



CONTENTS

I. NOTES TO THE MEMBERS AND FRIENDS OF THE BALATON GROUP .....1

II. STORIES AND QUOTES .....5

III. THE INTERNATIONAL NETWORK OF RESOURCE INFORMATION CENTERS..9

IV. INRIC'S IMMEDIATE FUNDING NEEDS .....15

V. STRATEGEM-1: A MANAGEMENT TRAINING GAME ON SUSTAINABLE AND  
BALANCED RESOURCE USE .....17

VI. A TEXTBOOK ON RESOURCE MANAGEMENT: RESOURCE SYSTEMS -  
MANAGEMENT FOR PRODUCTIVITY AND SUSTAINABILITY .....21

VII. THE INRIC MEMBERS.....25

VIII.HISTORY OF THE IDEAS UNDERLYING THE BALATON GROUP .....31

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NOTES TO THE MEMBERS AND  
FRIENDS OF THE BALATON GROUP

Presentation Issue of the Bulletin:

At the annual meeting in September 1983 we decided to produce each year one issue of The Balaton Bulletin that could serve as a "presentation issue," a report useful to each of us in our efforts to tell others about the history and the goals of our group. We especially wanted to develop a document that could be used in raising funds to support the collaborative activities of INRIC. This newsletter, Balaton Bulletin = 6, mainly consists of our first efforts to develop a presentation issue. The first eight pages contain some brief news items and the ever-popular stories and quotes. The remainder provides you with materials that you may use in telling others about our program and our requirements for funding.

Since the strength of INRIC lies with its members, we have tried to include information on many of you. In most cases we did not have enough data to provide a complete description of your past work or your current interests. We hope you will provide us with a set of corrections or changes that we can incorporate in the next version of this presentation. That request also applies to recipients of this bulletin who are not mentioned explicitly here. Please tell us exactly what to say. We expect to issue a revised version of this report before the fall meeting, and we would like to include in it much more information on the people affiliated with INRIC.

This text is available for you to use in several ways. We have put into it a set of modules that can be used separately or together (without attribution). We have removed the normal Bulletin headers and footers, so that you may even cut out parts of the text and xerox it for use in proposals. We can provide you with extra copies, if that would assist you in promoting your own research and in raising funds that support the overall Balaton Group program.

The text of this newsletter has been created on our IBM-PC using the text editing program, Microsoft Word. Anyone who has a compatible microcomputer can obtain a floppy disk with the text formatted for Word or stored as an ASCII file. That would permit you to adapt our text easily, so that it suits some specific funding source. Please let us know if there is any other way we can assist in your efforts to secure funding for the joint programs of the group.

At the interim meeting, held at IIASA April 29 - May 2, 15 of us worked to critique the current versions of the INRIC game and the textbook. We reviewed the work of other members, especially Hartmut Bossel's microcomputer-based ecological teaching models, and we identified several high-priority projects that are urgently in need of funding. Support from two of our principal sponsors, IIASA and the Dartmouth College RFC, will be drastically reduced by the end of 1984. Thus it is a matter of pressing importance to find new funding sources that will sustain the momentum and enhance the growth of our program. Every member of The Balaton Group has some responsibility to assist in that effort.

#### The Resource Management Game:

By the end of May we will have finished STRATEGEM-1, our first, simple version of a comprehensive resource management game. Although there are many useful ways to revise and extend the game, it is already a useful tool. We have used STRATEGEM-1 with resource professionals from more than twenty countries, and the general response has been very favorable.

We will produce 50 copies of the game including the playing board, all pieces, comprehensive users' manual, and the accompanying computer program. We will be able to provide tape cassettes for direct use on the SHARP PC-1500A and floppy disks that provide the program in BASIC for either the APPLE II or the IBM PC. If you have none of the computers just mentioned, it will be a rather easy task for you to convert our BASIC program for STRATEGEM-1 into a set of BASIC equations that are compatible with any computer available to you. The price of the game sets is not yet determined. If we can secure a grant in support of its dissemination, the game will be available for free. In any event it should be available for less than \$50. Grants will be available to those for whom even that amount is difficult to secure.

### The Resource Management Textbook:

All but one of the draft chapters on single resources has been submitted, and we are editing them into a consistent format. The first few chapters of the book were read and criticized by the group that met at IIASA at the beginning of May. If anyone else would like to see it, please just ask Dana Meadows at IIASA to send a draft of the manuscript. A first draft of all the single-resource chapters should be ready by the September Balaton meeting. Stories and case studies of good (or bad) resource management are still needed. The group felt that stories written by Balaton Group members about cases personally known to them are most effective.

### The Network Microcomputers:

By September at least five of our centers will have IBM PC's. We are now searching for funds that will permit their acquisition by the remaining I members of the network. We are beginning to develop and acquire a large amount of useful software for these machines, and it would greatly facilitate our work for the other centers to find some way of gaining the use of a PC or PC-compatible computer.

### The September Teaching Conference:

We have finally developed a precise focus and plan for the September teaching conference. We will offer it September 2-8 at the OKGT facility on Lake Balaton in Csopak, Hungary. (The seminar will not be in Budapest as originally planned.) The course will focus on tools for systems thinking and on the systemic behavior of resources and resource systems. Small simulation models of forests, watersheds, populations, and related single resources will be presented together with models of interacting resource systems.

Participants will work on microcomputers to run, test, and change these models. No particular technical expertise will be required. The models will be taken from the evolving Balaton Group textbook and from Hartmut Bossel's forthcoming book on small environmental models. Dennis and Dana Meadows and Hartmut Bossel will be the principal instructors. We envision this teaching conference as a prototype that we can make widely available to students, teachers, and decision makers in many parts of the world. Its purpose is not to impart any particular technical tools, but to convey some strong concepts of and direct simulation experience with the behavioral principles of complex resource systems. Participants should leave with a good foundation in structure-behavior understanding, the long-term consequences of resource management options, and the principles of sustainable resource management. Causal-loop diagrams will be the principal systems communication tool; the small models will be programmed in DYNAMO or in BASIC for the APPLE II computer.

Appropriate participants would be Balaton Group members who want a stronger foundation in systems thinking and microcomputer applications, outside clients or supporters of our groups who want a more rigorous understanding of what sustainable resource management means, and/or prospective teachers who will use our games, textbook, and workshop in their home countries.

With this focus in mind, anyone receiving this newsletter should consider what nominations they might care to make for participants in the meeting. Attendance will be limited to about 35 people, and we expect that most of the final invitations will be mailed out before mid June. Thus we would need your recommendations almost immediately.

#### The Balaton Group Meeting:

The third annual Balaton Group meeting will begin on the evening of Sunday, September 9, at the TOT hotel in Budapest. It will finish on the evening of Thursday, September 13. The meeting will take place primarily at the OKGT rest house on Lake Balaton, as in the last two years, and it will provide time for reviews of the book, the game, other joint research and administrative matters. There will also be time for each of us to become informed of each other's work during the past year.

The meeting will have a special theme this year - the measurement of resource wealth, carrying capacity, and sustainability. We expect to begin with a special public presentation on Monday, September 10, in Budapest for all Balaton Group members and for 20-30 guest. That will describe some new concepts for determining and reporting the actual state of the resource base for specific regions. Balaton Group members are invited to present their thoughts, information, and research on theories and objective measures of regional carrying capacity during the week. Please let us know if you wish to accept responsibility for a presentation; we will send out more details on the meeting and individual invitations during early June.

## STORIES AND QUOTES

### One Man's Forest:

In 1910 at the age of 52 Elzeard Bouffier left his farm in the valley where he had raised his family and climbed into the dry and barren mountains of Cevennes, France. Working in solitude, with the use of an iron rod, he began to plant acorns, where decades earlier people had burned all the trees to make charcoal\*

Jean Giono discovered Bouffier in 1913, while hiking in the otherwise deserted region. In 1920, after the end of World War I, Giono returned to the area to find that Bouffier had continued to plant 100 acorns a day, heedless of the war. By that time the replanted forest was, in parts, ten years old and measured eleven kilometers in length and three kilometers at its greatest width. Giono visited the old man every year thereafter and witnessed the growth of the most beautiful forest in France. In addition to acorns, Bouffier began to plant beech, birch, pine, and alder seedlings.

"Creation seemed to come about in a sort of chain reaction....I saw water flowing in brooks that had been dry since the memory of man. This was the most impressive result of chain reaction that I had seen. These dry streams had once, long ago, run with water. Some of the...villages had been built on the sites of ancient Roman settlements, traces of which still remained; and archaeologists, exploring there, had found fishhooks where, in the twentieth century, cisterns were needed to assure a small supply of water."

"The wind, too, scattered seeds. As the water reappeared, so there reappeared willows, rushes, meadows, gardens, flowers, and a certain purpose in being alive. But the transformation took place so gradually that it became part of the pattern without causing any astonishment. Hunters, climbing into the wilderness in pursuit of hares or wild boar, had of course noticed the sudden- growth of little trees, but had attributed it to some caprice of the earth...."

In 1935 the miraculous beauty of the "natural forest" prompted a delegation of government officials, water and forest experts, to place the area under protection. Although Giono told them of Bouffier's dedicated work, the delegation would not believe that the miracle was the work of one man.

"I saw Elzeard Bouffier for the last time in June of 1945. He was then eighty-seven. The bus put me down at Vergons. In 1913 this hamlet of ten or twelve houses had three inhabitants. They had been...living by trapping game, little removed, physically and morally, from the conditions of prehistoric man. All about them nettles were feeding on the ruins of abandoned houses...."

"(Now) everything was changed. Even the air. Instead of the harsh dry winds that used to attack me, a gentle breeze was blowing, laden with scents. A sound like water came from the mountains; it was the wind in the forest....! saw that a fountain had been built, that it flowed freely and --what touched me most--that someone had planted a linden beside it, a linden that must have been four years old, already in full leaf, the incontestable symbol of resurrection...."

"Ruins had been cleared away, dilapidated walls torn down, and five houses restored. Now there were twenty-eight inhabitants, four of them young married couples. The new houses, freshly plastered, were surrounded by gardens where vegetables and flowers grew in orderly confusion, cabbages and roses, leeks and snapdragons, celery and anemones....On the lower slopes of the mountain I saw little fields of barley and rye; deep in that narrow valley the meadows were turning green...."

After almost forty years of pursuing his dream, Elzeard Bouffier died peacefully in 1947 at the age of 89. Giono continued to spread the message of Bouffier's work. In 1970 he wrote in answer to a request for directions to Bouffier's forest:

"If you go to Vergons, Banon, or Le Lagne, you will see nothing: since that time everything has been changed so that silos for atom bombs, shooting ranges, and various oil reservoirs could be placed there. Only a few pine, beech, and alder groves remain. Be content with the story and the spirit of the dead,"

(Sources: Stewart Brand, ed.. The Next Whole Earth Catalog. 2nd edition, 1981, pp 78-79, and Joan Davis)

### The Power of Economists:

The ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas. Not, indeed, immediately, but after a certain interval; for in the field of economic and political philosophy there are not many who are influenced by new theories after they are twenty-five or thirty years of age, so that the ideas which civil servants and politicians and even agitators apply to current events are not likely to be the newest. But, soon or late, it is ideas, not vested interests, which are dangerous for good or evil.

(Source: J. M. Keynes, The General Theory of Employment, Interest, and Money, original 1936, New York, Harcourt, 1964 ed. pp. 383-4.)

The following is offered with apologies to the vegetarians in the Balaton Group - this poem is not actually about cutting up an ox<sup>1</sup>

### Cutting Up an Ox:

Prince Wen Hui's cook  
Was cutting up an ox.  
Out went a hand,  
Down went a shoulder,  
He planted a foot,  
He pressed with a knee,  
The ox fell apart  
With a whisper.  
The bright cleaver murmured  
Like a gentle wind.

Rhythm" Timing'  
Like a sacred dance,  
Like ancient harmonies\*

"Good work" the Prince exclaimed,  
"Your method is faultless"  
"Method?" said the cook  
Laying aside his cleaver,  
"What I follow is Tao Beyond all methods'."

"When I first began  
To cut up oxen  
I would see before me  
The whole ox  
All in one mass.  
After three years  
I no longer saw this mass  
I saw the distinctions."

"But now I see nothing  
With the eye. My whole being  
Apprehends.  
My senses are idle. The spirit  
Free to work without plan  
Follows its own instinct  
Guided by natural line,  
By the secret opening, the hidden space.  
My cleaver finds its own way.  
I cut through no joint, chop no bone."

"A good cook needs a new chopper  
Once a year—he cuts.  
A poor cook needs a new one  
Every month—he hacks'."

"I have used this same cleaver  
Nineteen years.  
It has cut up  
A thousand oxen.  
Its edge is as keen  
As if newly sharpened."

"There are spaces in the joints,  
The blade is thin and keen:  
When this thinness  
Finds that space,  
There is all the room you need  
It goes like a breeze  
Hence I have had this cleaver  
Nineteen years

As if newly sharpened"

"True, there are sometimes  
Tough joints.  
I feel them coming,  
I slow down, I watch closely,  
Hold back, barely move the blade,  
And whump'. The part falls away Landing like a clod of earth."

"When I withdraw the blade,  
I stand still  
And let the joy of the work  
Sink in.  
I clean the blade  
And put it away."  
Prince Wen Hui said,  
"This is it! My cook has shown me  
How I ought to live  
My own life"

(Source: Thomas Merton, The Way of Chuang Tzu)

#### Why the Universe is Organized by Hierarchies:

There once were two watchmakers, named Hora and Tempus, who manufactured very fine watches. Both of them were highly regarded, and the phones in their workshops rang frequently—new customers were constantly calling them. However, Hora prospered, while Tempus became poorer and poorer and finally lost his shop. What was the reason?

The watches the men made consisted of about 1,000 parts each. Tempus had so constructed his that if he had one partly assembled and had to put it down—to answer the phone, say—it immediately fell to pieces and had to be reassembled from the elements. The better the customers liked his watches, the more they phoned him and the more difficult it became for him to find enough uninterrupted time to finish a watch.

The watches that Hora made were no less complex than those of Tempus. But he had designed them so that he could put together subassemblies of about ten elements each. Ten of these subassemblies, again, could be put together into a larger subassembly; and a system of ten of the latter subassemblies constituted the whole watch. Hence, when Hora had to put down a partly assembled watch in order to answer the phone, he lost only a small part of this work, and he assembled his watches in only a fraction of the man-hours it took Tempus...

Complex systems will evolve from simple systems much more rapidly if there are stable intermediate forms than if there are not. The resulting complex forms in the former case will be hierarchic. We have only to turn the argument around to explain the observed predominance of hierarchies among the complex systems nature presents to us. Among possible complex forms, hierarchies are the ones that have the time to evolve.

(Herbert Simon, The Sciences of the Artificial, MIT Press, Cambridge, Mass., 1969, pp. 90-91 and 98-99)

## THE INTERNATIONAL NETWORK OF RESOURCE INFORMATION CENTERS

### The History and Purpose of INRIC:

The International Network of Resource Information Centers (INRIC) is an association of professionals who work within centers that analyze and disseminate information about resources and resource management. The network currently includes members from centers in eleven countries, including nations in the East, West, North and South. We define the word "resources" broadly, to include renewable natural resources—water, forests, soils, and agricultural products; nonrenewable resources—coal, petroleum, uranium, and minerals; and the interrelations of these resources with the human population and its economic production processes.

Our network was formally constituted in September 1982 at a week-long meeting on Lake Balaton in Hungary. It is now incorporated in the United States as a nonprofit organization.

The central purpose of the INRIC members is to promote high-productivity, sustainable use of resources in their respective regions of the world. We do that in many ways:

- collecting and reporting information on the state of our region's resource base,
- analyzing trends and forecasting alternative future behaviors of the resource base viewed as a total interacting system,
- testing, demonstrating, and publicizing innovative and successful experiments in sustainable, high-productivity resource management,
- consulting for public or private organizations on particular resource management problems,
- developing innovative new teaching materials on principles of sustainable resource use,
- training resource managers at all levels, and
- educating the public on the problems and potentials of their region's resources.

We believe that clear and accurate information is needed about the state of resources and about the potential for more rational and efficient resource use. We are committed to creating and delivering this type of information to decision-makers and resource managers at all levels. We use whatever tools of analysis and communication are most effective for this purpose, including various types of systems analysis, mathematical models, seminars, management games, and reports. Most important, we believe this information can make a major, positive difference in each region's ability to support balanced economic and social development for all its citizens indefinitely into the future.

We have created INRIC to support and strengthen each of its members as they work within their centers to enhance their organization's contributions to the goal of rational, sustainable resource use. We intend to encourage the establishment of new resource centers where they do not now exist, and to undertake joint projects on resource issues that transcend any single region.

INRIC also provides us with several means for exchanging information, methods, computer models, training tools, and ideas for effective communication. We exchange personnel among our centers for purposes of training and joint research. We keep in touch with each other via an international telecommunication system, a newsletter, extensive travel, and an

annual meeting. We help raise funds for each other and provide each other both with critical review of our work and with moral support. The last is especially important, since we must all work every day with many people who do not share our concern for the state of the globe's resources and do not hold our conviction that a relatively small number of people can produce large, constructive changes in the quality of the globe's environment and of human life.

The Members and their Centers:

The INRIC members work in a diverse group of centers. Some are based in universities, some in government; some are in private organizations serving both government and industry. Membership in INRIC evolves as some of us move and are promoted to take on new responsibilities. As of May 1984, there were about thirty INRIC members; they worked in the following institutions:

- The Resource Policy Center, Dartmouth College, Hanover, New Hampshire, USA.
- The Center for Systems Studies of Arid Zones (AZSA), Saltillo, Coahuila, Mexico.
- The Center for Agricultural and Technical Research and Training (CATIE), Turrialba, Costa Rica.
- The Center for Environmental Analysis, Technical University, Kassel, Federal Republic of Germany.
- The Resource Policy Group, Oslo, Norway.
- The Energy Studies Unit, University of Strathclyde, Glasgow, Scotland.
- The Swiss Federal Water Resources Institute (EAWAG), Zurich, Switzerland.
- The Natural Resource Management Center, Technical University of Denmark, Lyngby, Denmark.
- The All Union Institute for Systems Studies, Soviet Academy of Sciences, Moscow, USSR.
- The Institute for Thermal Energy Systems Engineering, Technical University of Budapest; the Bureau for Systems Analysis, State Office for Technical Development; the Department of Agricultural Economics, University of Economic Sciences, Budapest, Hungary.
- The Faculty for Environmental and Resource Studies, Mahidol University, Nakornpathom, Thailand.

We have also received requests for membership from people working in centers in India, the Netherlands, Canada, the People's Republic of China, South Korea, the German Democratic Republic, and Poland. We are beginning to use our most well-established centers as places for training new INRIC members who will help to establish new centers in many countries, especially in the South.

Each year members of INRIC assemble for a week-long working session. These meetings are the occasion for us to review the year's progress, develop new goals, and explore means of collaboration. Joining us in these sessions have been many individuals who are not associated with a regional resource information center, but who have been willing to make their expertise, advice, and support available to the INRIC members. They include administrators and resource analysts from international organizations such as the United Nations Environmental Program (UNEP), UNESCO, the International Institute for Applied Systems Analysis (IIASA) and the United Nations University, as well as university professors, government analysts and ministers, and corporate managers from several different countries. This informal group calls itself the Balaton Group, after Lake Balaton beside which the annual meetings have been held.

Later in this document we provide more details on several INRIC members and describe briefly the centers within which they conduct their research.

#### INRIC's Administration and Funding:

The concept of a network implies maximum participation, minimum hierarchy, and informal decision-making. INRIC was not organized in order to create a major new institution with its own large staff and facilities. Instead we have created a small, so-far unpaid, secretariat that collects communications from participants for a quarterly newsletter, operates a computer mail system, keeps account of the central budget, and arranges the annual meeting. Presently Dennis Meadows is the Executive Secretary of INRIC, and his activities on behalf of the group are normally conducted at Dartmouth College. However, during 1983-84 he is Leader of the Division for Integrative & Special Studies at IIASA in Laxenburg, Austria. During this year the informal INRIC secretariat is in Austria.

By far the greatest majority of the funding to support INRIC projects has come to our members from their regions and for work within their own centers. This will remain the case in the future. However, little of our joint work can be funded in this way, so we have begun to seek money for the coordinating activities of the network as well. We have had a very favorable response to our initial solicitations. The Hungarian Ministry for Industry has provided accommodations, meals, and staffing for the first three annual meetings. UNESCO has supported some of our travel costs. UNEP has given us a grant to support the participation of members from the South, the dissemination of the network's teaching materials, and the purchase of two microcomputers for centers that could not otherwise afford them. During 1984 the Resource Group, a private foundation based in London, is supporting a small, full-time staff for the development of the book and the game. The Resource Group's grant to INRIC also covers some travel costs and expenses for our electronic mail system. During 1984 IIASA is supporting the salaries of two people involved in development of the management game, covering some of our computing expenses, and hosting an interim meeting of the group.

#### The Work of the Network:

The primary job of each member is to help his or her center work more effectively in its own country or region. Thus the joint projects undertaken by the INRIC members are designed to raise the effectiveness of the individual centers. Examples of recent joint projects include:

- An analyst in Hungary worked with the center in Mexico to help it adapt a computer

model of the Hungarian agricultural economy as a tool for assessing alternative policies affecting the agricultural system of Mexico.

- Centers in the USA and the Federal Republic of Germany collaborated to assemble information on successful practices of regenerative agriculture in their two countries.
- The center in Scotland assisted a professor from Thailand in carrying out an energy flow analysis for several different agricultural development options in Thailand.
- The Danish and Norwegian centers developed a proposal and research plan for a joint study with Sweden on a sustainable future for Scandinavia.
- Forest models from the Norwegian center have been adapted for use on similar forest problems by the center in the USA.

These two- or three-center collaborations are extremely fruitful, and they will remain an important component of the INRIC program. However, the members of the network have identified two objectives that will require inputs from all the members. We have decided that a pressing priority for INRIC must be development of training and communication tools that will raise awareness about and understanding of long-term resource problems and potentials. Thus we have begun two major projects that involve nearly all the members in the network. We are developing generic educational tools -a management training game and a textbook - that can be adapted and used in each of our regions. They are described briefly here and discussed more completely later in this document:

#### The Management Training Game:

Our management game is called STRATEGEM-1. It allows players to assume the roles of ministers in a hypothetical country, allocating resources to different sectors in order to promote sustainable development. Sectors such as energy, agriculture, industry, environmental protection, and foreign exchange must be kept in balance while human services are developed and environmental quality maintained. Fifty years of simulated time are covered in about four hours of play. A microcomputer keeps track of all the players' decisions and indicates how the system responds to them through many complex interrelationships.

The game is designed for use by planners and managers as well as students of resource management. It conveys a sense of the timing and interconnectedness of the many complicated aspects of the development process and the importance of effective information flow among different government agencies. The game has been tested through use by resource professionals from more than twenty countries; it has already been adopted as part of the curriculum in several training centers, including the nine-month program on ecological management run each year in Dresden on behalf of the United Nations Environmental Program.

#### The Textbook on Resource Productivity:

Our textbook on resource management is called Resource Dynamics. It is suitable for use at the university level in all the countries of our members. The book illustrates the systemic nature and the interrelationships of physical resources through simple systems principles, and

through accompanying microcomputer programs that simulate resource systems and allow students to experiment with different policies and see their long-term results. The book also documents many case studies of successful management, in which resource bases are maintained or even enhanced while yielding a high rate of useful production. Users of the book will be left with concrete knowledge about specific resources in many parts of the world, basic principles of the operation of complex resource systems, and a set of operational concepts for high-productivity sustainable resource management.

The book is being developed through the joint efforts of INRIC members in eleven countries; it will be translated for use in all of our nations. So far as we know, this is the first textbook on resource management that is being explicitly designed for use in universities in the USSR and the USA, in Scandinavia, Latin America, and Asia. We consider it essential that leaders in these diverse areas begin to share certain basic perceptions about the long-term dynamics of resource deterioration, exploitation, and regeneration.

A week-long training workshop is being designed to use the game and the textbook. This workshop will be packaged so that it can easily be adapted by each center for short-term training of local corporate and government officials in the basic principles of resource system management.

These joint projects are directed toward education and communication, not basic science, but they also require significant research. First, they force us to rethink the established principles of resource management. As far as we know, ours is the first serious attempt to represent the total resource base in its interactions with the human population and economy, and to explore the long-term dynamics of its response to different policies in a way that is appropriate both to market and to centrally-planned economies, both to rich and to poor nations. .

Second, we are experimenting with radically different ways to convey systematic insights about long-term resource use through techniques that combine microcomputer models, role playing, gaming, interactive exercises, and a rigorous application of systems principles. All this is being developed in ways equally useful to those who are sophisticated in the use of computers and to those who understand little about computers or statistics.

### The Future of INRIC:

The programs of the network are not imposed on the members by a central staff. Instead they evolve as individuals discover areas of mutual interest. Thus it has not been appropriate or necessary to develop a detailed long-term plan. The secretariat staff has mainly concentrated on arranging the conditions for fruitful discussion when the members are together and for easy communication when they are apart. Nevertheless, it is possible to make a few statements that give some information about the future directions for the network.

We have identified several criteria for membership in the group. Members should be:

- well established within a center that has the technical capacity and the charter to conduct research and/or teaching on issues related to natural resource productivity,
- able to carry out professional work at the frontier of their chosen field,
- skilled and interested in practical research that is geared to the needs of real decision

makers, and

- personally concerned about the quality of the globe's natural resource base and its ability to provide a decent, equitable life for people.

In two years, without much trying, we have found about 30 people who meet those conditions. They are the core of INRIC today. We have expanded as quickly as our financial and administrative resources would permit, and we see significant pressure for further growth. The people who have expressed an interest in attending the next annual meeting easily total three times the number that can be accommodated.

Many scientists and policy makers have come to see the inadequacies of a policy that gives no concern to long-term resource productivity and to the carrying capacity of their region. A great need is felt for better insights and improved tools for resource management, irrespective of the nation's political ideology or level of development.

## INRIC'S IMMEDIATE FUNDING NEEDS

In early May 1984 members of INRIC met at IIASA to review progress on their various joint projects and to identify the most important needs for 1985. Those discussions identified ten projects that will require outside funding:

- purchase four more IBM microcomputers and the related computer programs for the centers that are unable to secure the necessary funds. These machines probably will go to India, Thailand, Mexico, and Costa Rica. (\$20,000)
- provide 15 members of INRIC with \$1000 each for travel expenses to be used in their efforts to develop and coordinate research between INRIC centers in the richer and the poorer nations. (\$15,000)
- construct 50 sets of the network's resource management game, STRATEGEM-1, and distribute them to teaching centers around the world that offer resource management courses to public and private officials. Twenty of these sets will include a cheap, batter-powered microcomputer, so that the game is available even to those centers with no computer facilities. (\$11,000)
- support during 1985 the microcomputer mail system that links the INRIC centers through an informal electronic message board. (\$3,500)
- provide six fellowships that will permit junior analysts from INRIC centers in the poorer nations to accept six-month apprenticeships within established centers. (\$36,000)
- provide salary, travel, and office expenses for one administrative staff person to handle the affairs of the INRIC secretariat in 1985. (\$16,000)
- support the salary, computer expenses, and research costs required to finish the textbook and coordinate its translation into Russian, French, German, and Spanish. Any royalties resulting from sale of the text will be retained by INRIC to finance future publications. (\$45,000)
- support the travel costs and materials for the 1985 meeting. (\$7000)
- finance five, one-week teaching workshops on resource dynamics, so that five of the INRIC centers can acquaint resource managers with the problems and potentials related to long-term productivity of natural resources in their regions. (\$6000/each)
- provide partial support for a team at IIASA during 1985, so that they can finish the work of disseminating STRATEGEM-1 and collect additional management training models currently in use around the world. These models will be converted to a standard format for use on universally-available microcomputers and then documented, so that they can be distributed widely. (\$30,000)

This may seem like a modest program for a group that wants its work to make a real difference that will be observable in the quality of their regions\* resources. But two factors give special power to the money made available for the joint projects of INRIC.

First, each dollar spent on INRIC projects has the power to influence the focus or enhance the impact of three to five other dollars that have already been allocated for expenditure within an INRIC center. Second, money invested now in INRIC will be used to build a strong foundation of expertise upon which the programs of many new INRIC members will be based over the next few years.

## STRATEGEM-1: A MANAGEMENT TRAINING GAME ON SUSTAINABLE AND BALANCED RESOURCE USE

### The Management Game:

At the September 1983 meeting members of The Balaton Group decided it was important for them to develop a management training game that would convey the principles of sustainable, high-productivity resource use. During the meeting they worked out the general features of a teaching tool that would:

- attract and hold the interest of senior public and corporate managers for a 1-2 day teaching seminar and workshop on natural resource management policies,
- convey to the players generic principles of successful resource management,
- create among clients of all the INRIC centers a common awareness of long-term resource problems and a strong interest in sponsoring and using research relevant to the INRIC program, and
- be adopted widely (at least 20 organizations in the first year after its release) for use as one unit in university and management training courses on natural resources.

It has taken us five months of hard work to complete STRATEGEM-1, the pilot version of The Balaton Group's first training game. The game we have designed is a simplified version of what INRIC ultimately needs. It has nine system levels - POPULATION, DEBT, QUALITY OF THE ENVIRONMENT, and six capital stocks:

- DOMESTIC ENERGY CAPITAL
- GOODS PRODUCTION CAPITAL
- FOOD PRODUCTION CAPITAL
- ENERGY EFFICIENCY CAPITAL
- HUMAN SERVICES CAPITAL
- ENVIRONMENTAL PROTECTION CAPITAL

The present version already illustrates numerous principles of sustainable resource management, and it contains sufficient complexity to tax the analytical and management skills of most participants. STRATEGEM-1 illustrates a number of important guidelines that are overlooked in practice when investment programs are developed to enhance the productivity of a region's energy and environmental resources. The game has already been tested with a variety of teams in five countries. Included was a group of senior public officials from 15 nations who are participating in a nine-month course organized for the United Nations Environment Program in Dresden. The game has proven to be challenging, educational, and very entertaining.

The goal of those participating in STRATEGEM-1 is to guide development of a hypothetical region for a period of fifty years. Winning the game requires participants to manage investment and debt so that there is a balanced development of society; that means adequate energy, sustainable (ie. declining) rates of population growth, rising nutrition, acceptable rates of growth in material consumption, tolerable debt, and highly productive environmental resources. The model does not contain sufficient detail for use in making specific decisions that would affect a particular region. Rather it illustrates a set of basic principles that generally characterize development in all regions.

There are five teams of players (5-15 players in all), they must make 9 major decisions each five-year cycle.

1. What fraction of agricultural output is consumed by the population (the remainder is exported to earn foreign exchange)?
2. What fraction of manufactured and imported goods is allocated to: household consumption, domestic investment, and export?
3. What fraction of domestically-produced and imported energy is consumed in households (the remainder is used to support production of food and goods)?
4. What fraction of energy is allocated to support production in the agricultural and the industrial sectors (the remainder is exported to earn foreign exchange)?
5. What fraction of investment goods is allocated to: food production capital, environmental protection capital, goods production capital, human services capital, energy production capital, and energy efficiency capital?
6. What amount of foreign currency is derived from; foreign aid, export of energy, export of goods, and export of food?
7. What amount of new debt should be incurred through loans?
8. What amount of foreign currency should be used to repay existing debt?
9. What fraction of foreign currency is allocated to: oil imports, goods imports, and food imports?

STRATEGEM-1 employs a board, illustrated in Figure 1, on which a variety of pieces are moved during the cycle to represent the consequences of the players' decisions. This board eliminates the need for any mathematical sophistication by those playing the game, and the evolution of its physical flows reinforces the lessons of play. At the end of each five-year cycle the players' decisions are entered into a microcomputer that accompanies the game. In the computer an elaborate model of interrelationships among the nine system levels calculates the results of the decisions and indicates the starting conditions for the next cycle. This model affords the opportunity for three different behaviors over a period of fifty years - stagnation, balanced growth leading to a high-quality, sustainable state, and overshoot with decline.

Two strategies have been adopted to facilitate widespread use of the game, and its eventual descendants. First, we have programmed STRATEGEM-1 in the world's most widely used computer language, BASIC, and we have implemented it on a variety of small, relatively inexpensive microcomputers.

Second, the IIASA group is compiling a library of information on potential teaching centers that currently offer continuing (post-graduate) courses to public managers and that might become interested in adapting INRIC games for their own use. Examples of centers we have identified as potentially interested in this program are the Taiwan Institute for Land Reform Training, the International Management Institute in Zurich, Switzerland, and the School for

International Training in Brattleboro, Vermont, USA. We have not contacted most of these centers yet, but we are preparing a mailing to assess their interest.

The IIASA staff is now working to prepare the final version of the game and to construct a set of kits that include the game board, computer program, all pieces, users' manual, operator's manual and the projection transparencies required to introduce the exercise. We expect the kit will cost \$50 - \$100 to produce, omitting the cost of the computer. However, many centers will receive it free if we can secure a grant to support its construction and distribution. The game should be first available in August 1984.

#### The INRIC Computer System:

To facilitate collaboration and reduce drastically the cost of developing computer tools for our work, the members of INRIC have adopted a set of standard microcomputers and computer languages. Our implementation of the game illustrates this approach.

One version of STRATEGEM-1 runs on a battery-powered, pocket micro computer, the SHARP 1500-A, a machine that offers 8-24k of RAM memory, a four-color graphics printer, and a relatively complete set of BASIC commands. The computer costs between \$135 and \$400 in versions that will run the game. We have also developed the game to run on the APPLE II computer, which, together with its many imitations, is available widely around the world.

#### A Catalogue of Resource Management Games:

To supplement its work on STRATEGEM-1 the IIASA group is also acquiring resource management games that have been developed elsewhere. These are being translated into a standard form of BASIC, so that they can be run on a variety of standard microcomputers, and their documentation is being translated into English. So far this activity has focused on a farm management game and an industrial management game that have been used for several years by university groups in Budapest. However, preliminary surveys indicate that there is a substantial inventory of management training models and games available that could be converted for use in connection with the INRIC program.

A TEXTBOOK ON RESOURCE MANAGEMENT: RESOURCE SYSTEMS;  
MANAGEMENT FOR PRODUCTIVITY AND SUSTAINABILITY

AUTHORS:

The International Network of Resource Information Centers (INRIC). (Resource analysts in the USA, USSR, Norway, Germany, Switzerland, Mexico, Hungary, Poland, Thailand, and other countries.) Edited by Donella H. Meadows. The multiple authorship does not imply separate chapters in differing styles—the book will be tightly edited to use the expertise of the group but to maintain uniform tone and format, as if written by one author.

INTENDED AUDIENCE:

College and graduate students in environmental studies, resource, and planning courses; managers and planners; the educated and concerned public\* The book will represent resource problems and solutions in many different countries. It should be suitable for use in market, centrally-planned, and developing economies. The authors are interested in translating it into Russian, Spanish, German, perhaps other languages.

PURPOSE:

To communicate:

- basic information about the state of global resources, the underlying structure and dynamics of resource systems,
- the interconnections among different types of resources,
- the principles of high-productivity, sustainable, resource use,
- current and future opportunities and problems in resource management,
- an appreciation for the similarities and differences in resource systems in different parts of the world.

FORMAT:

A textbook, accompanied by an optional workbook with microcomputer diskettes allowing students to simulate resource systems and see the long-term effects of different management policies. The book will be readable and colorful, using maps, photographs, graphs, and stories of actual resource management successes and failures.

WHAT MAKES THIS BOOK DIFFERENT:

The international perspective and authorship, the rigorous underlying systems approach, the accompanying computer programs, the frequent use of real-world examples, the emphasis on sustainability, the emphasis on good news, the description of possibilities for accomplishing important goals, and the high level of clarity and readability, all differentiate this text from others that are widely used.

TENTATIVE OUTLINE CHAPTER ONE: Introduction to the Book

- I. The purpose of this book.
- II. The definition of "resource" and the role of values.
- III. The resource base as a dynamic, interconnected system.
- IV. The resource base as a local, national, and global concern.
- V. On models and modeling
- VI. The structure of the book.

## CHAPTER TWO: Introduction to Systems Thinking

- I. What is a System?
- II. Events, Behavior, Structure
- III. Bathtub Dynamics: Stocks and Flows
- IV. Thermostat Dynamics: Feedback 'V. Linked Feedback Loops: Total Systems

CHAPTER THREE: The-Human Population (note: all single-resource chapters will have a similar structure)

- I. Introduction and Definitions
- II. The State of the Resource
- III. Stories to Illustrate Basic Dynamics
- IV. The System Structure (with computer models)
- V. Stories of Good and Bad Management
- VI. Management Issues and Principles

CHAPTER FOUR: Productive Capital (note: this chapter outline is given in more detail to illustrate the nature of the book's content)

### I. Introduction and definitions

- A. Definition—the produced input to production; the longest-lived input after land. Standing demand for all other types of resources; the physical embodiment of technology.
- B. Types; capital-producing, goods-producing, household, service-producing, resource-producing, infrastructure.
- C. Problems of measurement—too varied for a single numeraire; can be related to the effort required to produce it (money units) or to its productive potential (product units); perpetual inventory method and its problems for validation (what if actual lifetime varies?). Distinction between physical and financial capital; this chapter is about physical capital.

II. The state of the resource (emphasize throughout the particularness of capital, the information lost in over-aggregation; encourage thinking in specific physical terms).

- A. Global total amounts and growth trends; differences in different parts of the world.
- B. Amounts distinguished by different capital types; shift in industrialization from agriculture to industry to services and away from household.
- C. Quality of capital; age, productivity, efficiency, lifetime and maintenance (follow through with particular plants -- Brown Paper Company in Berlin N.H. vs International Paper Company in Ticonderoga, N.Y.)

### III. Stories to illustrate basic dynamics

- A. Exponential growth (Brazil, Japan)
- B. Poverty, lack of growth (Africa)
- C. Permanence, immobility, long delays in technical change (U.S. crop planters)
- D. Cycles (apartments; Business Week, Oct. 82)

### IV. Basic dynamics (check in each case for market, planned, and developing economies)

- A. Bathtub (slowness of increase or decrease, an increase in demand has to result in a temporary increase of investment over depreciation in order to come to equilibrium). CAPITAL1
- B. Exponential growth and decay (the positive loop of investment, the negative loop of depreciation). CAPITAL2
- C. Pipeline and vintaging delays (the possibility of overshoot from physical delays). CAPITAL3
- D. Feedbacks to adjust production, the roles of inventory and backlog (overshoot and oscillation from information delays).
  - 1. Adjustment through capacity utilization—business cycles. CAPITAL4
  - 2. Adjustment through investment—Kuznets cycles. CAPITAL5
- E. Linkage of goods sector with capital sector, self-ordering—Kondratief cycles. CAPITAL6
- F. The problem of allocation (keeping sectors balanced, growth limiting itself through imbalance). CAPITAL?

### V. More stories, emphasizing principles of good and bad management

- A. Schumacher—appropriate technology
- B. U.S. automobile industry—are those who buy the new cars the ones who should determine the long-term market?
- C. Deliberate design for long lifetime—Troybilt
- D. Examples of good buffering against cycles
- E. Cummins Engine inventory policy—constant loss of market share.
- F. Central planning, good and bad G. Coal-fired boilers

### VI. Management issues and principles

- A. Dealing with immobility—long-term planning, lifetime enhancement, maintenance, design for retrofit
- B. Sensitivity of capital/output ratio (efficiency), lifetime, investment ratio
- C. Ways to deal with oscillations—keep track of pipeline, forecasts that aren't self-fulfilling, larger inventories, proper response delays and information systems
- D. Pulling out of the poverty trap
- E. The eventual steady state

CHAPTER FIVE; Water

CHAPTER SIX: Soil

CHAPTER SEVEN: Forests

CHAPTER EIGHT; Fish and Game

CHAPTER NINE: Fossil Fuels

CHAPTER TEN: Minerals

CHAPTER ELEVEN: The Atmosphere and the Climate

Following will be chapters on:

- linked resources, probably soil/water/forest, which will bring up the issue of environmental integrity and environmental services, and capital/labor/energy, which will bring up the issue of energy end uses, and:
- a chapter on the total resource base.

These later chapters are subject to the further planning and approval of INRIC, and to the development of adequate underlying models.

## THE INRIC MEMBERS

The primary purpose of INRIC is to identify, build, and strengthen excellent resource information centers all over the world. Its members are individuals and their work is institution-building. Here we introduce a few of the INRIC members and describe the centers within which they do most of their work.

In some cases INRIC members have a dominant influence over their institute, and there is little difference between their own professional goals and the objectives of the entire center. In other cases we work within centers and groups that have little or no concern for long-term resource trends and no interest in developing the concepts and tools that will assist in attaining high-yield, sustainable resource systems. Those members may even conduct most of their INRIC-related activities outside the formal programs of their center. In every case, however, INRIC members work within centers that could potentially have a major influence over the policies that govern natural resource by corporations and government agencies within their region. And all of us are working to focus our center's programs more directly on problems of long-term resource productivity.

In most cases more than one INRIC member is important to the work of a given center. But to keep this appendix a reasonable length, we will choose in each case the person who has been the original or most persistent contact with INRIC. Though it will not be complete, this list will convey an idea of the quality, the skills, the energy, and the diversity of the human beings upon whom the work of INRIC depends.

### THE RESOURCE POLICY CENTER

Thayer School of Engineering  
Dartmouth College  
Box 8000  
Hanover, N.H. 03755  
USA

The Resource Policy Center (RFC) was founded in 1972 as a new research and graduate training center at Dartmouth within the Thayer School of Engineering. It admits about 10 students per year for a two-year master's program in systems analysis and resource management. The Resource Policy Center has been involved in projects that include long-term analysis of U.S. energy supply and demand, the effects of increasing use of fuelwood on New England forests, the possibilities for development of low-head hydropower installations in New England, the future of dairy farming in Vermont, and the implications of alternative policies for reducing transportation energy demand.

Models developed by the RFC have been the basis for Congressional solar energy legislation, for U.S. Forest Service investment programs, and for state health care programs. An RPC simulation model has been used for the past six years by the U.S. Department of Energy for its official, long-term forecasts of oil and gas prices.

Dr. Dennis L. Meadows, who founded and for many years directed the Resource Policy Center, is a co-founder of INRIC, with his wife, Donella H. Meadows. Dennis was trained in system dynamics under Jay Forrester at M.I.T., where he served for several years on the faculty of the Sloan School of Management. With Donella he conducted the Club of Rome study that became famous through the 1972 book *The Limits to Growth*. The Meadows have

been involved in most of the RFC studies listed above, and have also been active as organizers and supporters of the developing field of global modeling.

They have served as reviewers and critics of the field of social-system modeling in general. They have served as consultants or advisers to several resource studies of the Office of Technology Assessment of the U.S. Congress, to the Winrock International Livestock Research Institute, to the Electric Power Research Institute, and the US National Science Foundation. They also practice sustainable resource management directly by operating a small organic farm in New Hampshire.

#### THE CENTER FOR SYSTEMS STUDIES OF ARID ZONES

CIQA

Aldama Ote. 351

Saltillo, Coahuila 25000

Mexico

CIQA was originally founded as a center for applied chemistry on uses for desert plants in the arid zones in Mexico. It has pioneered in developing processes such as the extraction of rubber from guayule and various oils and waxes from other native plants of northern Mexico. When it became clear that major social and economic changes would be required in Mexico to commercialize the CIQA discoveries, the institute began to develop research programs that applied concepts of systems analysis and modeling to resource management.

CIQA's founder and director over the past eight years. Dr. Enrique Campos-Lopez, was trained as a chemical engineer. In his work at CIQA he became interested in the total spectrum of problems of northern Mexico, including the management of water, soil, forests, and the creation of employment for a population growing by migration as well as by natural increase.

He developed the systems analysis and planning branch called ASZA to work with nearby localities on resource management. He began to coordinate his work with other arid-zone research institutes specializing in agriculture and water resources, so that they could begin to look systematically at planning problems as a whole instead of at a single resource at a time. All these activities became more urgent when the Mexican government began decentralizing the planning process to the various Mexican states and CIQA became responsible for technical support of planning activities within the state of Coahuila.

Enrique has recently left CIQA and has taken responsibility for the development of planning skills and training for all the Mexican states in his new position as Director of Management Technologies at CONACYT, the Mexican federal science foundation. He now oversees the budgets of eight national institutes, and he is working to create an advanced training center that will convey principles of sustainable resource management to officials in the Mexican government and industry.

THE CENTER FOR AGRICULTURAL AND TECHNICAL RESEARCH AND TRAINING  
CATIE

Turrialba, Costa Rica

CATIE is an experimentation center and training institute for tropical agriculture and forestry, serving the 7 Central American nations. It trains students each year in agronomy, silviculture, and regional planning, maintains a large research farm, and carries out consulting services for governments, communes, and private landowners all over Central America.

Dr. Gerardo Budowski is director of agroforestry at CATIE and a former Executive Director of the International Union for the Conservation of Nature based in Switzerland. His special interest is in the interplanting of native leguminous trees with coffee and other crops for soil protection, and in the regeneration of deforested areas in tropical Central America.

THE ENVIRONMENTAL SYSTEMS RESEARCH GROUP

Gesamthochschule

Monchebergstrasse 19

D3500 Kassel

Federal Republic of Germany

The Environmental Systems Research Group conducts research and teaching at the undergraduate and graduate level on environmental science, systems analysis, and sustainable resource use. It has recently undertaken such projects as energy conservation strategies for the city of Kassel, hydropower potential for Northern Hesse, and the simulation of environmental decision making by cognitive systems representations. One of its current projects concerns the dynamics of forest and soil damage from acid rain in central Europe.

Dr. Hartmut Bossel was on the faculty of the University of California before he returned home to the Federal Republic of Germany. There he became responsible for the energy sector of the Mesarovic/Pestel global simulation model in the mid-1970's. He has been continuously active in shaping the energy policy of the Federal Republic of Germany, and more recently he has become involved in promoting the technologies of sustainable high-productivity agriculture. Professor Bossel was a founder and member of the board of the OKO Institute, a public-interest research center in the FRG that has had significant influence over the government's energy and environmental policies. Bossel sits on the board of a major German environmental foundation, and he is just completing a textbook with 26 small simulation models of environmental systems, usable on most standard micro-computers.

THE RESOURCE POLICY GROUP

Gruppen for Ressursstudier

Sagveien 21

N-Oslo 4

Norway

The Resource Policy Group is a respected center for analysis, financed by government and private-sector contracts and by the Norwegian national science foundation, NTNF. Its staff includes 16 professionals, experts in particular economic and resource areas and in general policy analysis. Study results are disseminated through books, papers, briefings, radio and television. Recent work includes an analysis of the future of the energy-intensive industries in Norway, a study of Norway's ten major resources examining the strengths and weaknesses

of market-economy versus more directly-regulatory management, and a project to measure the actual effects of energy conservation policies in the Nordic countries.

Carsten Tank-Nielsen was trained originally as a transportation engineer and analyst. He spent a year at the Dartmouth center learning system dynamics and returned to become an analyst at the Resource Policy Group. In 1979 he became co-director of the group, with Jan-Evert Nilsson. Carsten has recently accepted a position as Deputy Director for a strategic analysis group within a Norwegian oil and gas company. He will be leaving the Resource Policy Group, which will remain an INRIC center, in September 1984.

#### THE ENERGY STUDIES UNIT

Strathclyde University  
100 Montrose  
St. Glasgow  
Scotland

The Energy Studies Unit offers a Ph.D. degree in energy systems analysis with a special emphasis on energy-agriculture interactions and on the estimation of carrying capacity using energy as a common numeraire.

Dr. Malcolm Slesser the director of the Unit is cooperating with another member of the Balaton Group, Jane King of the Population Division of UNESCO, and with the FAO to develop methods for analyzing the carrying capacity and long-term sustainable options for development of several countries, including Kenya and South Korea.

#### THE SWISS FEDERAL INSTITUTE OF WATER RESOURCES (EAWAG)

8600 Duebendorf  
Zurich, Switzerland

With a total staff of 190, EAWAG is the principal federal center in Switzerland responsible for issues related to water quality and quantity. Its staff carries out basic research in water geochemistry and surface/ground water interrelationships. They also provide consulting services to federal officials responsible for maintaining the productivity of Switzerland's water resources.

Dr. Joan Davis was trained as a water chemist in the United States; she has lived and worked in Switzerland since the early 1970s. Her work is designed to provide better understanding of water behavior in a watershed. She studies the sources of water and of the various biogeochemical substances that may contaminate it. She has done extensive research on social measures for reducing phosphate contamination in regional water supplies. She was a principal contributor on this topic in a European tribunal on water policy held recently in The Hague, Netherlands. Dr. Davis shared in the award of the first Mitchell Prize, a major international competition designed to stimulate thinking about dimensions of sustainable societies. She is an expert on the link between nutrition and health, and she is known to a wide popular audience in Switzerland on that topic.

### THE NATURAL RESOURCE MANAGEMENT CENTER

Natural-Resource Management Center  
Physics Laboratory III, Building 309  
Technical University of Denmark  
DK 2800 Lyngby  
Denmark

The Natural Resource Management Center was founded within Denmark's leading technical university when a group there found that its investigation of matters related to energy policy led it into a complex set of economic and social issues. The center has been a major proponent of energy conservation and renewable energy sources in Denmark. Its studies on low-energy futures were translated by the US Department of Energy for use in the United States. Its report on alternative development paths for Denmark caused a major sensation in that country; it was on the best seller lists for many months. The center's current projects include the DEMO-project on policies that can drastically reduce Denmark's reliance on imported energy. The group is also designing and building prototypes of electrical household appliances with electricity consumption far below the average of products available on the market.

Jorgen Norgaard teaches systems analysis techniques within the center and carries out a variety of research projects on high-efficiency resource use within specific communities. Dr. Norgaard is the Danish national representative to an international association for renewable energy sources. He travels extensively to consult with those who wish to adapt his low-energy scenarios to their own region.

### GLOBAL MODELING DIVISION

The All Union Institute for Systems Studies  
9 Prospekt 60 - letija Oktiabria  
Moscow 119034, USSR

Dr. Victor Gelovani leads over 100 scientists in the Global Modeling Division of this institute within the Soviet Academy of Sciences. His training is in cybernetics, but he directs an interdisciplinary team that includes soil scientists, sociologists, economists, and others. Dr. Gelovani led the development of the Soviet Union's entry in the field of global computer simulation models. He uses interactive models in presentations on resource management before senior Soviet managers in the Institute for Management Sciences.

### THE FACULTY FOR ENVIRONMENT AND RESOURCE STUDIES

Mahidol University  
25/25 Phutthamonthon 4  
Salaya, Nakornchaisri  
Nakornpathom 73170  
Thailand

The Environment and Resource Studies Faculty has a professional staff of 20 and 86 students. It specializes in studies related to energy-food planning and policy, biomass energy, environmental impact assessment, appropriate technology and rural development.

Dr. Chirapol Sintunawa has a PhD in energy systems from the University of Strathclyde. In his university he is responsible for many activities related to the concerns of INRIC. He

organizes four short courses each year for students and school teachers. These disseminate the concepts of environmental control and natural resource conservation. He is carrying out a study on the optimum size for a farming complex that would make total use of its biomass production through biogas production, fish farming, and mulching. He is initiating a study of the carrying capacity of Nakorn-pathom Province. The project will investigate crop productivity, animal farming, food and energy consumption, and trends in population growth and urbanization to identify the ideal level of population for the province.

#### DEPARTMENT OF AGRICULTURAL ECONOMICS

University of Economic Sciences

#### BUREAU FOR SYSTEMS ANALYSIS

State Office for Technical Development

#### INSTITUTE FOR THERMAL ENERGY

Technical University of Budapest

#### INSTITUTE FOR NATIONAL PLANNING

Ministry of Industry

Budapest, Hungary

There is so much expertise and interest in total-system, sustainable resource planning in Hungary that we have not yet identified a single INRIC center in that country. Rather, there are several people in centers, both in government and in universities, who participate in INRIC and who work together within Hungary on various resource projects. One of them is Dr. Ferenc Rabar, now at the Institute for National Planning, who founded and directed for many years the Food and Agriculture Program at IIASA. In that program Ferenc studied world agricultural commodity trade and its impact on world hunger. He has also been involved in constructing energy, environment, and general economic planning models for Hungary.

Professor Thomas Jascay, Director of the Institute for Thermal Energy at the Technical University, is Hungary's representative to the World Energy Conference, where he has chaired the Committee on Energy Conservation for several years. The Committee's last three-year project focused on energy conservation in buildings. Now Jascay is redirecting its efforts to consider rational use of energy in agriculture. Jascay is also a consultant on energy policy to the World Bank.

Professor Csaba Csaki, Dean of the Department of Agricultural Economics, has constructed models of the agricultural economy of Hungary and of the CMEA, and he has served as a consultant to many of the large farming enterprises of Hungary. He spends several months each year in the Middle East as a consultant to governments there on behalf of the United Nations Food and Agriculture Program.