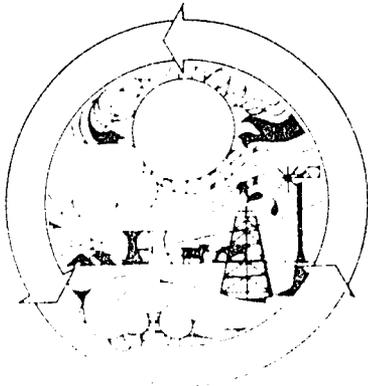


PN-NN-972



100-106
100-107

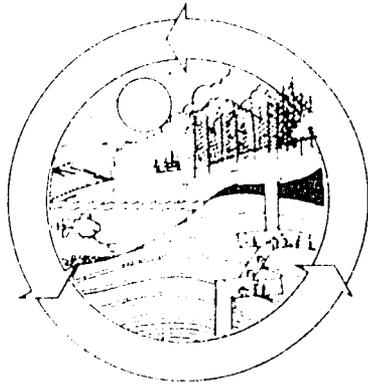
FIRST ANNUAL REPORT
ENERGY AND RURAL DEVELOPMENT GRANT



of the Agency for International Development
to the East-West Resource Systems Institute

April 5, 1979 to April 4, 1980

**energy
systems**



June 1980

FIRST ANNUAL REPORT
ENERGY AND RURAL DEVELOPMENT GRANT

April 5, 1979 to April 4, 1980

FOUNDATION FOR THE PROGRAM

This Program attacks problems that touch a quarter of mankind; if the plans outlined here to sustain and improve rural development are encouraged and permitted to evolve, certain regional and sectoral concerns about the impending scarcity and cost of energy (power and fuel) could indeed be less alarming than they now appear. Innovative organizing steps were completed by representatives of some 55 institutions during the first year of the grant. Eight working groups, a Steering Committee, and a Research Committee were formed, establishing a foundation for achieving the purposes and goals of the program. These purposes and goals, as defined in the grant "Program Description" are:

A. Purpose of the Program

1. To develop and undertake collaborative research and analysis activities with selected Asian research institutions on problems of energy, particularly as they relate to agriculture and rural development in Asia.
2. To train and involve cadres of Asian and American researchers and practitioners at the East-West Center in the analysis of country-specific and regional energy problems in Asia, thus preparing them to become involved with decision-making processes concerning energy-related and regional energy policy problems.
3. To organize workshops and seminars in cooperation with host institutions in developing countries in Asia, as well as at the East-West Center, dealing with specific aspects of national and regional energy policy problems....

B. Goals of the Research Effort

1. To obtain an understanding of energy flows in selected rural areas of several developing countries, with particular reference to the coupling of agricultural and related processes to trends in patterns of energy use....
2. To assess the impacts of changes in the supply of traditional forms of energy in relation to demand due either to rapid population growth, environmental degradation or combinations of both, on the nutritional health of rural populations and access to basic human needs....
3. To synthesize and compare alternative methodologies for assessing the mix of energy sources most appropriate at different stages of rural and agricultural development and to examine alternative energy policies which might be directed toward achieving patterns of rural energy use consistent with development goals....

Innovative organizational steps to meet these goals are necessary because the conjoining of energy and rural development represents in large part a new policy arena. Policy interactions between energy concerns and concerns centering on agriculture and rural development either are being created or are being abruptly altered, especially as a result of the sharp changes since 1973 in international energy supplies and prices. This new policy arena, yet largely unshaped, is characterized by wide gaps in motivation, experience, and knowledge. Gaps yet to be bridged include:

- the various interests of energy suppliers and industries, on the one hand, and those of farm operators and related rural sectors on the other (although on a given farm, the energy-crop-livestock-forestry interests are closely intertwined);
- the diverse spatial, institutional, cultural environments of farm and rural household users and producers of energy, on the one hand, and national policymakers and implementers, on the other.
- the different experiences, perceptions, and specialized qualifications among scientists, technologists, and enterprise managers in these diverse sectors.

A fundamental objective of the Program, therefore, is to form links between the policy, technology, marketing, and production systems that relate energy sources and supplies to rural purposes and tasks. Innovative combinations of personal and organizational perspectives are required to reach this objective. Creation of such new perspectives has been a basic accomplishment of the first year of the Program.

The diversity and mutually reinforcing strengths of institutions that have taken part in forging an integrated, applied research approach in this new arena are evidenced in Table 1. The table lists some 10 national policy agencies, 25 universities or specialized centers of learning, and 20 implementing agencies in eight countries that have participated in organizing the Energy for Rural Development Program. A sound mix among fields of specialization has been achieved, including capabilities in development planning, energy administration, science policy, energy technologies, economics and sociology, agriculture, forestry, rural organization, public systems management, and industrial production and marketing.

Agreement on the scope and the methods of work and the modes of organization and funding among the eight countries involved was reached by representatives of 40 of these institutions at Chiang Mai, Thailand, in February 1980. Groundwork for this cooperative research agreement had been established through in-country and inter-country documentation, consultation, and workshops engaging over 140 persons in the previous 14 months (see the summaries of documents in "Outputs to April 1980" in this report). A Steering Committee composed of the principal research coordinators from each country and from RSI was named and agreed to

TABLE 1
 INSTITUTIONAL INVOLVEMENT IN ENERGY FOR RURAL DEVELOPMENT RESEARCH PROGRAM
 (By Country and Type of Institution, 1979-1980)

Country	National Policy Agencies			Academic Institutions		Implementing Agencies		
	Planning and Finance	Energy	Science and Technology	Scientific and Technological	Social and Institutional	Agriculture, Forestry and Rural Development	Technology Research, Development and Extension	Energy and Industry
Thailand	National Economic and Social Development Board	National Energy Administration	National Research Council	Chulalongkorn Univ., Chiang Mai Univ., King Mongkut Inst., Khonkaen Univ., Mahidol Univ.	Institute of Agricultural Technology	Royal Forest Department, Department of Agriculture	Applied Scientific Research Corp. of Thailand	National Energy Administration
Bangladesh	Planning Commission			Bangladesh Univ. of Engineering and Technology	Bangladesh Inst. of Development Studies	Department of Forestry	Inst. of Fuel Research and Development	
India				Madurai Kamaraj Univ.	Indian Inst. of Management, Ahmedabad Council for Social Development		State Planning Inst., Lucknow, Appropriate Technology Development Association	Central Electricity Authority, Central Electronics, Ltd., Jyoti Ltd.
Indonesia		Ministry of Mines and Energy		Development Technology Center, Inst. of Technology Bandung	Center for Strategic and International Studies, Agency for Application and Technological Assessment	Forest Products Research Inst., Directorate of Rural Development, Community Development Department		National Electric Co., Directorate General Oil and Gas
Nepal	National Planning Commission		National Council for Science and Technology	Tribhuvan Univ.		Agriculture Project Service Center		
Philippines		Ministry of Energy		Univ. of the Philippines at Los Banos	Inst. of Phil. Culture, Development Academy of the Philippines	Ministry of Human Settlements		Center for Nonconventional Energy Development
Sri Lanka	Ministry of Finance and Planning		Ministry of Industries and Scientific Affairs	Univ. of Peradeniya		Department of Agriculture		
United States of America (U.S.A.)				Lawrence Berkeley Laboratories	Resource Systems Inst., State Univ. of New York, Harvard, Cornell, California, Hawaii Minnesota		National Center for Appropriate Technology	

provide continuing coordination in the execution of the Program. A significant contribution to structuring the Program as a new mode of international research was made by members of the Steering Committee. Dr. Sanga Sabhasri, Secretary-General, National Research Council of Thailand, was requested by the workshop to serve as continuing Chairman and accepted. Eight Inter-Country Activity Planning Groups were organized to develop research plans on defined problem areas. The Steering Committee created a Research Committee and a Resource Committee, the former to review the quality and integration of research plans, the latter to monitor budget requirements and mobilize funds.

The principal instrument of research cooperation, Energy for Rural Development Implementation Plan for Inter-Country Activities 1980-1983, was completed in provisional form at Chiang Mai and finalized, with incorporation of corrections and revisions by participants, in April 1980. The Research, Resource, and Steering Committees will convene in Honolulu at meetings from June 26-July 3, 1980 to review decisions by the participating institutions and to consider further required action.

INTER-COUNTRY PLAN FOR PROGRAM IMPLEMENTATION

The most important research problem emphasized in the Implementation Plan for Inter-Country Activities is to assess the energy needs of rural people in the context of energy resources in order to gain better understanding of the policy and technology requirements for advancing rural development objectives. An iterative research process is projected. Activity Plan 1 focuses the Program on rural development needs and their implications for energy policies and technology development. Plan 2 is motivated directly by these policy and assessment issues. It seeks methodological advances and data development required (a) for current policy analyses and (b) for assessing felt needs and defining attributes of viable energy technologies based on renewable resources. Plans 1 and 2 thereby provide design contexts and supporting data for Plans 3, 4, and 5 which undertake development, verification, and dissemination of specific energy technologies: biogas, fuelwood and biomass, and hydro, solar, wind, and animal power for selected rural applications.

Technology improvements and developments will in turn be assessed in Plans 6, 7, and 8 in terms of real-world applicability and of economic, social, and institutional factors in successful introduction, adoption, and widespread use of new technologies. These assessments will be directed to decisions faced by policymakers on priorities to be assigned for research and development investments in new energy technologies, and on opportunities and alternatives for substitution among fuels including effective price, tax, subsidy, or allocation measures.

The Implementation Plan for Inter-Country Activities provides detailed problem statements, objectives, scope, methods, activity workplans, timetables, and three-year budgets for each of the eight Activity Plans. An integrated schedule of research, in-country and inter-country workshops, researcher exchange, and cooperative research

outputs is provided for each Activity Plan, and among Plans.

The ERD plan details the rationale and organizational structure for a proposed Information Exchange and Clearinghouse System to support the Program. Four information exchange modes are provided: (1) document exchange, especially of preliminary reports and working notes, (2) bibliography and directory exchange, (3) technical inquiry services, and (4) newsletters and reports of research in progress. The information network would provide timely exchange of relevant research information and findings, thereby increasing the productivity of all institutions and individuals involved.

SIGNIFICANCE OF NEED-BASED RESEARCH

In short, a need-driven research program has been established. The Program is need-driven in several ways. Plans 1 and 2 seek assessment of needs that are locally specific in terms of energy end uses or tasks, of place and time required, of form and quality of energy, and of amounts at present efficiencies. The plans seek to build region-specific patterns of needs by combining such local studies with intermediate-level structural analyses using available secondary data. The plans are also people-specific, seeking rural communities' own perceptions of needs, constraints possibly stemming from lack of purchasing power or of energy-related resources such as land and water, and rural communities' cultural variations that influence their energy choices. Involvement in the Program of implementing and policy agencies has sharpened the attention of the inter-country group to such variations in patterns of needs and related opportunities. Needs assessment will be coupled with estimates of current energy demand-supply balances and trends in representative subregions as a basis for (1) policy considerations relating to fuel conservation, substitution, and short-term measures to overcome supply bottlenecks, and (2) design, development, and investment considerations relating to new and improved technologies.

A striking analogy has evolved, here, between need-based rural energy research and the style of farming systems research successfully sponsored by the Agency for International Development in Asian and other countries in recent years. Crop-specific, enterprise-specific research progressively managed by the small farmer on his own farm and suited to the specific agronomic and resource/market characteristics of the particular farming system has become the hallmark of this work as reported by Harwood,¹ Shaner,² and others. RSI and University of Hawaii staff, serving as resource persons with the Farming Systems R & D Methodology Project conducted by the Consortium for International Development on behalf of the Office of Agriculture, AID, point out significant characteristics of such farming system research. Individual farms ("micro-units")

¹Harwood, Richard R. Small Farm Development: Understanding and Improving Farming Systems in the Humid Tropics. Boulder: Westview Press. 1979.

²Shaner, W. W. Farming Systems R & D Methodology Project: An Issues Paper. Logan: Utah State University. November, 1979.

shape problem specification and contribute to the creation of research findings that are relevant to the definition of larger systems. Analysis and integration of findings on many farms, representing different vectors of farming characteristics, contribute to the delineation of meaningful farming systems and to the understanding of changes in those systems. Such local, need-based research promises new contributions to the sociology of knowledge.

The energy-related characteristics of a farming system are integral to its definition. Shortcuts to establishing patterns of energy requirements may thus be achieved by studies of energy needs and valuations on farms that are representative of farming systems on which related agricultural data have already been obtained and classified.

Needs assessment in the context of village and farming system typologies will require sharper definitions of data requirements and improved methods compared to those used only for estimation of present energy demand-supply balances or flows. The structure and phasing of the program are influenced by these requirements for implementable results.

STRUCTURE AND PHASING OF THE PROGRAM

The strong attention to rural energy needs, in the context of current policy analyses and technology development and assessment, has contributed to more rapid progress on technological, institutional, and skill-development elements of the Program than originally anticipated. It has also sharpened the definition and utility of data development on energy demand-supply interactions. These shifts in the substances and timing of research components may be reviewed by reference to the relevant sections of the grant "Program Description."

The sequence of work conceived in Section D. Research Plan of the "Program Description" involved studies by country teams organized in two phases:

- I. Analysis of existing energy flows in selected agrarian areas.
- II. Assessment of alternative technologies and energy mixes and study of energy policy alternatives for the achievement of specific patterns of energy use.

In that first Plan, each phase would require an average of 18 months. Expected program achievements reflecting this expected Phase I and Phase II sequence were structured as follows in these preliminary and illustrative terms:

E. Expected Achievements of the RSI Five-Year Program

The broad result of the cooperative research program is seen as the identification and possible widening of energy policy and technology options toward improved productivity and attainment of basic human needs in rural communities of South and Southeast Asia. Documents, analytical methods, field implementation and building of institutional capabilities and personal skills to expand and apply these options are visualized as follows, in preliminary terms.

1. Country reports: Preliminary and Final Reports

Each country team is expected to produce a Preliminary and Final Report, at the end of Phases I and II, respectively. Illustratively, content of country reports would be on the following lines.

. Preliminary Report

- a. Analysis of existing energy flows in rural areas, if appropriate in matrix form showing energy source, quality and technological characteristics on one axis and end use sector, function, scale and location on the other axis.
- b. Identification and quantification of constraints on agricultural and related sectoral development, and on attainment of basic human needs in rural areas attributable to absence, inefficiency or costs of energy.
- c. Preliminary formulation of criteria for evaluating social, economic and environmental effects of alternative energy technologies.
- d. Scope, focus and design outline for Phase II studies.

Final Report

- a. Identification of energy source and quality, or energy mixes, appropriate for each functional or sectoral application derived from "b" above.
 - b. Reports on field tests applying evaluation criteria to design concepts or prototypes experimentally introduced by cooperating institutes.
 - c. Refinement of social, economic and environmental assessment criteria based on field test experience.
 - d. Policy guidelines with respect to public investment, research and development, pricing, locational incentives and institutional requirements toward implementation of the energy options identified and evaluated in the country research.
 - e. Institutional and manpower capabilities to implement above.
2. Synthesis of Country Reports: one Preliminary and one Final Report

The content of country reports would be assessed in comparative form to draw generalizable conclusions, and region- or location-specific variations, for presentation in the overall program report.

3. Institutional Development

A primary objective of this category of the program would be to strengthen the capabilities of key cooperating institutions in participating developing countries in Asia and the Pacific to undertake the necessary pilot programs in applied research, development, and the implementation of small-scale, decentralized energy sources in rural areas. It is perceived that this category of the grant would also provide opportunity for the cooperating institutions to further develop capabilities enabling them to interact more effectively with regional (subnational), national and international agencies concerned with various aspects through which energy policy serves rural development goals.

Applied research materials as well as information and communication linkages created through the program would be designed to provide a continuing resource in each of the cooperating institutions.

4. Upgrading of Applied Research Skills for Indigenous Staff

It is estimated that some 40-50 staff members from the cooperating institutions in the developing countries in Asia and the Pacific would be engaged fulltime during one or both phases of the program. Their involvement with the program would be both at the Resource Systems Institute, working as members of the project team, and also back at their home institutions. The primary objective of this category of the program would be to upgrade the skills of these staff members in the necessary continuum of applied research, development, and implementation. There would be joint follow up on their use of this new knowledge upon their return home by both the cooperating institution and RSI.

A smaller, select number of this group would also be engaged in the interrelationships of (1) applied research, development and implementation, and (2) the policy relevance of their professional experience and their interdisciplinary skills.

5. Other Publications

On an illustrative basis, the following types of publications are anticipated over and above the Country and Program reports:

- a. Manuals on socio-economic and environmental assessment criteria and techniques
- b. Field technology evaluation monographs
- c. Case studies on field project development related to energy and rural development (these case studies would be written in the framework of an integrated project planning and management cycle).

In contrast to this initial phasing of work, which would separate energy flow analysis from technology development and assessment, the Core Program established by the inter-country group is structured as a minimum set of activities and events required to assess rural energy needs, resources, gaps, and technological options in an integrated manner. To achieve essential linkages among policy, technology, and assessment activities, an initial balance of work and subsequent progression of collaborative events is provided in the Core Program Schedule (Figure 1).

Essential linkages and communication among data development, technological, assessment, and policy aspects of the Program are portrayed by vertical dotted lines in Figure 1. These represent inter-activity workshops provided in the Core Program. For example, these include:

- Year 1 Activities 3 (biogas) and 7 (village organization)
- Year 2 Activities 2B (techno-economic parameters) and 3 (biogas)
Activities 4 (fuelwood) and 7 (village organization)
- Year 3 Activities 2A (policy analysis) and 2B (felt needs and
techno-economic analysis)
Activities 3 (biogas) and 4 (fuelwood)
Activities 5 (selected technologies) and 8 (technology transfer)

The Program's evolution to date makes possible an improved definition and scheduling of its expected achievements.

Work toward two achievements regarding capability enhancement has moved forward ahead of the original schedule:

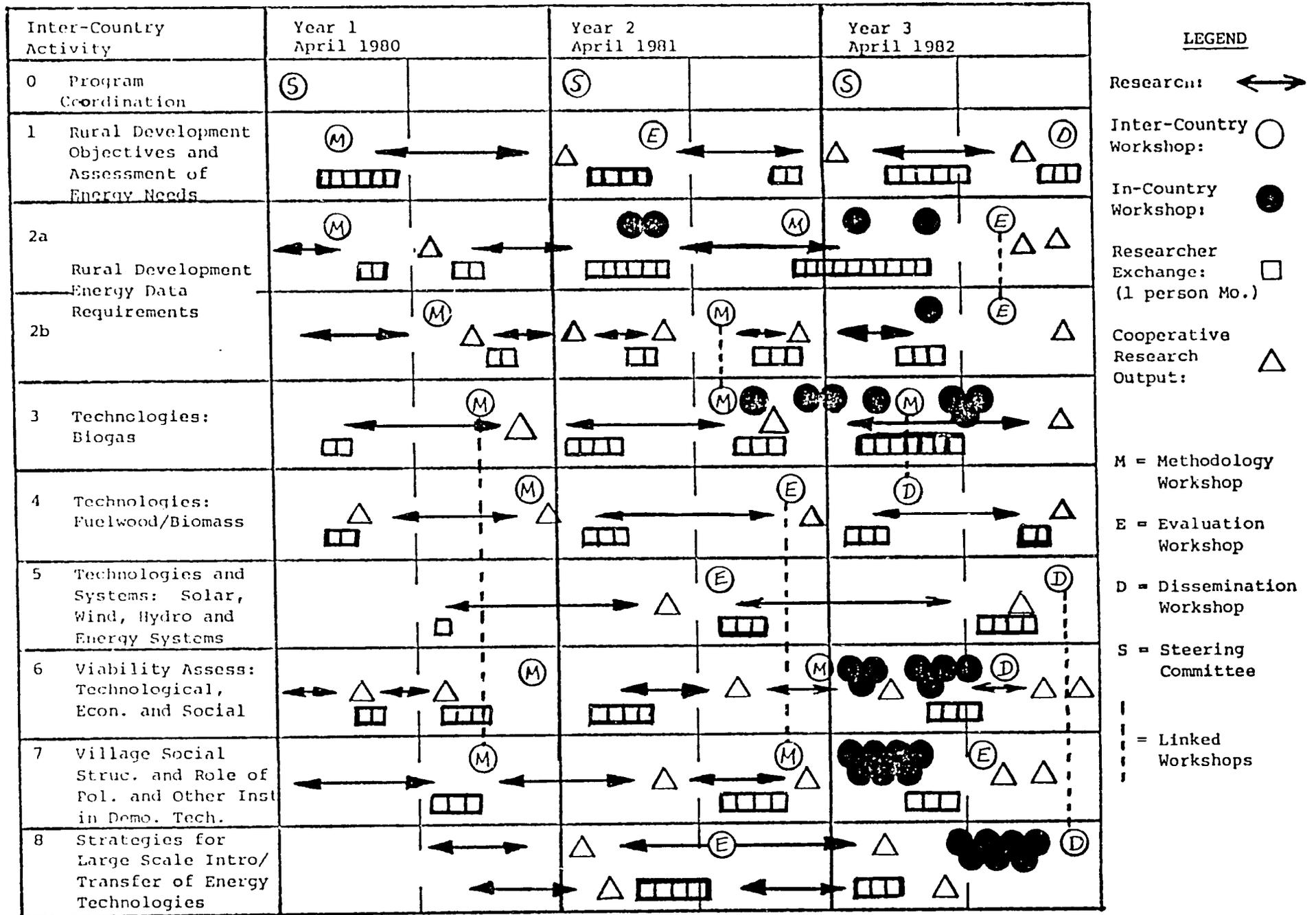
Institutional Development

Twenty-one institutions with responsibilities for technology development (11 policy and implementing agencies and 10 academic centers, named in Table 1) have been engaged in the Program from its first year. Their capabilities in project planning have been advanced through participation in identification of specific technologies and problems for attention (Activities 3, 4, and 5). Their knowledge of relevant design considerations and factors in rural application of technologies has been enhanced by direct engagement with persons concerned with end-use and needs assessment, market and techno-economic environments, and policy as well as social factors influencing technology adoption.

Upgrading of Applied Research Skills for Indigenous Staff

Requirements for researcher exchanges among participating institutions as well as subject areas for specialized methodology, evaluation, and dissemination workshops are detailed in each Activity Plan. Each institute is in the process of identifying specific qualifications and experience of professional staff who would be seconded to cooperating institutes and of persons desired on secondment. Since each activity is defined in terms of applied policy and applied technology results, the institutional setting

Figure 1 ERD Core Program Schedule



for strengthening of manpower capabilities has been established.

Progress in formulation of technology assessment criteria and in development and field testing of specific rural energy technologies will guide data development and policy analysis at an earlier stage of the work than originally envisaged. Comparative aspects of the technology and policy assessments between countries and subnational regions will be correspondingly advanced. The structure of program reports and publications will reflect this closer integration of techno-economic, institutional, and policy aspects of the program.

Country Reports and other Publications

The criterion framework developed in preliminary terms by RSI for comparing and evaluating energy technologies (Smith et al. 1979) has demonstrated that energy flows serving social ends must be represented and analyzed in the context of at least three sets of transformations:

1. Transformation of resources available locally or from outside of the region by means of alternative energy-supply technologies into various fuels or energy carriers.
2. Transformation of these fuels by means of alternative end-use technologies into specific tasks.
3. Alteration of the spatial, temporal, and quality characteristics of the resources to provide fuels which match the spatial, temporal, and quality requirements of the tasks.

In addition to examining and tabulating how physical resources such as steel and concrete are transformed into physical tasks such as cooking, the framework also considers the transformation of social resources, such as labor and organization, into social tasks such as increasing equity and the transformation of environmental resources, such as climate and geography, into environmental tasks such as soil conservation. The accounting methodology for these tabulations provides a consistent means to distinguish between those resources required locally and those provided regionally or nationally or imported. Thus, this framework is not just a means to compare alternative technological paths for performing a mix of social, physical and environmental tasks; it also provides a structure for energy data gathering. The temporal, spatial, and quality variables used to define fuel flows provide the necessary information format for making tabulations of energy flows robust and flexible enough to adequately reflect the uses of and trade-offs among resources in local areas. In this way, the alternative technologies could be matched to actual conditions.

Multiple tasks or services are often performed in a transformation activity. Multiple uses of resources and fuels obscure the identification of scarce or constraining inputs and the valuation of joint products. A particular material is often both an input and an output in a farming system (Bhatia 1979), further complicating scarcity and value determination.

Only by examining unit data in the context of particular needs and technological as well as locational transformations can realistic conclusions be reached on energy as a limiting factor, or on opportunities for adding greater value to a local resource.

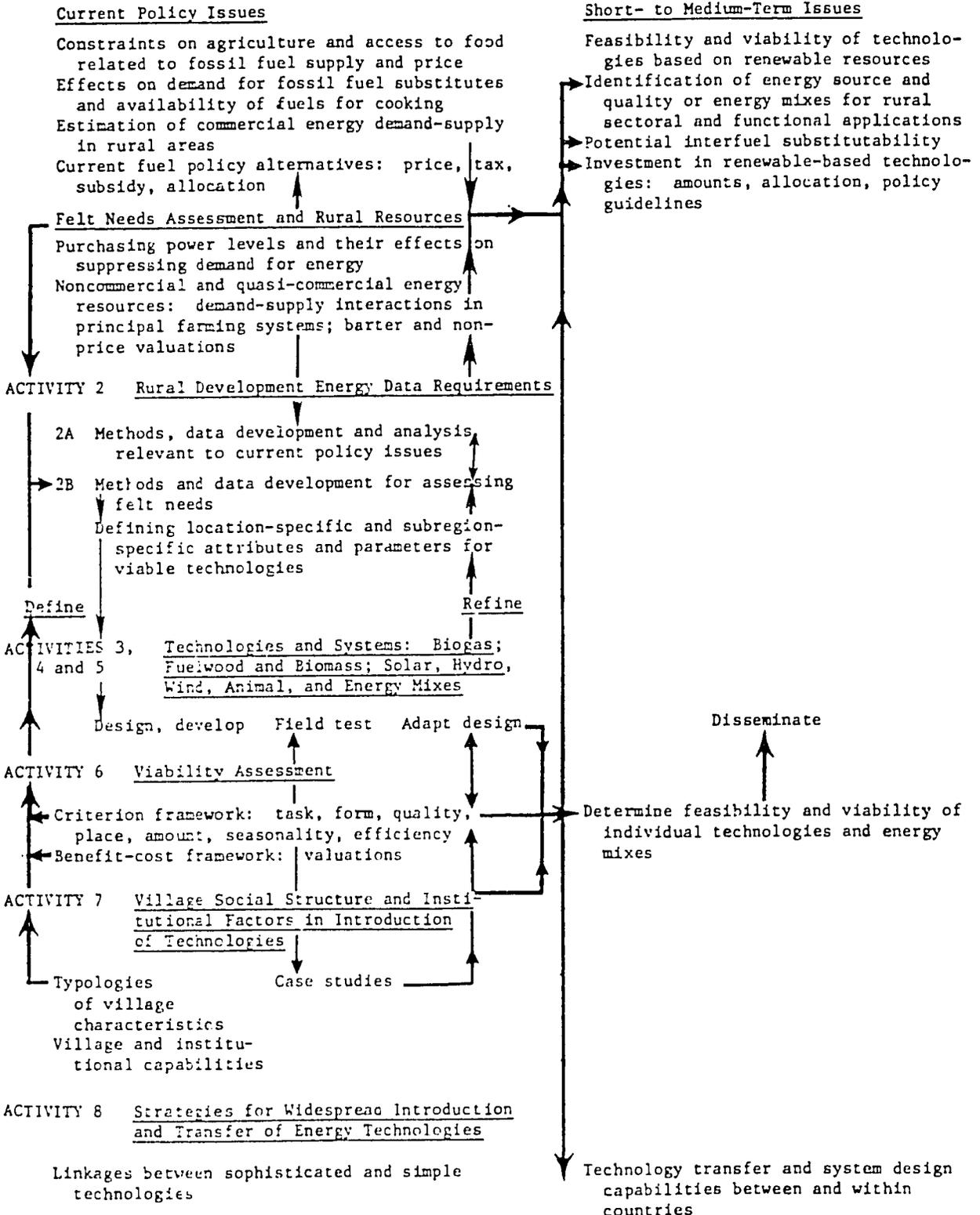
Field tests of technologies reported to and examined by the inter-country group (such as, a community-scale biogas plant assessed by Bhatia (1979) and Ghatge (1980)) demonstrate that even an intensive baseline data study may fail to capture essential factors in viability unless internal aspects of need, technological transformation, scarcity, and value determination are incorporated into the work. The institutional composition of the inter-country ERD Program makes possible such integration of planning, design, and assessment aspects.

Performance in the first year of the Program thereby demonstrates that, instead of the illustrative phasing and outline of country reports presented in the grant Program Description, subheads (b) and (c) under "Final Report" (that is, reports on field tests and refinement of assessment criteria based on field tests) will be most productively accomplished in close conjunction with subheads (a) and (b) under "Preliminary Report" (analysis of existing energy flows and identification and quantification of constraints on agricultural and related sectoral development and attainment of basic human needs).

Phasing of program reports therefore will be undertaken as a series of integrative reports combining area-specific needs, technology, and supply-demand relations in a policy context rather than merely as a sequence of topics. In effect, the scope, focus, and design outline for country reports and the synthesis report can be seen in the summation of these integrative reports. A preliminary outline of the synthesis is constructed in Table 2 based on the Activities defined in the Implementation Plan.

TABLE 2
 SCHEMA FOR INTEGRATING POLICY, DATA,
 TECHNOLOGY DEVELOPMENT, AND ASSESSMENT ELEMENTS
 OF THE PROGRAM

ACTIVITY 1 Rural Development Objectives and Energy Policy Alternatives



OUTPUTS TO APRIL 1980

RESEARCH PLANNING DOCUMENTS

Energy and Rural Development: Prospectus, Research Planning Workshop, May 6-19, 1979. Honolulu: East-West Center, December 1978. 9 pp.

This prospectus broadly outlines the problem, suggests organizational approaches, and poses a preliminary agenda of research issues as the basis for planning a multi-country, multi-institute research program.

Santerre, Michael, Gladys Wong, Josephine Malilay, and Fredrich Burian.
Provisional Bibliography on Energy and Rural Development.
Honolulu: East-West Center, May 1979. 172 pp.

This Bibliography includes over 400 references pertinent to energy and rural development. It features a keyword index to facilitate locating references concerned with specific topics.

Although principally designed to provide Energy and Rural Development Workshop participants with rapid access to documents in RSI files, the Bibliography is also a valuable asset to other individuals engaged in activities related to energy and rural development in developing countries.

Indicative Research Plans on Energy and Rural Development: Report of Research Planning Workshop, May 7-18, 1979. Honolulu: East-West Center, 1979. 84 pp.

These provisional research plans were drafted as a result of two weeks of group consultations among over 30 participants from the Asia-Pacific region. An introductory section summarizes and sets forth approaches for joint research. The plans covered are, (1) rural energy demand-supply database, oriented to rural development planning requirements; (2) introduction of appropriate rural energy mixes with emphasis on renewable resources; (3) viability assessment of rural energy strategies; and (4) factors affecting energy and rural development policy formulation and responses.

Koppel, B. and C. Schlegel. 1979. "Sociological Perspectives on Energy and Rural Development: A Review of Major Frameworks for Research on Developing Countries." Prepared for presentation to the Annual Meeting of the Rural Sociological Society, August 1979, at Burlington, Vermont. 30 pp.

This paper discusses a number of frameworks being used, including, socio-technical analysis, diffusion, dependency, social impact analysis, and ecological analysis, which is the predominant view in social research on energy and rural development. The authors believe that one question is more important in viewing energy for rural social systems: "what are the capabilities of rural social institutions to respond and how, to altered accessibility to important resources bases?"

More coherent statements of what is "unique" and what is most crucial in social terms about energy or energy derived issues are necessary before deciding which paradigms to apply in pursuing that question.

Energy and Rural Development Progress Report on Research Plans.

Honolulu: East-West Center, December 1979. 17 pp.

This informal report describes steps made toward research definition and organization by country groups involved in formulating workplans and proposals for the cooperative Energy and Rural Development Program as of December 1979.

Energy for Rural Development in India: Report of the Research Planning Workshop, December 27-29, 1979. Ahmedabad: Indian Institute of Management (IIM). 60 pp.

The main purpose of this workshop was to develop an integrated need-based research and implementation program consisting of projects for energy supply in rural areas of India to be undertaken by the institutions represented at the workshop in a coordinated manner. Projects and technologies based on renewable sources were emphasized.

Malla, U. M. Perspectives in Research on Energy and Rural Development in Nepal. Kathmandu: National Planning Commission, 1980. 15 pp, annex.

This report discusses the shortcomings of traditional fuels, especially utilization of fuelwood, and the Integrated Rural Development programs (currently seven) which form the core of the government policy for development of rural areas. Other energy sources, such as hydropower, are also discussed, as well as solar and biogas energy.

Country Report of Thailand. Bangkok: National Research Council, 1980. 75 pp.

This report outlines the country's priority energy and rural development research components: development of rural energy demand-supply data-base; appropriate energy mixes; firewood plantation; solar water heaters, cookers, and dryers; and comparative benefit-cost analyses of energy systems.

Morse, Richard, et al. Preliminary Research Plan on Energy and Rural Development. Honolulu: East-West Center, January 1980. 61 pp. attachment.

Authored by 14 RSI staff and fellows, this preliminary plan presents conceptual, applied, and methodological aspects of studies already underway in the work of RSI staff, fellows, and interns and defines prospective dimensions of RSI research as a component of the cooperative inter-country program on Energy and Rural Development. Preliminary workplans are presented for: identification and quantification of energy constraints on agriculture and nutritional health; methodology handbook for socio-economic assessment of changing rural energy constraints and opportunities;

social and organizational considerations in energy technology development, assessment, and use; criterion framework and indicators for comparing and evaluating alternative energy technologies; and policy monograph series on rural energy technology systems.

Sarvate, S. and J. P. Holdren. A Proposal to Study the Potential of Biomass Technologies for Rural Development in the Developing Countries. Berkeley: Energy and Resources Group, University of California, 1980. 25 pp.

The research proposed would attempt to clarify the potential contribution of biomass technology for energy supply in rural developing countries, including quantitative assessment of availability of biomass and related resources, and of magnitudes of existing and competing uses for these resources.

Energy for Rural Development: Implementation Plan for Inter-Country Research Activities, 1980-1983. National Research Council of Thailand and the East-West Resource Systems Institute, April 1980. 100 pp.

This research plan presents an integrated set of eight inter-country activity plans that were formulated by participants from seven Asian countries and the United States at a workshop held in Chiang Mai, Thailand in February 1980.

The objective of the cooperative research effort is to clarify key energy policy and technology development issues faced in meeting rural development needs. Assessment of felt energy needs of rural consumers and producers is a central research activity. Analysis of rural energy demand-supply gaps, opportunities, and constraints will contribute to policy guidelines for fuel conservation and substitution, and guide technological development and assessment based on renewable energy resources.

Recognizing the important role of information sharing to the success of the program, the plan proposes the formation of an Energy for Rural Development Information Network (ERDINET) centered in Asia, operating in four modes of information exchange among participating institutions and with other organizations worldwide.

GENERAL

Brown, H. S. and K. R. Smith. "Energy for the people of Asia and the Pacific." Annual Review of Energy, vol. 5, 1980.

This article analyzes traditional and modern fuels, their consumption patterns, energy flows, and future developments in the Asia-Pacific region. The authors discuss energy supply alternatives for the region in light of two basic energy problems: (1) providing adequate quantities of the right kind of energy for the rural people of the region (who make up most of the population and who produce most of the food consumed by both rural and urban people) and (2) developing and fueling the large-scale energy systems needed for the economic and social development of the urban areas.

Consideration of rural energy statistics suggests uncertainty by perhaps a factor of two in estimates of traditional fuel consumption over large parts of the developing world. Income elasticities of energy use point to the consideration that the rural poor often cannot afford to save energy. They cannot afford the cash necessary to more effectively use traditional fuels or to make the transition to commercial fuels which are more efficient and convenient by urban standards. In the final consuming sector in rural areas, while an economic calculus will be pertinent, a wide range of other factors must be considered if the patterns of consumption and prospective changes in these patterns are to be understood. The article illustrates these considerations for two energy supply alternatives, biogas digesters and plantation of leguminous trees, that receive attention in the Energy for Rural Development Program.

SELECTED PAPERS AND ANALYSES RELEVANT TO
INDIVIDUAL ACTIVITY PLANS

Activity Plan 1

Bhatia, Ramesh. Energy and Rural Development: An Analytical Framework for Socio-Economic Assessment of Technological and Policy Alternatives. Honolulu: East-West Center, 1980. 33 pp.

This paper first presents aspects and interdependencies of energy generation and use in rural areas that require systematic inquiry. Methods for analysis are suggested in the context of data needs for both technological and non-technological policy interventions. A framework of modified social benefit-cost analysis (and its variant, cost effectiveness) is suggested for ranking and selecting the "mix" of alternatives to be implemented. The paper brings out the social and organizational aspects of generation and diffusion of new technology and implementation of other policy alternatives. The need for tracing macro implications of selected policy options is also emphasized.

Mukherjee, S. and R. Jagannathan. "Energy Requirements in Agriculture Sector in India: Some Empirical Observations." Ahmedabad: Indian Institute of Management (IIM), 1980. 17 pp.

This paper provides some empirical data on the human, bullock, and mechanical energy requirements and rupee costs per quintal of output of various crops, such as paddy, wheat, and sugarcane, on bullock-operated and tractor-operated farms and analyzes the variation in energy requirements based on the size of farm, type of irrigation, and other factors. Energy requirements for different farming operations are also compared for different types of farms. A simple benefit-cost analysis of various sources of energy is also presented. The data presented in this paper are obtained from various surveys undertaken on farms of various sizes and using diverse technology in different states of India.

Activity Plan 2

A Study of Energy Situation in Rural India: Proposal for a Pilot Survey
Lucknow: Appropriate Technology Development Association, 1980.
17 pp.

This study plan employed a perspective of technological changes and innovations to guide data collection relevant to developmental plans meeting the realistic aspiration of populations in particular ecosystems. The study would be of use to two audiences: policymakers and technologists. Carried out in carefully selected regionally representative groups of villages, the methodology would consist of three approaches--survey, documentation, and participant observations--with three study schedules: one for collecting data for domestic and agricultural operations, the second for data from rural industries in the region, and the third for recording social, psychological and economic values, aspirations and linkages. The proposal includes a questionnaire for surveying energy consumption, especially domestic and agricultural uses of energy.

Islam, M. N. Study of the Problems and Prospects of Biogas Technology as a Mechanism for Rural Development: Study in a Pilot Area of Bangladesh. Progress Report No. 1, up to 30th November 1978.
Dacca: Department of Chemical Engineering, Bangladesh University of Engineering and Technology. 26 pp.; tables.

This report presents preliminary results of the research work carried out in a pilot area of Bangladesh, including the method of approach and the mode of operation and the general observations about the initiation of a national biogas program. Detailed tabulations are included on household resources of land, livestock, trees, stoves and on household energy consumption by type and source of fuels.

Nathans, R. and R. Chatterjee. "An Approach to the Assessment of Rural Energy Delivery Systems in Developing Countries." Institute for Energy Research, State University of New York, Stony Brook, May 1979. (draft manuscript) 21 pp.

This paper describes the integrated approach being developed collaboratively in Thailand and Sri Lanka. A pilot study will test methodology for assessing energy alternatives in a field survey of six villages. The findings should lead to conclusions regarding: (1) the utility of the conceptual approach described; (2) the need to modify the selection criteria outlined; (3) the ability to obtain a sufficiently rich database with which to conduct such an integrated analysis; (4) the utility of the sensitivity analysis which is part of the methodology; and (5) the feasibility of making such a study on a regional or national basis.

Activity Plan 3

Bhatia, R. Energy Alternative for Irrigation Pumping: Some Results for Small Farms in North Bihar. Delhi: Institute of Economic Growth University Enclave, 1979. 30 pp.; tables.

This paper identifies the economic, social, and technological implications of using alternative sources of energy for irrigation pumping. Detailed comparisons are made for pumping based on diesel oil, biogas, electricity from regional grids, and photovoltaic cells. Preliminary findings suggest advantages to decentralized energy sources and point to the need for selectivity in rural electrification through benefit-cost analysis of schemes for each particular subregion.

Ghate, P. B. "Action Research in Community Biogas Programmes."
Lucknow: State Planning Institute, 1980. 8 pp.

This paper briefly describes the two existing community biogas plants in India as well as the plans of other organizations in the country to set up further plants. It also lists some of the issues that have emerged since the two existing plants opened in order to provide preliminary feedback for those engaged in planning activities for similar plants elsewhere.

Activity Plan 4

Research Proposals: Biomass Centre. Madurai: Madurai Kamaraj University.

Proposals for four interrelated projects are presented, including (1) a Biomass Centre in Madurai set up on the lines of the Agricultural Research Stations developed a few decades ago for improving farm productivity; (2) pilot studies on fuelwood plantations, of five major tree forms, in Madurai-Ramnad Districts; (3) a study on energy consumption and rural development in the Madurai District; and (4) a study of the socio-cultural influences on the use of various energy sources in Tamil Nadu villages.

Activity Plan 5

Hawkins, John N. with the assistance of Li Shengyun. Energy for Rural Development in the People's Republic of China. Honolulu: East-West Center. April 1980. 51 pp.

This case describes the construction of a 0.85 MW rural electrification project in the People's Republic of China. An extensive canal system was constructed in an energy-poor, drought-prone region to serve three functions: water control, irrigation, and energy. To build the mini-electric facility, a decision based on the energy policy and needs of Henan Province, manpower was organized by identification of key people from communes and a simultaneous training program to deliver the system into local control.

Jain, J. C. Solar Energy for Rural Development in India. Baroda: Jyoti, Ltd., 16 pp.

This proposal demonstrates the potential contribution that various solar technologies, especially those already at an advanced state of development, could make to remote areas of developing countries like India. The program described includes selection of an appropriate site, selection of and planning for a proper mix of relevant solar technologies, actual hardware installations, and careful study of the impact of these technologies.

Activity Plan 6

Mukherjee, S. and A. Arya. "Comparative Analysis of Social Cost-Benefit Studies of Biogas Plants." Ahmedabad: Indian Institute of Management (IIM). 8 pp.

An analysis of social cost-benefit studies of biogas plants in India is made so that the underlying assumptions can be critically examined and compared. This analysis should also help to make possible more objective evaluation of the cost economics of biogas plants.

Smith, K. R., M. T. Santerre, and C. S. Schlegel. Criterion Framework and Indicators for Comparing and Evaluating Alternative Energy Technologies. Honolulu: East-West Center, 1980. 40 pp.

This paper presents a preliminary framework for incorporating physical, social, and environmental aspects of resources and tasks in the comparison and evaluation of alternative energy technologies. System boundary problems are examined as a context for adapting two tools from economics: financial accounting and input-output analysis. Sets of criteria for evaluating the appropriateness of energy production technologies are presented including specific quality, temporal, spatial, and other characteristics. Environmental appropriateness, defined as a measure of the degree of beneficial interaction or as the absence or minimizing of detrimental interactions, is also discussed. It is proposed to apply the criterion framework, after critical review, to twelve technologies for producing different fuels at different scales. Further work on the framework will include measures for social resource requirements, measures for social and environmental tasks, and further elaboration of the spatial and flexibility characteristics of fuel flows.

Activity Plan 7

Harahap, F., B. Kartasasmita, and T. Muljadi. Appropriate Technology in the District of Sukabumi: A Case Study. Translation of Working Paper presented at the Indonesian National Seminar on Rural Technology, March 12-15, 1979, Jakarta. 22 pp.

This case study discusses the experiences of the Development Technology Center of the Institute of Technology Bandung in research and development in appropriate technology with field tests carried out in the District of Sukabumi, West Java. Included in the discussion are the methods used to accumulate and disseminate information on appropriate technology which includes a system to process field experiences into appropriate technology information.

Tesna, B. and F. Burian. "Potentials for Community Participation in Alternative Energy Development." Thailand, 1980. 17 pp.

This paper presents economic and energy use profiles and describes land ownership and use, agricultural practices, and economic, political, civil and social institutions of Nong Kon Kru Village, in San Sai District, Thailand. These studies are based on data from the Social Laboratory Project, Institute of Agricultural Technology in Thailand.

PERSONNEL AND LEVEL OF ACTIVITY

RSI research staff and fellows who have substantively engaged in this program are:

Harrison Brown
Principal Investigator

Kirk R. Smith
Energy Systems Project Leader

Bruce Koppel
Food Systems Project Leader

Saleem Ahmed
Fredrich Burian
Donald G. Green
Gary Hansen

John E. Bardach
Program Manager

Richard Morse
Project Coordinator and
Steering Committee Member

Michael Santerre
Sarita Sarvate
Charles Schlegel
Yueh-Heng Yang

Staff and fellows who have served as resource persons include:

Bruce Currey
Robert H. Randolph
Corazon M. Siddayao

Specialized bibliographic, program, editorial, and secretarial support is provided by Donine S. Hedrick, Kajorn Howard, Cynthia Shklov, Grace Johnson, and Lizabeth Decova. In addition, Research Interns directly engaged in the project include Grace Cabahug, Kazi Memon, Diane Pruett, and Ted Toyoshiba.

Fields of specialization and qualifications of professional staff and fellows engaged in the program are summarized in Appendix 1.

The mobilization of specialized personnel in the first year of the program is seen in the fact that Asian governments and sponsoring institutions contributed, without cost to the program, an estimated 85 man-months of senior staff time to preparation for and engagement in joint workshops. In-country workshops in India and Thailand and project committee meetings in other participating countries involved perhaps an equivalent additional staff contribution. The synergistic effects of the joint program are suggested by the fact that some 10 senior policy officials in the participating Asian countries are directly involved, with approximately 36 scientists, engineers, and technologists and some 24 social scientists, economists, planners, and administrators.

FUNDING

Utilization of funds provided in the grant for the first year is summarized in Appendix 2. The principal shift in allocations among budget categories was to increase the allotment for workshops, thereby enabling adequate, diversified participation in the two major planning workshops.

APPENDIX 1

EAST-WEST RESOURCE SYSTEMS INSTITUTE STAFF

DIRECTOR

BROWN, Harrison, Ph.D. Chemistry, Johns Hopkins University, 1941: Came to the Center in August 1977 from post as Professor of Science and Government at the California Institute of Technology. For many years served as Foreign Secretary of the National Academy of Sciences and as head of the Academy's World Food and Nutrition Study. Was President of the International Council of Scientific Unions from 1974 to 1976, and also a former faculty member with the University of Chicago's Plutonium Project and the Oak Ridge Laboratory. Special research interests: inter-relationships between resources, technological change, and economic and social development.

SMITH, Kirk R., Ph.D. Environmental Health Sciences, University of California at Berkeley, 1977: Was employed in the Energy and Resources Group at University of California, Berkeley. Served as Advisor to several state and national energy organizations. Has extensive lecturing experience in the Soviet Union and Eastern Europe. Special research interests: environmental and risk assessment, long-term impacts of coal and nuclear power systems, resource implications of national defenses, and the shift of temporal perspective due to technological changes.

KOPPEL, Bruce, Ph.D. Rural Sociology, Cornell University, 1973: Spent two years in the Philippines working in the University of the Philippines College of Agriculture/Cornell University Graduate Education Program sponsored by Ford Foundation at Los Banos. Special research interests: technology assessment and social impact analyses, regional and rural development, and institutional aspects of food policy.

BARDACH, John E., Ph.D. Zoology, University of Wisconsin, 1949: Served as Director of Hawaii Institute of Marine Biology; is now also Adjunct Professor at University of Hawaii; has chaired aquatic food sources team as part of the World Food and Nutrition Study of the National Research Council/National Academy of Sciences. A former faculty member at University of Michigan, is executive council member of the Pacific Science Association and board member of the Law of the Sea Institute. Special research interests center around the relationship of aquatic ecology to economics, including resources management aspects of extended maritime jurisdiction.

MORSE, Richard, M.A. Economics, Harvard University, 1958: Joined the Center as Research Associate in 1974. Was independent consultant on South Asia investment and industrial development, 1969-74; served with Economic Cooperation Administration and Ford Foundation in Burma, 1951-56. Also was consultant to Ministry of Industrial Development, Government of India, 1958-60 and 1964-66; and Senior International Economist, Stanford Research Institute, 1961-63 and 1966-69. Special research interests: local innovation, cooperative development, and socio-economic aspects of decentralized development paths.

AHMED, Saleem, Ph.D. Soil Science, University of Hawaii, 1965 (on East-West Center Scholarship): Came to the Center in 1973 from position as Senior Technical Services Advisor with a multinational fertilizer manufacturing and marketing firm in Pakistan. Was formerly on faculty of the University of Karachi. A Pakistani national, serves as a consultant on fertilizer marketing and management to several international agencies. Primary research interests: the area of food and agriculture including micro aspects such as inputs use and farmer decision making, and macro aspects such as rural dynamics, agri-business marketing, and management of human resource management.

BURIAN, Fredrich, M.A. Philosophy, University of Hawaii, 1972: Served as Research Assistant in Chemistry departments at Wayne State University, Stanford University, and University of Hawaii. Holds certificate in Instructional Media Systems. Special research interests: the impact of graphic/kinetic information displays on policy formulation and the international flow of scientific information.

CURREY, Bruce, Ph.D. Geography, University of Hawaii, 1979; M.P.H. International Health, 1977: Was formerly Assistant Professor of Geography at University of Hawaii. From 1974-76 worked for Ministry of Relief and Rehabilitation, Government of Bangladesh, mapping areas liable to famine. Currently holds joint appointment with University of Hawaii as Assistant Professor at Geography Department. Special research interests: catastrophic breakdown of resource systems, famine warning systems, and vulnerable food systems mapping in South and South-east Asia.

GREEN, Donald G., Ph.D. Extension/Adult Education, Cornell University, 1964; B.S./M.S. Agricultural Education, Iowa State University, 1953-54: Joined the Center in 1971 after four years in India with the Ford Foundation. Was also associated with the Agricultural Development Council, with Stanford University in the southern Philippines, and was a short-term consultant to Jordan for FAO and UNDP. Special research interests: rural development with emphasis on alternative energy sources for agriculture and on improvement of quality of life in rural areas through better food systems.

HANSEN, Gary, Ph.D. Political Science, University of California at Berkeley, 1971: Served as a staff member of the Ford Foundation from 1963 to 1965 in Indonesia. From 1969 to 1970 was a Fulbright Scholar in Indonesia. Special research interests: rural development policy, administrative aspects of local development, and rural energy policy.

HEDRICK, Donine, S., M.L.S. University of California at Berkeley, 1975; B.A. Latin American and African History, Humboldt State University, 1974: Research Materials Specialist for the joint EAPI and RSI Research Materials Center. Studied Asia/Pacific History at Otago University, New Zealand, in 1967. From 1976 to 1979 was Head Librarian at the California Energy Commission in Sacramento responsible for developing a collection of materials on energy resources and the environment.

HOWARD, Kajorn, M.Sc. Nutritional Science, University of Hawaii, 1966: As Program Officer, is primarily responsible for coordination of professional development activities. Born in Thailand, received bachelor degree at Chulalongkorn University. Studied at Institute of Food Technology, London, for 18 months and came to the University of Hawaii in 1962 as East-West Center student. From 1965 to 1969, served as a Research Assistant in Anthropology at Bishop Museum. Before joining the staff of the former Food Institute in January 1976, was a staff researcher with the Population Institute.

RANDOLPH, Robert H. (U.S.A.) 03/01/79-02/28/81; Ph.D. History, Stanford University, 1978: Came to the Center from the International Institute for Applied Systems Analysis, Laxenburg, Austria, where he worked with an international team investigating technological change in agriculture and the links between food and energy systems; also initiated the first computer-assisted international team research linkages between the U.S.A., Austria, Poland, and the U.S.S.R. Earlier experience included technological forecasting, technology assessment, probabilistic simulation modeling, and teleconferencing system development. Special research interests: application of computer methods to RSI research and communication problems, specifically the exploration of long-term future alternatives for Asia-Pacific resource systems.

SANTERRE, Michael T. (U.S.A.) 10/01/78-09/30/80; M.S. Oceanography, University of Hawaii, 1974: Former Research Associate, Hawaii Natural Energy Institute and Hawaii Institute of Marine Biology. Has researched various aspects of applied aquatic ecology with emphasis on waste utilization. Special research interests: evaluation and comparisons of various renewable energy technologies that have potential applications in rural areas of developing countries; information sharing techniques, especially as they apply to energy and rural development.

SARVATE, Sarita (India) 08/21/79-08/20/80; M.S. Energy and Resources, University of California, 1978: An Energy Specialist with the California Energy Commission, with the responsibility of doing computer analysis and estimation of heating and cooling loads in existing as well as future buildings in California. A 20-year forecast of energy use for California is soon to be finished based on this analysis. Special research interests: Energy and Rural Development project and liaison with the Energy and Development groups at University of California, Berkeley.

SCHLEGEL, Charles C. (U.S.A.) 10/01/77-03/31/81; Ph.D. Development Sociology, Cornell University, 1978: Has field experience in Malaysia; served as Methodological Consultant for USAID/Cornell Center for International Studies evaluation research project in Indonesia. Special research interests: the comparative analysis of development topics cross-nationally and among subnational units in Southeast Asia, social indicators as a tool for development planning and evaluation, and methodologies for establishing and utilizing social information systems for developing countries.

SHKLOV, Cynthia, B.A. English, University of Hawaii, 1974: Associate Editor (limited appointment). Worked at Communication Institute before joining RSI staff. Edits RSI newsletter.

SIDDAYAO, Corazon M. (Philippines) 11/01/78-10/31/81; Ph.D. Economics, George Washington University, 1975: Served as Senior Research Economist at the Institute of Southeast Asian Studies, Singapore; consultant at the U.S. Federal Energy Administration, the Ford Foundation Energy Policy Project, the World Bank, the United Nations, and other organizations. Was Teaching Fellow (Economics) and Research Associate (Policy Studies in Science and Technology), George Washington University. Engaged in resource-related research since 1971 with special focus on the international and domestic resource aspects of government intervention in the energy industries. Special research interest: energy policy issues in Southeast Asia.

YANG, Yueh-Heng, M.S. Food and Nutrition, 1946, and M.A. Agricultural Economics, 1947, St. Johns University, Shanghai: Has 25 years of progressively responsible professional experience with the Sino-American Joint Commission on Rural Reconstruction and with the United Nations Food and Agriculture Organization. Prior to joining the Center, served as Deputy Director of the Caribbean Food and Nutrition Institute in Jamaica, and FAO Nutrition Officer in INCAP, Philippines, and Korea. Special research interests: food and nutrition policy, planning, and development of micro-level support programs.

APPENDIX 2

ENERGY FOR RURAL DEVELOPMENT GRANT EXPENDITURES AND ENCUMBRANCES
APRIL 5, 1979 - MARCH 31, 1980

	First Year Allocation 4/5/79-4/4/80	Fiscal Year 1979 Expenditures 4/5/79-9/30/79	Fiscal Year 1980 Expenditures 10/1/79-3/31/80	Open Purchases	Total Expenditures and Encumbrances 4/5/79-3/31/80	Balance	Incomplete Travel Report	Unencumbered Balance
Staff Salaries								
Permanent Staff		\$12,917.40	\$29,174.05		\$42,091.45			
Fellows:		1,490.98	15,932.74		17,423.72			
Subtotal	\$72,000.00	14,408.38	45,106.79		59,515.17	\$12,484.83		
Short-term Professional Services	1,700.00	0	2,531.78		2,531.78	(831.78)		
Workshops	50,000.00	27,969.00	26,247.44	\$ 184.02	72,618.44	(22,618.44)		
Researchers from Developing Countries	0	0	0		0	0		
Staff Travel, International								
Permanent Staff		5,971.00	3,209.65	3,249.28	12,429.93		\$3,702.00	
Fellows			4,012.30		4,012.30			
Subtotal	248.00	5,971.00	7,221.95	3,249.28	16,442.23	8,357.77	3,702.00	
Institutional Administrative Support								
Research Interns			11,877.94		11,877.94			
Temporary, Casual, Student Help			2,894.49		2,894.49			
Communications		258.65	2,418.92		2,677.57			
Printing & Reproduction		16.50	1,776.00		1,792.50			
Computer Use		0	554.32		554.32			
Supplies, Office		0	1,195.65		1,195.65			
Supplies, Education		0	0		0			
Staff Travel, Domestic		0	628.74		628.74			
Equipment		0	0		0			
Subtotal	\$51,500.00	\$275.15	\$21,346.06		\$21,621.21	\$29,878.79		
Total	<u>\$200,000.00</u>	<u>\$48,623.53</u>	<u>\$102,454.02</u>	<u>\$21,651.28</u>	<u>\$172,728.83</u>	<u>\$27,271.17</u>	<u>\$3,702.00</u>	<u>\$23,569.17</u>

THE EAST-WEST CENTER—officially known as the Center for Cultural and Technical Interchange Between East and West—is a national educational institution established in Hawaii by the U.S. Congress in 1960 to promote better relations and understanding between the United States and the nations of Asia and the Pacific through cooperative study, training, and research. The Center is administered by a public, nonprofit corporation whose international Board of Governors consists of distinguished scholars, business leaders, and public servants.

Each year more than 1,500 men and women from many nations and cultures participate in Center programs that seek cooperative solutions to problems of mutual consequence to East and West. Working with the Center's multidisciplinary and multicultural staff, participants include visiting scholars and researchers; leaders and professionals from the academic, government, and business communities; and graduate degree students, most of whom are enrolled at the University of Hawaii. For each Center participant from the United States, two participants are sought from the Asian and Pacific area.

Center programs are conducted by institutes addressing problems of communication, culture learning, environment and policy, population, and resource systems. A limited number of "open" grants are available to degree scholars and research fellows whose academic interests are not encompassed by institute programs.

The U.S. Congress provides basic funding for Center programs and a variety of awards to participants. Because of the cooperative nature of Center programs, financial support and cost-sharing are also provided by Asian and Pacific governments, regional agencies, private enterprise and foundations. The Center is on land adjacent to and provided by the University of Hawaii.

1777 East-West Road, Honolulu, Hawaii 96848

THE EAST-WEST RESOURCE SYSTEMS INSTITUTE is directed to the overall goal of understanding how nations can maintain adequate, equitable, and reliable access to resources. The Institute program consists of a broad study of three interrelated projects: Food Systems, Energy Systems, and Raw Materials Systems.

International research groups are collaborating with RSI staff to analyze and conduct research on these systems. A series of data bases and information exchange facilities is now being developed to support their studies. On an interdisciplinary basis, the various project teams will explore these problems stressing their interrelationships in both local and international terms in the Asian and Pacific region.



Food Systems builds knowledge about the dynamics and interdependencies of food flows, foreign exchange, and demands for energy and raw materials; explores ways for food importing nations to develop diversified food systems and to improve utilization of available food; does research on less energy intensive methods of food production; and evaluates alternative policies of pricing and land use.



Energy Systems provides analyses of the vulnerabilities of nations to disruptions in the flow of fuels; collects and analyzes data on energy supply, demand, and flows, especially those in rural areas; evaluates alternative development policies on a variety of energy systems and develops energy indexing methodologies and information exchange both within and among nations.



Raw Materials Systems focuses on analysis of the distribution problems and on opportunities for the development of the most important raw material resources of the Asia-Pacific area, particularly fertilizer, raw materials and forest products.