research teams working in Asia, Africa, and Latin America.

Speaking at an intergovernmental meeting of development assistance co-ordinators in Asia and the Pacific, held in February 1981 in New Delhi, the Rector of the UNU, Soedjatmoko (1981), first made reference to what was to become FEN:

Rising fuel prices, boosting transportation and agricultural costs, will inevitably push food prices beyond the reach of hundreds of millions of already hungry people. Rising



## 2 *Food and Energy*

populations, despite the best efforts to reduce fertility rates, will continue to increase the demand for both food and energy. The developing countries will not be able to solve their food problem without solving their energy problem and, without a satisfactory solution to both, their economic growth will be severely constrained. The centrality of the food and energy nexus calls for a comprehensive policy approach. Only through a clear understanding of this food-energy pivot can the situation be turned around.

The following year, Sachs (1982) described the food-energy nexus as a convenient entry point into the problematique of efficient resource use patterns for sustainable development and of local solutions to global problems.

FEN was thus initially designed to develop the following activities:

- policy-oriented studies of the energy profile of food systems to identify options leading to a more efficient use of energy in the production, processing, distribution, preparation, and consumption of food;
- analyses of integrated food-energy systems in diverse ecosystems, including studies of how different cultures manage to extract from similar environments their food and energy supplies; and
- research on the household economy in both rural and urban settings and the role of women and children in the provisioning of food, fuel, and water.

Further attention to the conceptual development of FEN resulted in the sharpening of its focus around two axes: integrated food-energy systems as a catalyst for rural development and industrialization; and alternative urban development strategies based on greater self-reliance. The FEN description that was prepared in 1985 remained more or less unchanged during the lifespan of the programme:

FEN is predicated on the idea that positive synergies can be developed by addressing simultaneously the ideas of production and access to food and fuel and by building around these twin objectives self-reliant development strategies. It thus promotes action-oriented, interdisciplinary research in the following four areas:

1. integrated food-energy systems based on closed-loop ecological models and adapted to site-specific environmental and cultural conditions;
2. social innovations in the urban setting leading to greater equity, efficiency, and sustainability in the use of resources to improve access to food and energy by the urban poor;
3. social impacts of food processing and energy-producing technologies; and
4. adaptation of resource-use patterns in diverse ecosystems for the provisioning of food and energy to the rural and urban poor.

The broad scope of FEN and the modest resources that it had available pointed naturally to the significance of its “enzyme” role. It was thus active in inspiring projects funded from local sources, assisting third-world-based research organizations in the design of such projects, stimulating real-size experiments, collecting and disseminating information in the form of state-of-the-art reports, and promoting the exchange of scholars and bringing them together in

workshops and through networks. Special attention was paid to the “third system” or citizens’ organizations through, *inter alia*, the urban self-reliance project that was implemented with the International Foundation for Development Alternatives (IFDA) in Nyon, Switzerland.

From the very beginning, an effort was made to give a global learning dimension to FEN and to emphasize South-South co-operation. This began with a study tour by four Brazilian researchers to Senegal, India, and China and was facilitated by FEN conferences that were subsequently held in Latin America, Asia, and Africa. This policy of strengthening research capacities in third world countries and improving communication between people working on similar issues was also adopted by FEN projects in the urban field.

## Analytical Framework

### Local Solutions to Global Problems

Before referring to specific work on integrated food-energy systems in rural areas and alternative urban development strategies, it may be useful to highlight the conceptual framework which provided the intellectual impetus for FEN.

Food and energy are global problems in at least four ways. First, their regular and continuing availability is a condition *sine qua non* of human survival, posing a formidable challenge that must be tackled simultaneously from both the supply and demand sides. Food and fuel stocks are of no help and little consolation to people who cannot afford to buy them and have no access to the resources needed to produce them.

Second, assuming optimistically that humanity will manage to solve the problems posed by its bare survival, the quality of life of millions of people will still depend to a great extent on increased supplies and better use of both food and energy; their central role in a need-oriented development strategy is only too obvious.

Third, both food and energy loom large in the North-South confrontation as potential weapons and tools of domination; hence the importance of global negotiations to modify the present gloomy picture and bring about some constructive international co-operation in both fields.

Finally, food and energy production affect and are affected by the state of the environment: energy-, land-, and water-use patterns will increasingly influence the climate and other aspects of our life-support systems. This will have far-reaching consequences for the long-term prospects of food and energy production in semi-arid areas and threatens the very existence of flood-prone coastal settlements, home to millions of people.

In contrast with the considerable research effort that has been spent on each of these problems in their own right, however, little attention has been paid to the food-energy nexus or the systematic exploration of the ways in which they

are linked. Must we be reminded that the prospects for both of these resources, treated individually, are rather dismal?

According to the *Global 2000 Report* (Council on Environmental Quality 1980), the amount of arable land per person is projected to decrease from about 0.4 ha in 1975 to about 0.25 ha by the end of the century. If current trends continue, the world's per capita growing stock of wood will be 47 per cent lower in the year 2000 than in 1978 and 40 per cent of the forests still remaining in the third world will have been razed. Under such conditions, the real price of food is likely to multiply, along with long-term declines in the productivity of such over-taxed renewable resource systems.

Furthermore, according to a study by the International Institute for Applied Systems Analysis, 30 to 70 per cent of the intermediate input costs of agricultural crop production in developing countries are directly or indirectly related to energy. On the other hand, agriculture provides 20 to 90 per cent of primary energy through the supply of the so-called non-commercial energy sources such as wood and agricultural residues (Parikh 1981).

The intellectual challenge is to go beyond the simple analysis of data and assist governments in transcending the current crisis management approach by embracing development planning conceived as a societal learning process. This calls for the enhancement of the capacity of social organizations and individuals to respond creatively to new situations, constraints, and opportunities and to shape new trajectories for industrialization and rural modernization that are different from the models derived from the historical experiences of industrialized countries of the North.

Projections serving in lieu of forecasts can only lead to mistaken conclusions when they concentrate on quantitative growth within ossified structures rather than anticipating structural changes and modifications in social behaviour. Specific local solutions responding to the variety of ecological, cultural, socio-economic, and political contexts in today's world must thus be found to the global problems of food and energy.

The *differentia specifica* of FEN consisted in its concentration on planning, designing, implementing, and evaluating ecosystem-specific, culture-specific, and even site-specific solutions to global problems. Such research must necessarily be done downstream from other work on food and energy macro-models, such as the Global Food-Energy Modelling Project (Robinson 1986) that FEN was associated with.

Useful as the latter may be to sensitize policy-makers about the long-term implications of their decisions, or to test the coherence of proposed policies, they do not lend themselves to straightforward translation into planning guidelines at regional, micro-regional, or project level. Macro-models must perforce assume away the diversity of local conditions and thus cannot do justice to people's resourcefulness, a key concept for successful ecodevelopment planning.

## Entitlement and Ecodevelopment

FEN was premised on the "entitlement" approach articulated by Amartya Sen and on the concept of ecodevelopment. In a recent publication, Sen (1987) aptly summarizes the entitlement approach to food, which must be extended equally to energy for cooking:

The real issue is not primarily the overall availability of food, but its acquirement by individuals and families. If a person lacks the means to acquire food, the presence of food in the market is not much consolation. To understand hunger, we have to look at people's entitlement, i.e. what commodity bundles (including food) they can make their own. The entitlement approach to hunger concentrates on the determination of command over commodities, including food. Famines are seen as the result of entitlement failures of large groups, often belonging to some specific occupations (e.g. landless rural labourers, pastoralists).

The entitlement of a person stands for the set of different alternative commodity bundles that the person can acquire through the use of the various legal channels of acquirement open to someone in his position. In a private ownership market economy, the entitlement set of a person is determined by his original bundles of ownership (what is called his "endowment") and the various alternative bundles he can acquire starting from each initial endowment, through the use of trade and production (what is called his "exchange entitlement mapping"). A person has to starve if his entitlement set does not include any commodity bundles with adequate amounts of food. A person is reduced to starvation if some change either in his endowment (e.g. alienation of land, or loss of labour power due to ill health) or in his exchange entitlement mapping (e.g. fall in wages, rise in food prices, loss of employment, drop in the price of the good he produces and sells), makes it no longer possible for him to acquire any commodity bundle with enough food.

As for ecodevelopment (Sachs 1980), it is based on the simultaneous pursuit of the following four objectives:

1. *Social equity*, that is, better access by low-income people to goods and services needed for a decent life. This can be achieved through a variety of means deemed culturally desirable by those concerned: employment and higher incomes, generation of opportunities for self-production and self-help construction (assisted by the state), subsidized housing, free education and health services, and, in the case of poverty, food distribution through special programmes.
2. *Ecological sustainability* both in terms of resource conservation and the minimization of the harmful impacts of production on the environment and, by extension, on people's health and quality of life.
3. *Economic efficiency* considered at the macro-social level, that is, ensuring a rational pattern of resource use for the whole society, the aim of the economic policy being to create such conditions for private enterprises as to

make the micro-entrepreneurial criteria coincide to a large degree with the social ones.

4. *Balanced spatial distribution* of human settlements and activities so as to avoid some of the worst problems resulting from excessive concentration or dispersion of human endeavours.

The concept of ecodevelopment emphasizes the sustainable use of local human and natural resources for meeting locally defined needs. It therefore embraces a radically participatory approach. People's needs must be defined realistically and autonomously so as to avoid the harmful "demonstration effects" of the consumption style of rich countries. Since people are the most valuable resource, ecodevelopment should contribute primarily to their self-realization.

This calls for the establishment of a horizontal authority which can transcend sectoral particularism, an authority concerned with all the facets of development and which makes continual use of the complementarity of the different actions undertaken. To be efficient, such an authority requires the effective participation of the people concerned.

In other words, ecodevelopment is closely related to the "strong" version of the basic needs approach defined by Wisner (1988) in contrast with the "weak" version. The former encourages poor people to understand the social origins of their poverty and to struggle to change them. Insofar as the latter involves the delivery of a bundle of goods and services, it treats the poor as passive recipients, not activists capable of helping themselves.

## The Urban Challenge

If current urbanization trends continue, by the year 2010 – just one generation from now – low-income people in third world cities will become the new majority among the world's population, displacing the rural poor.

All three developing continents are facing very serious urban problems. The backlog of unattended needs for housing, food, energy, and services is so great and the pace of urbanization so rapid that it has become physically and financially impossible to solve this situation by providing more of the same. The conventional solutions, which proved more or less effective in industrialized countries, simply cannot be afforded unless there is a drastic reallocation of world resources, currently directed at military spending. This sane alternative to the arms race, however, appears highly unlikely.

Thus, the degree of satisfaction of the basic needs of the growing urban populations will, to a great extent, depend on the creativity and resourcefulness of the communities themselves as well as of their administrators. New urban development strategies are called for, based on social innovations.

Let us start by enumerating the five main fields of potential innovation.

*The first* deals with new forms of organization of economic activity, capable of improving the degree of utilization of human potential for work available in society. In order to ascertain it, we must better understand the everyday structures of material life, the cultural models of time use, and the working of the "real economy". This term encompasses the complex web of interconnected markets of labour, goods, and services ranging from the official to the criminal, as well as the non-market household economy, the embryonic forms of the non-market social economy, and the multiple interventions of the state. In other words, it is necessary to go beyond the formal/informal dichotomy and to analyse both the monetary flows and the cultural patterns of time allocation for work in the market-oriented and non-market economic endeavours, as well as for non-economic activities (Sanchez 1988).

*The second* consists of the untapped, under-utilized, misused, or wasted resources existing in the urban ecosystem: vacant land, waste, and sewage that can be recycled or reused, energy and water that can be conserved at a lower cost than the production of additional supplies, etc. Such resources, detected through an ecological analysis, offer interesting opportunities for employment and/or self-employment, often requiring only a moderate investment per worker. More generally, countries short of capital ought to pay the utmost attention to "non-investment" sources of growth, such as maintenance of existing equipment, elimination of wasteful resource-use patterns, recycling, etc.

*The third* sphere encompasses the whole area of identification and production of appropriate technologies, enabling a rational and more intensive use of the capacity to work of people and available physical resources. The concept of appropriate technology is, once more, relative to a given ecological, cultural, and socio-economic context. There exist no appropriate technologies, as such, that are universally applicable. Nor is it reasonable to choose, *a priori*, capital-intensive technologies or labour-intensive ones. A selective use of the whole range of technologies is called for and scientists should be encouraged to search for new "knowledge-intensive", resource-conserving technologies.

*The fourth* domain is the institutional one, perhaps the most difficult and, in many respects, the most decisive. Development cannot be left to market forces alone, nor be made an exclusive responsibility of the state. Community involvement is indispensable at all levels: setting of priorities, creativity in searching for solutions, participation in implementing them. Institutional breakthroughs will only happen through new forms of partnership for development between society, the market, and the state. The whole field of party politics, non-party politics related to citizens' organizations, and workers' self-management within enterprises needs to be reconceptualized.

Finally, *the fifth* field for innovations in the urban setting is concerned with public policy instruments and the selection of policy packages that stimulate and support social innovations. The emphasis on community participation and self-help programmes should not be taken as a pretext to reduce the responsi-

bility and the share of the state in carrying out vigorous activities aimed at alleviating the plight of low-income urban populations.

In the following chapters, some of the ways in which this conceptual approach was exploited by FEN researchers are described. It should be borne in mind that the interdisciplinary and evolutive nature of this approach was consciously designed to stimulate work in this field, not to confine it to a preconceived framework.



## **Integrated Food-Energy Systems**

One of the two major focuses of FEN was the analysis of systems designed to integrate, intensify, and thus increase the production of food and energy by transforming the by-products of one system into the feedstocks for the other. Such integrated food-energy systems (IFES) can operate at various scales, ranging from the industrial-sized operations in Brazil designed to produce primarily ethanol and fertilizer (La Rovere and Tolmasquim 1986), to the village- and even household-level biogas systems in India (Moulik 1985). A conceptual outline of such systems, including the long-ignored but vitally important component of water for biomass-based production, is shown in figure 1.

This valorization of agricultural by-products plays an important role in the design of IFES for specific agro-climatic regions, designs which should closely follow the paradigm of natural ecosystems. These modern, ecologically sound systems are characterized by their closed loops of resource flows. In a sense, they incorporate the same rationality of traditional peasant farmers, albeit at a completely different level of scientific and technical knowledge.

The study of such systems, adapted to the diversity of natural environments and responding to a wide spectrum of needs in terms of size, technological sophistication, and capital intensity, became the main thrust of FEN research activities in this field. Earlier UNU work on patterns of resource use and management in Asian villages (Ruddle and Manshard 1981) provided a very useful starting point for this research.

Two international conferences in this field were held in Brasilia (FINEP/ UNESCO 1986) and New Delhi (Moulik 1988), organized with the co-operation of UNESCO as well as that of Brazilian and Indian authorities, research organizations, and universities. They provided a valuable forum to review on-going work on IFES and to discuss future research priorities (Wisner 1986). These conferences were complemented by a subsequent symposium in Changzhou, organized by the Chinese Association for Science and Technology, which compared IFES in seven ecologically diverse regions of China.

Such events were instrumental in showing that this concept had attracted considerable attention in many developing countries, leading to both research