THE BALATON BULLETIN

A quarterly newsletter
of The Balaton Group

January, 1986

CONTENTS

I. FUNDING

A. The Rockefeller Brothers Fund

We are delighted to announce that INRIC has been awarded a grant of $50,000 per year for three years from the Rockefeller Brothers Fund (RBF) of New York City. This is a general-purpose grant, to support the basic operations, administration, and annual meeting of INRIC. It will be used to fund the Balaton Bulletin and the computer mail system, for travel to annual meetings and other interim work meetings, for preparation of workshop materials and books, for part of Betty Miller's salary as INRIC's administrator and treasurer (now she has some money to be treasurer of!), and for part of Dana Meadows' salary as she works on the INRIC books.

This grant could not have been more timely or more essential. INRIC now has enough members in enough different parts of the world that communication and management are beginning to be significant undertakings, just at the time when the Dartmouth Resource Policy Center is less able to finance INRIC operations out of its own budget. The RBF grant will guarantee the organizational viability of INRIC for three more years.

It is always especially good to receive funding from people who share our values and purposes and who are good friends. The President of RBF, Bill Dietel, and the program manager of this particular grant. Bill Moody, are long-time friends and compatriots. They have both attended system dynamics workshops at the Resource Policy Center. For years they have put their personal efforts and the resources of the Foundation behind the concepts of sustainable resource use, environmental awareness, and people-oriented, community-level development. Other like-minded organizations that have been funded by RBF include CATIE (Gerardo Budowski's center). The International Federation of Institutes of Advanced Studies (IFIAS), The International Union for the Conservation of Nature (IUCN), the New Alchemy Institute, and Gerald Barney's new organization, the Global Research and Training Center.

B. The Jessie Smith Noyes Foundation

The Jessie Smith Noyes Foundation of New York is another foundation dedicated to wise resource use, with emphasis on sustainable agriculture, family planning, water resources, and tropical ecology. Last summer we received a three-year grant from them to facilitate exchange programs among our centers, especially for the purpose of training young people. At the Balaton meeting in September, we discussed how best to use this grant, and several written proposals were submitted.

From those proposals the money for the first year and part of the second year of the grant has now been allocated. The exchanges that have been tentatively approved, subject to working out the details, are:

- a tour of organic farms in the USA by Hungarian agriculturalists interested in setting up an experimental organic farm in Hungary,

- a tour of European and American energy-conservation facilities and laboratories by Laszlo Lovei of Hungary,

- study visits by members of the faculty of Mahidol University in Thailand to the INRIC centers in Denmark, the Federal Republic of Germany, and the United States,

- study visits by members of INRIC centers in China and India to the Resource Policy Center at Dartmouth,

- a workshop on game development to be conducted at the Systems Research Institute in Pune, India.

Other suggestions for exchanges are always welcome, and especially if they will take time to arrange, they should be submitted soon. Send a proposal in writing (it needn't be long or elaborate, just clear) to Betty Miller at Dartmouth.

C. A Desertification Game for UNEP

Dennis and Dana Meadows and Diana Shannon have submitted a proposal to UNEP that will fund the development of a computerized training game on desertification. This idea was originally put forward by the African participants in a workshop held in Nairobi last March, after they had played the STRATEGEM-1 game. The game will be used as part of a workshop for government officials and environmental educators in Africa. It will be developed with the assistance of the Desertification Unit at UNEP and experts on desertification from several African countries. If granted, the project will take about one year.

D. What Else?

The Balaton Group members agreed in September that it is necessary and healthy for all the INRIC centers to assume responsibility for securing funds that will support collaboration among the centers. Thus each INRIC center agreed to submit at least one funding proposal before September 1986 for a project of joint interest to several centers. So far only two centers have announced plans to do this——Dennis Meadows is carrying out a UNIDO-funded joint project with the Hungarian center this winter, and Antonio Camara is preparing a proposal for a mathematical model for the development of the Azores Region, to be carried out jointly between the University of Lisbon and Dartmouth College. He plans to submit the proposal to the Portuguese-American Foundation, NATO, USAID, and the Azores Regional Government.

It is important for the other centers to honor this obligation. Without greater participation in this aspect of our activities, the vision of a network of equal centers working together will lose its credibility. Obviously all centers do not have equal potential for raising funds, but every participant in the network certainly has the possibility to submit at least one proposal requesting support for work of interest to it and another INRIC center. We are waiting eagerly to hear about other proposals.

II. NEWS FROM THE MEMBERS

Dennis Meadows, Enrique Campos-Lopez, and Roberto Armijo, spent much of December in Cuba, working for UNIDO. Enrique and Roberto were helping a small firm that manufactures antibiotics to develop some microcomputer-based tools that would raise the efficiency of their management. Dennis demonstrated STRATEGEM-1 and other training games to officials from the Ministry of Health. Enrique and Roberto, having survived the Mexican earthquake, also weathered a major hurricane during their first days in Cuba.

Dennis Meadows will be spending the first three months of 1986 leading 16 Dartmouth students in an academic term at the Karl Marx University in Budapest. The students will be studying East European history, the economics of central planning, and technology and society. They will probably also visit the Hotel Petrol in Csopak to go ice skating on Lake Balaton! This is the first installment of an ongoing exchange program between the University and Dartmouth, arranged by Dennis and by Csaba Csaki, who is now Rector of the

Karl Marx University. During the fall term Dezso Kulcsar from Budapest was in residence at the Resource Policy Center at Dartmouth, where he took courses in system dynamics and In macroeconomics. Dezso will be the coordinator of the exchange program from the Hungarian side.

Paula Antunes from the University of Lisbon was also at Dartmouth for the fall term. She mastered system dynamics and the STELLA computer language and returned to Portugal clutching a Macintosh computer. She will probably join Dennis in Budapest this winter, along with Enrique Campos-Lopez, Diana Shannon and Krystyna Stave (both former Dartmouth students, whom many of you know from IIASA and various workshops) and Elzbieta Naumienko from Poland. This stellar international team will be working on the sustainable resource management workshop, integrating the microcomputer exercises and the lectures more consistently with the various sectors of the STRATEGEM-1 game. They are preparing for the next presentation of the workshop, which will be in Portugal in July (see below).

Jaswant Krishnayya and his wife Veronica are the proud parents of a baby girl, born November 4. The baby's name is Alisha-Helen Sornan Krishnayya, and we are told by an unbiased source that she is particularly beautiful. The Systems Research Institute in Pune is hoping to be connected to TYMNET by mid 1986 through the INDONET system. The Indian Planning Commission has asked the Institute to adapt the ZENCAP energy model for India to investigate alternate technological futures and investment policies.

Malcolm Slesser dropped by the Resource Policy Center in November for some good talks, and also presented his work on the ECCO model and workshop in Washington and New York. Malcolm feels that INRIC could have the greatest possible impact if we could come up with some serious, measurable, well-publicized indicators, on the order of GNP or PQLI, to express the quality and quantity of the resource endowment of a nation or region and the sustainability of resource use. This might be a major topic for discussion in this Bulletin and in an annual meeting, and a subject for joint projects by INRIC centers.

Chirapol Sintunawa writes, "After I returned to Thailand I had a chance to play STRATEGEM-1 at the Ministry of University Affairs and created a new project on the future of Thai universities. The introduction of the game and approach of system studies have led me to become closely associated with many people at the Ministry level. I am now an advisor to the Minister of the Ministry of University Affairs, in addition to working as a lecturer at the Faculty and a director of System Planning Project for the Office of the Rector. These all make me busy since I came back."

Niels Meyer will be contacting the Brundtland Commission on Environment and Development to introduce them to INRIC. He writes that the Danish government has increased the yearly funding to his center in the field of renewable energy. "We have also established a better relationship with the Ministry of Energy and are providing input to the next official Danish energy plan."

III. WORKSHOPS

A. Portugal

With support of the Gulbenkian Foundation, Antonio Camara has organized a session of the INRIC resource management workshop to be held near Lisbon July 8-13, 1986. Dana Meadows, Dennis Meadows, Joan Davis, and Bert DeVries are currently scheduled to cooperate with their Portuguese friends in conducting the session. The seminar will be held in English, and it will be adapted to run on the Macintosh computer. This will be a drastically revised version of the workshop that has been offered already in Hungary, Costa Rica, and Kenya. There are still a few places for participants. Probably one of your clients or staff members would benefit from the meeting. Please contact Antonio directly for more detailed information and application forms.

B. China

Dr. Li Wenhua, Executive Director of the Commission for Integrated Survey of Natural Resources of the Chinese Academy of Sciences, participated in the second Hungarian workshop on sustainable resource management. He found the teaching approach and the content of the seminar to be of interest in China. There Dr. Li must each year organize a number of expeditions consisting of up to 1500 scientists, who go out into a province of China for exhaustive analysis and planning efforts related to the region's natural resources. Since these team members come from many different institutes and disciplines, getting them to coordinate their efforts is difficult. A Chinese version of the INRIC workshop will be developed to help achieve that goal.

Materials from the Hungarian workshop are now being translated into Chinese. A scientist from Dr. Li's group will work at the Resource Policy Center next winter to become acquainted with the techniques of gaming and system dynamics. Then Dana and Dennis Meadows will offer a two-week, intensive session of the workshop in Beijing during May and June of 1987. That will train the Chinese in the seminar's content and in techniques for its administration, so that they may take it over fully and teach it in Chinese.

IV. BOOKS

Good-news stories are due NOW to Dana Meadows. Without them the good-news-story book simply will not go forward.

The first publisher approached with the children's book has turned it down. Other publishers are now being approached.

UNEP has provided a grant of $15,000 for the completion of the textbook. It will be used to develop the final set of microcomputer programs to supplement the text. This book will be back in full-scale writing mode starting in February. Everyone who has something to submit, please do it as soon as possible. A group work session on this book is now scheduled to be held at the Meadows farm in New Hampshire starting March 4. Anyone who would like to join us is welcome.

V. NEWS OF OTHER ORGANIZATIONS

A. IUCN

At the 1985 meeting we agreed that INRIC should now establish ties with a number of important, policy-oriented organizations that could use our technical resources and the results of our work. Three groups were mentioned; one of them was IUCN, the International Union for the Conservation of Nature. Two IUCN officials have responded positively to our initial proposal for exploratory talks. Dennis will meet with them in Geneva early in February to demonstrate the game and invite their participation in the 1986 Balaton Group meeting.

B. JOINT SOVIET-US AGREEMENT

In November officials from the United States government met in Moscow to discuss renewal of the formal, bilateral agreement on environmental protection between the two countries. The protocol, which was signed to extend the program for several years, included a project designed through discussions between the Resource Policy Center and INRIC's Soviet members. This project will develop a set of management-training games that illustrate the interactions between environment, resources, and economic development. A Soviet scientist from the Ail-Union Institute for Systems Studies will work with Dennis Meadows this winter in Budapest on the first stage of the project. Detailed discussions in the Soviet Union in March will provide a plan to guide the work over the next several years.

C. NATO FELLOWSHIPS

Here is an interesting opportunity for INRIC members in the USA, Denmark, the Netherlands, Norway, Portugal, and West Germany. The NATO Programme of Research Fellowships in Science and Technology provides opportunities for research scientists and engineers of NATO countries to pursue their work or to continue their training at institutions in other countries. The scheme is flexible enough to offer international mobility to scientists at different stages of their careers, and in a very broad spectrum of sciences.

Four types of fellowships are awarded:

- basic fellowships, to Individuals who have a first university degree and who wish to further their education by following a higher degree course,
- advanced fellowships, to scientists who have a Ph.D. or equivalent degree and who wish to carry out research in foreign institutions,
- senior fellowships, to senior scientists of high professional standing who wish to lecture and/or carry out research in foreign institutions,
- senior guest fellowships, awarded to senior scientists of high professional standing who wish to lecture and/or carry out research in institutions located in the country awarding the fellowship.

Usually NATO fellowships cover travel costs, living costs and school tuition fees where applicable. The customary length for basic fellowships is one year with a renewal in certain cases; the minimum duration for advanced fellowships is usually six months, for senior fellowships three months, and for senior guest fellowships three weeks.

Information and applications for countries represented in INRIC can be obtained from:

Denmark; Mrs. S. Sandorff, Danish Research Administration, Holmens Kanal 7, DK-1060 Copenhagen K (deadline 15 February).
Germany: Mr. F. Eschbach, Deutscher Akademischer Austausschdienst-DAAD, ProgrammbereighII, Kennedyallee 50 - Postfach 200/804, D-5300 Bonn-Bad Godesberg 2 (deadline 1 February).
Netherlands: Dr. J. Dijkhof, Nederlandse Organisatie voor Zuiver Wetenschappelijk Onderzoek, Juliana van Stolberglaan 148, P.O. Box 93138, The Hague (deadline 1 January).
Norway: Mr. T. Hernes, Committee for Scientific Personnel, Royal Norwegian Council for Scientific and Industrial Research, Sognsveien 72, Postboks 70 -Tasen, Oslo 8 (deadlines 1 April and 1 October).
Portugal: Dr. J. Mendes-Mourao, Junta Nacional de Investigacao Cientifica e Tecnologica - JNICT, Av. D. Carlos I, 126, 2°, P-1200 Lisbon (deadline 15 February).
USA: Dr. Walter L. Gillespie, Dep. Asst. Director, Directorate for Science and Engineering Education, National Science Foundation, 1800 G. Street NW, Washington, B.C. 20550 (deadline 2 November).

VI. VIABILITY AND SUSTAINABILITY

(Note: this is an edited version of a paper delivered by Hartmut Bossel at the annual Balaton meeting last September. Several of us were impressed by the paper and asked to have it reproduced in the Bulletin, for our own benefit and for those who were not at the meeting. If you would like a copy of the full version of the paper, you can get it from Dr. Hartmut Bossel, Umweltsystemanalyse, Monchebergstr. 19, Gesamthochschule, D-3500 Kassel, FRG.)

The basic orientors

We will define "viability" of a system as its ability to function in a way that preserves its integrity and allows it to develop according to its abilities. To understand the concept, we have to look at the components of viability of a self-organizing system.

All systems have a purpose; self-organizing systems (such as organisms) are able to pursue that purpose in a changing environment by adapting their behavior and/or their structure. This general task is handled by organisms in an immense variety of ways. Despite this variety, it is possible to discern a limited set of design principles ensuring viability of each system. We refer to the design principles as "basic orientors". In order for a system to be viable, each of these basic orientors must be represented. If even one of them is missing, the system is not viable.

Our analysis yields the following set of basic orientors:

- physical existence needs
- freedom of action
- security efficiency
- adaptivity

"Physical existence needs" is a basic orientor because the survival of an open system depends on an exchange of matter, energy, and information with its environment.

"Freedom of action" is needed because some environmental states may pose a threat to the system, and the system should have means of avoiding those states.

"Security" is necessary because any system has a finite information processing capacity and finite means of coping with the environment. The system can survive only if its environment likewise has only a finite variety with respect to survival-threatening states and exhibits a certain continuity, stability, regularity, and hence predictability.

The basic orientor "efficiency" is required to ensure that efforts to Influence the environment produce reasonable yields.

"Adaptivity" is necessary to enable the system to cope successfully with fundamental changes in the environment by changing its structure and/or its basic behavior modes.

If we consider an isolated robot or organism, these basic orientors span the full orientation space——if a certain minimum of attention is given to each of the orientors, the system will be viable. However, in discussing the viability of humans and their organizations, another dimension has to be added.

The ability of human beings to reflect about themselves, their actions, and their environment, enables them to recognize how their actions affect themselves and other systems. Human reflective abilities also enable them to recognize purpose and value in other societies, in living organisms, etc. Therefore, for human beings another basic orientor has to be added:

"responsibility". This orientor implies the consideration of the viability interests of other systems affected by human actions——it is the essence of humanity.

Orthogonality and the Law of the Minimum

Each orientor is vital to the viability of the system. A deficit with respect to one orientor cannot be made up by a surplus of another. The situation is analogous to Liebig's Law of the Minimum for essential plant nutrients: development of a system is only possible up to the point where the supply of one single factor becomes inadequate.

The state of basic orientor satisfaction is best indicated by the polar diagram of Fig. 1. The circle indicates the minimum, below which orientor satisfaction should not drop. Fig. la indicates viability. The system corresponding to Fig. Ib is not viable, since one orientor is below the minimum required.

How to Measure Orientor Satisfaction and Viability

For applications in policy analysis, these general considerations must be translated into practical procedure. The approach is to look systematically for all the measurable state variables that could be used to describe the satisfaction state of a particular orientor, to determine quantifiable reference levels or minimum values, to determine the relationship and importance of the different criteria, and to relate them to the basic orientors through a

criteria hierarchy. See Fig. 2 for examples of state indicators that relate to system orientors.

It has has been our experience so far that objective measures can indeed always be found for each orientor dimension in a given application. We have also found surprising agreement concerning the structure of criteria hierarchies and the relative importance of criteria for basic orientor satisfaction, even among groups of different political persuasion.

Viability over Time: Carrying Capacity

It is obvious from the dimensions of viability, especially "security", that viability must refer not only to present states but' to future ones as well. "Responsibility" includes the idea that today's generation has to take into account and ensure the viability of future humankind and other species. Safeguarding tomorrow's viability means working not just for a future subsistence, but for the full development of human potential (that is, paying attention to the other five orientors, not just "existence").

The maintenance of viability obviously requires the maintenance of the supporting environment——the maintenance of a minimum carrying capacity. The term "carrying capacity" will be used here with reference to renewable processes and will be measured in such terms as biomass per unit area per unit time that can be harvested indefinitely at a given location. Renewable processes may include both natural and technical processes.

Carrying capacity is not a constant in a given area. In ecological succession, carrying capacity increases as nutrients from weathering or biological fixation slowly accumulate in the system. In erosion, the disappearance of fertile soil produces the opposite effect. The loss of carrying capacity by such processes as erosion or destruction of tropical rain forests or desertification is often irreversible, at least over time periods of human interest.

Since the only major source of energy for renewable processes is solar, there is an upper limit on the potential carrying capacity of a region. Future technical processes may make better use of solar energy than plants, but at present it is reasonable to use primary production potential as an upper limit of carrying capacity.

Viability for How Many?

Our concept of humanity includes the right of each living individual to a viable life. However it also means assurance of continuation of human life in the future. That implies both a lower and an upper limit for the viable number of human beings.

On the one hand, human population must be maintained above the minimum level necessary for society to function. On the other, population must not grow beyond the carrying capacity. Furthermore, any decrease of population must not affect the viability of living individuals——it can come about only as a result of birth rates being smaller than death rates. Viability of the individual certainly also means a right to children. Their number, however, is limited by the responsibility dimension in the set of basic orientors.

The maximum viable population will change as carrying capacity changes, up or down. Since we do not know how populations will develop in the future——and there is the probability of substantial further growth in many countries——responsibility demands that we maintain or enhance carrying capacities.

Social Goals must be Consistent with Viability

A major conclusion from the argument so far is that short-term development goals can only be acceptable if they have been derived from long-term viability analysis. Some development goals that seem obvious today (such as the promotion of industrial growth, the centralization of government, the industrialization of agriculture, etc.) may in fact be detrimental to viability.

The constantly-changing conditions in a development process mandate a constant adaptation of goals to changing conditions, always keeping the long-term viability in view. Keeping the same set of goals (e.g. maximum economic growth) over many decades without being able to relate them to long-term viability is irresponsible.

Of course, that is the situation now. We have never analyzed our options with respect to future viability. We may be squandering resources irretrievably for trivial purposes, and those resources will then not be available for the transition to long-term viability. At stake in this gamble is the viability of society, and hence society itself.

Trading the Present against the Future: Nonrenewable Resources

Even in a stationary society, a constant set of goals nay not be possible, since there is always a degradation of resources, especially nonrenewable ones. This means that all development paths are irreversible in principle, since reversibility would mean 100Z recycling, which is impossible. Hence there will always be a requirement to match short-range goals against long-term viability. There will never be complete insurance against catastrophic breakdown, but the constant revision of goals in view of long-term viability is probably the best way of coming close to it.

In the interests of long-term viability, it may be prudent to knowingly increase irreversibility over a limited period. For example, the only way to build up a sustainable resource base may be to invest heavily in nonrenewable resources now. In other cases, temporary impairment of some present viability dimension may have to be tolerated to ensure long-term viability.

However, in general, the viability of current industrial society is directly threatened by the depletion of nonrenewable. A different, sustainable technology is needed, based on full recycling, conservation, and the use of renewables. Efforts in this direction are all a contribution to viability.

The yardstick of development cannot be the current availability of nonrenewables, but must be the long-term availability of renewables.

The Crucial Role of Time Horizon

These considerations indicate the crucial role of time horizon in development planning. A short time horizon increases drastically the possibility that an irreversible path leading to loss of viability is being pursued. It also means that correcting action, if found to be necessary, must be quicker and harsher than it would otherwise have to be. A long time horizon makes it much easier to avoid irreversibility pitfalls, to implement necessary changes gradually, and to proceed toward long-term viability without making undue demands of

present generations.

The likelihood of avoiding pitfalls and of guaranteeing continuous viability is maximized if we make the length of our time horizon identical with the time range of our actions.

Interregional Exchange and Viability

The distribution of both resources and people over this globe is very uneven. That obviously leads to transportation of resources from surplus areas to deficit areas. Apart from any other considerations, that transportation today means the irreversible loss of fossil fuels. In some cases (e.g. the export of kiwi fruit from New Zealand to Europe or carnations from Colombia to the U.S.) such trade must be classified as downright irresponsible.

In terms of long-term viability there are additional reasons to question many interregional exchanges. If an area exports nonrenewables, there is a regional loss of resources that will not be available for development later. Such an exchange seems justified only if it is temporarily used to trade for resources that are necessary to ensure a path toward long-term viability. The import of resources may actually decrease the long-term viability of the importing region by encouraging resource waste, discouraging conservation and recycling, and delaying efforts to get on a sustainable path.

Also, an importing region becomes dependent on another region for its viability. This means that its security, freedom of action, and adaptivity orientors are impaired, and hence its viability. From the point of view of transportation costs and foreclosure of conservation options, the efficiency orientor is also weakened. An exporter may have its viability impaired by its dependence on an exogenous system that may be in a position to impose conditions, such as prices.

The exchange of renewables between regions might not necessarily be a threat to viability, in contrast to the exchange of nonrenewables. However, at the moment such an exchange does not seem possible without a loss of nonrenewables (fossil fuel, fertilizers, etc.)

Self-sufficiency therefore generally implies higher viability. That does not hold true, however, for the exchange of information, especially Information about the efficient use of resources, which should be available to all, without delay. Information can only increase the options, and hence the viability, of a system.

In short, regional self-sufficiency of materials and energy is a logical long-term development goal, and the use of nonrenewables can only be justified if used to build up the sustainable carrying capacity. Regional exchange should take place only during the period while each region is building up its sustainable self-sufficient capacity. Of course, today we are far away from such a view of interregional exchange.

Research and Action Needed

From the general principles developed here, some concrete proposals for research and other action can be derived.

1. A precondition for the sort of assessment discussed here should be a "state of resources" assessment for each region, stating the present stocks and yields of renewable and nonrenewable resources. Also the current rates of change, of resource depletion, of

population growth, etc. will have to be known. Population and its development, urbanization, and the economic, industrial, ecological etc. development and their perceivable future consequences would have to be documented.

2. The carrying capacity for renewable processes has to be determined for a given region and for different development paths. Important yardsticks are the current equilibrium carrying capacity of the present ecosystem, the maximum biological carrying capacity, the present carrying capacity erosion rate, the carrying capacity development potential, and finally the equilibrium carrying capacity for various possible states of resource erosion or enhancement.

3. A crucial element is the systematic construction of plausible development paths from today's conditions to future possible sustainable states. Such a path study must include a set of qualitatively different paths, which in their totality span the whole space of future development possibilities. The presentation of a single path, with perhaps a single alternative, does not amount to a credible path study——the investigators and their clients would be fooling themselves.

4. One aspect of path study that can be handled without getting into questions of criteria and evaluation is the identification of paths that have a high probability of breakdown, due to resource erosion, overpopulation, or inattention to long-term viability. Recognition of such paths is an early warning system, and very inexpensive compared to the costs of failure.

5. It is necessary to identify those state variables that can be used to assess the state of orientor satisfaction and hence the state of viability. Using the six orientor dimensions as a checklist and various measurable indicators of the system as a guide, the task is to link the indicators with the orientors in a hierarchical criteria system. Effort must be taken to avoid double-counting or incompleteness. Once this connection has been made, the "orientor star" can be plotted and the viability determined. The viability of various possible development paths can also be identified and hidden development traps revealed.

6. The conclusion from a path study will generally be that the path is unsustainable in the long run and that sooner or later a switch or an evolutionary transition to another path is necessary. Normally the timing for the switch is not arbitrary, and the path study will help identify favorable timing patterns, as well as new values for goals and constants. It will also identify obstacles to the switching process and ways to remove them.

7. The path study will provide hints for the temporal goals or constraint adjustment patterns leading to long-term viability. Control of the development process is possible by two different approaches.

In one approach, typical for planned economies, goals are revised at certain intervals (five year plans, etc.). Assuming that goals are set correctly and pursued efficiently, this approach may indeed steer the system on the desired course. However it leaves little way for the creative impetus and corrective actions of subsystems, and hence if goals are not set correctly, this approach may suffer from inefficiency and may actually accelerate the departure from viability.

In the second approach, the setting of goals is left to subsystems, but their actions are constrained by mechanisms (rates of interest, subsidies, taxes, regulations, etc.) that restrict

the systems from taking paths that are undesirable. This approach often suffers due to the inefficiencies connected with unsuccessful trial-and-error adjustment processes in the market place; it is also difficult to set the constraints accurately and to enforce them.

The second approach is more typical of market economies, but actually all economies today are a mixture of both approaches.

Whether we rely on goals or constraints or a combination, the important thing is that efficient means are found to force the system on a viable path; or to prevent the system from getting onto paths that will be unviable and unsustainable in the long run.

8. More efficient, less energy- and resource-consuming, less polluting, more information-intensive, sustainable technologies are obviously necessary——technologies based on the principles of conservation and the use of renewable resources. Substantial research and development of these technologies will be necessary.

The technological development must be complemented with information and education to ensure that the technologies are understood, welcomed, and used. These education efforts must concentrate on: possible and competing development paths and their implications; the dynamics of renewable and nonrenewable resources; and finally, the concept of viability and the responsibility of human society.

VII. STORIES AND QUOTES

Visit to a Man-Made Oasis (submitted by Li Wenhua, from the February, 1984 issue of China Reconstructs, pp. 44-46)

It was the season of melons, for which Xinjiang is famous, but I cherished no hopes of having any in the desert Junggar Basin. There they were, though, melons grown in the man-made Mosuowan oasis, which has been created here since 1958, served me by members of the Xinjiang Afforestation and Sand Control Institute research base. The Mosuowan oasis protrudes for 60 km into the Gurbantunggut Desert, China's second largest after the Taklimakan in southern Xijiang. On three sides sand dunes stretch off into the distance.

The area that is now oasis was covered by such dunes with only a few scrubby desert plants growing on them in 1958, when a regiment of the Xinjiang Uygur Autonomous Region's Production and Construction Corps arrived at Mosuowan to fulfill the dual task of converting wasteland and constructing a base from which to guard the frontier. The corps men and women leveled more than 2,000 sand dunes and mixed more than 9 million cubic meters of sand with the soil to loosen the hard clay base that covered most of what was destined to become farmland. They created 14,000 hectares of arable land. They also dug 1,200 km of irrigation ditches, coaxed into hardy growth plant cover over 6,000 hectares, sowed 200 hectares of vegetation specially suited to sandy and arid regions and established a total of 1,200 hectares of forests and shelter belts.

At first, despite their efforts at shelter belts, they found their fields still menaced by wind and sand. In May 1961, for instance, the crops on 21.5 percent of the sown area were lost after a Force 8 windstorm that lasted 8 hours. Technicians sent there in 1973 by the Afforestation and Sand Control Institute found that though shelter belts had been planted between the fields, not enough attention had been paid to building a complete shelter system, or to

afforestation on the outer edges of the farmland along the fringe of the oasis. Gradually this has been done.

Much research has centered around the shrub sacsaoul. It is ideal for sand-fixing in shelter belts because of its ability to withstand drought, wind and sand. Despite its adaptation to dryness, it has been found to grow much more quickly with water. Average annual precipitation in the Gurbantunggut Desert is only about 100 millimeters. Much of it comes as snow in winter. The snow cover lasts between 100 and 120 days and attains a thickness of 20 or more centimeters. Good results were obtained by broadcasting the seed on the snow, rather than sowing them in the ground after the snow has melted.

Other research with sacsaoul has been carried out, particularly on the laws of natural regeneration of the shrub. "We are mastering the techniques of creating belts with sacasoul under different natural conditions," says Liu Guangzong, head of the Afforestation and Sand Control Institute's research base.

At the base stand row upon row of different species of trees brought in from other parts of China. Ten of a type are planted in each row, for the scientists to observe their growth and recommend the more successful types for wider use. Among the 53 kinds of trees and 17 of bushes and shrubs, elms from China's central plains have already achieved a height of eight meters, and several kinds of pines from north and northeast China are doing very well. Beneath the pines the planting of soybeans is being tested as a means of providing shade for the ground surface and reducing evaporation.

The shelterbelt designed by the scientists ten years ago and planted and tended by the local people under their guidance has become a full-fledged forest. It actually consists of three sections. The first, three kilometers wide, stretches for 22 km along the outer edge of the oasis, the first bulwark against the desert wind and sand.

The second section, 25 km long and 20-30 meters wide, lies between this first section and the edge of the farmland it protects, and further serves to keep out sand and reduce the force of the wind. The third section consists of large and small networks of trees along the edges of the checkerboard of fields.

The three together make up a complete and effective shelterbelt system. Surveys show that wind speeds inside the checkerboard average 20-40 percent lower than outside, and evaporation is 12-25 percent less. Inside the belt, a favorable microclimate has been created for crop-growing. The grain yield has increased from 95 kilograms per mu (1 mu = 1/15 hectare) in the early days to more than 200 kg today. Hence the belt's name: Bumper Harvest Forest.

The Mosuowan research base is a long way from any city. Life is hard, but the staff are a group of devoted people. Even in 1982 things looked pretty forbidding to Liu Jin, a 1982 forestry graduate of the Xinjiang Institute of Agriculture, when she arrived. It was in the middle of a cold spring and vegetables were scarce as they always are at that time of year. She tells me how she couldn't swallow the brackish drinking water. It is brought from a long distance away and stored in cisterns near the buildings. "Even brushing my teeth with it made me want to throw up." But she gradually became accustomed to the life there, and conditions improved somewhat. Why did she want to work there? "Xinjiang has some big deserts," she said, "and forestry is my vocation. I want to develop forestry here and transform the desert."

If the Earth Were a Ball (from a Christmas card sent by Joan and Roger Evens of London, England)

If the Earth
were only a few feet in
diameter, floating a few feet above
a field somewhere, people would come from
everywhere to marvel at it. People would walk around
it, marvelling at its big pools of water, its little pools and
the water flowing between the pools. People would marvel at the bumps
on it, and the holes in it, and they would marvel at the very thin layer
of gas surrounding it and the water suspended in the gas. The people would
marvel at all the creatures walking around the surface of the ball, and at the
creatures in the water. The people would declare it as sacred because it was
the only one, and they would protect it so that it would not be hurt. The
ball would be the greatest wonder known, and people would come to pray
to it, to be healed, to gain knowledge, to know beauty and to wonder
how it could be. People would love it, and defend it with
their lives because they would somehow know that their
lives could be nothing without it. If
the Earth were only a few feet
in diameter.

Thought Traps and Escape Routes

(This is an outline of a talk given by Dana Meadows, first at the Institute for Futures Research at Stellenbosch, South Africa, and later at the INRIC workshop at Sopron, Hungary. It is a reconstruction out of her memory, since the notes appear to be lost. Perhaps one of you out there who took good notes can supply what is missing. Or better yet, contribute some thought traps and escape routes of your own.)

Thought Trap	Escape Route
scarcity——there is not enough money, time, material, energy, love, to go around, therefore these things must be hoarded and I must get mine first.	sufficiency——there is just exactly enough money, time, material, energy to do what has to be done, therefore not a bit can be wasted, but everyone can have all he or she needs.
abundance——there is so much money, time, material, energy, love that it can be used without thought, wasted, applied to the most trivial purposes.	
pessimism/optimism	clearheaded realism, awareness, truthfulness
hopelessness/complacency, both of which justify inaction	commitment and action
either/or	both/and
burden, sacrifice, difficulty——the job is all on my shoulders, no one else will help, and it will be so very very hard.	partnership, privilege, joy— we are all in this together, everyone has something to contribute, and it will be fun.
sabotage -it has never been done before -it won't make a difference -last time it didn't work -I'm not good enough -it's not time yet	empowerment -about time someone tries it -every little bit helps -we learned from that mistake -someone has to, why not me? -no time like the present
win/lose	win/win