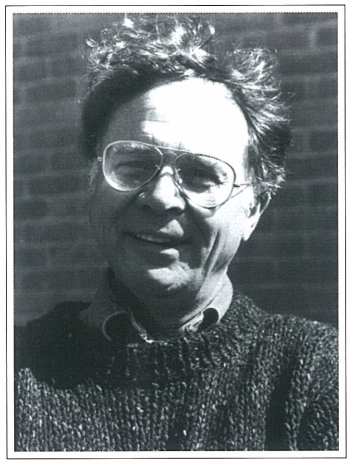
The Winners of the Blue Planet Prize
1996

1996

Blue Planet Prize

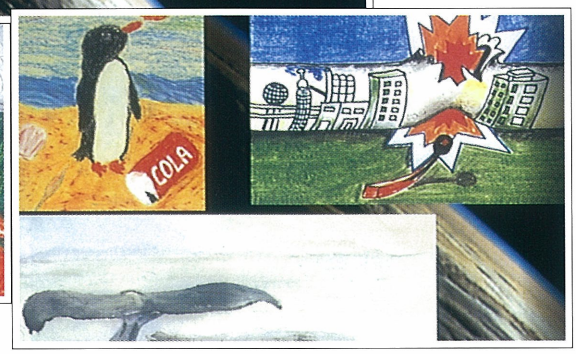
Dr. Wallace S. Broecker (U.S.A.)

Newberry Professor of Geology at Columbia University, Lamont-Doherty Earth Observatory



The M.S. Swaminathan Research Foundation (MSSRF) (Established in India)

Excerpts from a book of stories and pictures by children from around the world formed the basis of the 1996 awards ceremony slide presentation. The issues of humankind versus nature and of civilization coming to terms with environmental problems were put in clear focus by the messages from the children to adults about how they want the Earth to be left for future generations.



Professor Kenichi Fukui, Nobel laureate and a councillor of the Asahi Glass Foundation, gets the party started with a toast.

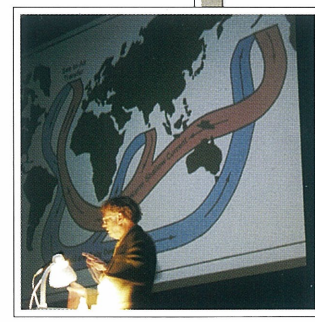
His Highness Prince Akishino and Her Highness Princess Kiko congratulate the laureates.

The awards ceremony is opened by Jiro Furumoto, chairman of the Asahi Glass Foundation.

Prior to the awards ceremony, the award recipients are interviewed by members of the press. From right to left: Dr. Swaminathan; Dr. Broecker; Jiro Furumoto; and Osamu Shiragami.

Dr. Swaminathan participates in a follow-up discussion after delivering his lecture on sustainable development.

Walter F. Mondale (left), ambassador of the United States of America to Japan, and Kuldip Sahdev, ambassador of India to Japan, address the audience at the awards ceremony.



During his lectures, Dr. Broecker explains his theory of the ocean's circulation system.

Profile

M.S. Swaminathan Research Foundation (MSSRF)

Chairman: Dr. M.S. Swaminathan

History

1988 MSSRF was established by M.S. Swaminathan, the Chairman of MSSRF

1990 MSSRF established the Centre for Research on Sustainable Agricultural and Rural Development as its core organization

The M.S. Swaminathan Research Foundation was founded in 1988 with the goal of promoting research and activism devoted to furthering rural and agricultural development by environmentally sustainable and socially equitable means. The founder and chairman of the organization is Dr. M.S. Swaminathan, the recipient of the 1986 Albert Einstein World Science Award and the first World Food Prize, in 1987.

One of the research foundation's major achievements has been the study and conservation of coastal ecosystems, particularly mangrove wetlands. Based on its research into vegetation, soil salinity, and other aspects of mangrove habitats, the research foundation has taken steps to restore degraded wetlands while promoting sustainable agroforestry and aquaculture.

The M.S. Swaminathan Research Foundation conducts a community biodiversity program to rescue endangered plant species from extinction. Furthermore, it engages in a wide variety of research projects, including one aimed at identifying microorganisms that serve as bioindicators of ecosystem health, and another concerned with conserving the genetic diversity of plant species.

Another program of the Foundation is the creation of an economic stake in conservation by linking conservation and commercialization in a symbiotic manner. The Foundation has established a Technical Resource Centre for the implementation of the equity provisions of the Convention on Biological Diversity. The Foundation is also the coordinating center for the Asian Technology Network sponsored by UNESCO.

In addition, the research foundation promotes the bio-village model of sustainable rural development in India, the People's Republic of China, and Southeast Asia. By helping to conserve the natural environment of developing countries while supporting the economic viability of rural communities, the M.S. Swaminathan Research Foundation is playing an important role in the search for solutions to global environmental problems.

Essay

Sustainable Development—Five Years after Rio

Dr. M. S. Swaminathan
Chairman, MSSRF

February 1997

The UN Conference on Environment Development (UNCED) held at Rio de Janeiro in June 1992 was designed to bring about a global transition from unsustainable to sustainable development. The conference was not an exercise in empty rhetoric. On the contrary, it came to grips with the most serious challenges facing humankind in restoring harmony between economic development and conservation of nature and natural resources, and in ensuring opportunities for sustainable food and livelihood security for generations yet to be born. Agenda 21, the global conventions on climate and biodiversity and the forestry principles adopted at UNCED provide a blueprint for sustainable development. Five years after Rio, we have to admit that the enthusiasm witnessed there in adopting these commitments has yet to be translated in an adequate measure into political and public action.

The change in course recommended by business and industry at Rio for making good business and good ecology two sides of the same coin has also yet to take place on a significant scale. There has, however, been great progress in the greening of the media and judiciary. Leading organizations, like the Asian Productivity Organization, are doing their best to promote green productivity movements. The Blue Planet Prize instituted by the Asahi Glass Foundation on the occasion of UNCED and similar initiatives have helped to keep environmental issues high in the public mind and political agenda.

Japanese institutions and individuals have been at the forefront of human efforts in promoting the coexistence of the Earth, economy, and humankind. The Tokyo Declaration, adopted on February 20, 1997, at a symposium organized on the occasion of the Mainichi newspaper's 125th anniversary, articulates current concerns and enunciates a global plan of action, including the establishment of a Council on the Earth's Environment by the United Nations to perform functions in the area of ecological security—similar to that of the Security Council in the field of peace among nations. Japanese scientists and technologists have also shown ways of achieving very considerable reductions in CO_2 and SO_2 emissions. Scientific work is responding to societal concerns. The Japanese example needs to be replicated worldwide speedily.

The conventions on biological diversity and climate adopted at Rio and ratified subsequently by most member nations of the United Nations are slowly being given operational content at the meetings of the Conference on Parties (COP). COP-3, which relates to the Framework Convention on Climate Change and is scheduled to take place in Kyoto, Japan, in

December 1997, should establish clear numerical goals to reduce emissions of greenhouse gases. Developing countries have to be helped in meeting their energy needs through environmentally benign technologies.

We are now in the second age of massive species extinction. The Convention on Biological Diversity (CBD) shows the way for the conservation of biodiversity and its sustainable and equitable utilization. Today, the primary conservers of the Earth, mostly rural and tribal women in developing countries, are poor, while those who utilize the genetic material conserved and enhanced by them, through biotechnology and breeding enterprises, are rich. We should end this sad irony soon by implementing the equity provisions of the CBD in both letter and spirit. At our Foundation in Madras, India, we have established the Technical Resource Centre for the implementation of the equity provisions of the CBD and we will be happy to assist all committed to recognizing and rewarding the invaluable contributions of the primary conservers of the Earth. Such a step will help to create an economic stake in conservation.

Conservation and commercialization can become mutually reinforcing and not remain antagonistic as at present if principles of ecology, equity, and ethics are integrated with those of economics in the exploitation of natural resources. Business and industry should work together with nongovernmental organizations engaged in such a mission. The Iwokrama International Rainforest Center, established in Guyana in about 400,000 ha. (about a million acres) of prime forest land—generously made available by the government and people of Guyana for developing and demonstrating methods of sustainable management of tropical rain forests—is currently engaged in developing ground rules for the involvement of the private sector in equity-based bioprospecting and sustainable forest management. There is an urgent need for adequate international donor support for this unique adventure in harmonizing the goals of conservation and commercialization in the management of rain forests. Tropical rain forests provide the home for over 60% of the world's species and saving them is a priority task for humankind.

The term green revolution, coined by Dr. William Gaud of the United States in 1968, has come to be associated not only with higher production through enhanced productivity, but also with several negative ecological and social consequences. There is also frequent reference to the fatigue of the green revolution, which relates to stagnation in yield levels and the ever-increasing requirements for nutrients to produce the same yields as in the early 1970s. Experts like Lester Brown have been warning about an impending food crisis for several reasons:

- increasing population;
- increasing purchasing power, leading to the consumption of more animal products;
- increasing damage to the ecological foundations of agriculture;
- declining per capita availability of land and water;
- the absence of technologies that can further enhance the yield potential of major crops.

Should we therefore assume that as we enter a new millennium, we will not have the benefit of new technologies that can help our farmers to produce more food and other agricultural commodities from less land and water?

I believe we are now in a position to launch an "evergreen revolution" that will help to

increase yield, income, and livelihood per unit of land and water—if we bring about a paradigm shift in our agricultural research and development strategies. The green revolution was triggered by the genetic manipulation of yield in crops like rice, wheat, and maize. The evergreen revolution will be triggered by farming systems that can help to produce more from the available land, water, and labor resources without either ecological or social harm. Thus, progress can be achieved if we shift our mind-set from a commodity-centered approach to one based on entire cropping or farming systems. This does not mean that we should decelerate our efforts in the area of crop improvement research. But such research should be tailored to enhancing the performance and productivity of an entire production system. The transition from the fatigue of the green revolution to an evergreen revolution involves a shift from a crop-centered to a systems-based approach to technological development and dissemination.

Scientists now have unique opportunities for designing farming systems that will achieve the triple goals of more food, more income, and more livelihood per hectare of land, provided we harness the tools of ecotechnologies: biotechnology, informatics (including GIS mapping), space technology, and renewable energy technologies (solar, wind, biomass, and biogas), as well as management and marketing techniques. We can enter a millennium of hope if we abandon the old concept of a crop-centered green revolution and substitute it with an evergreen revolution, centered on farming systems and frontier technologies.

Industrialized countries are responsible for many of the global environmental problems, such as potential changes in temperature, precipitation, sea level, and incidence of ultraviolet-B radiation. While further agricultural intensification in industrialized countries will be ecologically disastrous, the failure to achieve agricultural intensification and diversification in developing countries, where farming provides most of the jobs, will be socially disastrous. This is because agriculture—including crop and animal husbandry, forestry and agroforestry, fisheries and agrofisheries—provides livelihoods for over 70% of the population in developing countries. The smaller the farm, the greater is the need for higher marketable surplus for increasing income. Eleven million new livelihoods will have to be created every year in India and these have to come largely from the farm and nonfarm rural industries sectors. Importing food and other agricultural commodities will have the same impact as importing unemployment.

In the ultimate analysis, the environmental and intergenerational equity goals of UNCED can be achieved only if material affluence is tempered by spiritual influence. Both unsustainable lifestyles and unacceptable poverty should become features of the past in the coming millennium. This can be achieved if the rich of the world regard themselves as trustees of their surplus wealth and use it for public good. The following principles, enunciated by Mahatma Gandhi over 60 years ago, illuminate the path to sustainable societies and nations.

- Nature provides for everybody's need, but not for everybody's greed.
- We cannot be nonviolent to nature unless the principle of nonviolence becomes central to the ethics of human culture.

Here is the pathway to keep our planet ever blue.

Lecture

Ecotechnology and Sustainable Food Security

Dr. M.S. Swaminathan
Chairman, MSSRF

I. Introduction

Chairman Furumoto, ladies and gentlemen. On behalf of my colleagues, my research center, my wife, and myself, thank you again for this honor and this great opportunity also to meet so many distinguished scientists and experts here this afternoon.

The topic on which I would like to speak, the topic which is consuming a large portion of the resources of our small research center, is ecotechnology and sustainable food security. I would like to define the two terms so that you can understand what I am going to say subsequently. Ecotechnology means at least three E-words: ecology, economics, and equity. Without economic viability, the technology will not take off. Without ecological sustainability, the gains will be very short-lived. And without equity, both in gender and economic terms, we will find that the world will not be a happy place. There will be more and more social disintegration and the rich-poor divide will increase.

So ecotechnologies are those which can combine some of these characteristics, particularly environmental soundness with economic viability. And what little work has been done in the world, both in industry and agriculture, shows that this is quite feasible. In fact, the book produced by the World Business Council during Rio, titled *Changing Course*, has stated that good ecology is also good business today. Conversely, ecologically unsound practices are not good business practices. The Asahi Glass Foundation has shown this with the Blue Planet Prize.

The concept of food security has undergone considerable change in the last 40 or 50 years. In fact, ever since the Food and Agricultural Organization was established in 1945, the problem of global food security has received attention in numerous fora. In the 1940s, 50s, and 60s, the problem of food security was largely considered in the context of food production; the amount of food produced globally at the macro level, and the population and the amount of food required for the population. Then it became clear that this definition was inadequate, because there might be a lot of food in the world but still very many hungry or undernourished people. And therefore the economic dimension of food security—namely, sustainable livelihoods or the purchasing power of the people, the ability to buy food—became very important.

And later it became clear that these two definitions alone, that is, economic access and physical access to food, are not adequate. It is also important to consider other aspects of food, not only calories and proteins, but particularly micronutrients, like iron, zinc, iodine, and Vitamin A; deficiencies of these nutrients lead to what is often called hidden hunger. In fact, according to recent United Nations figures, if about 800 million women, men, and children go

to bed hungry tonight, nearly two billion suffer from hidden hunger, or hunger for micronutrients. Vitamin A deficiency, for example, causes blindness in children.

And the third dimension of food security relates to environmental parameters, particularly hygiene, environmental hygiene, safe and clean drinking water. Because it is not enough if we take food. The biological retention and absorption of food are equally important for a healthy body. And therefore the food security concept has undergone considerable evolution in the last 40 or 50 years.

The science academies of the world have been meeting in order to articulate the scientific viewpoint on matters which are largely discussed at the political level at these summits. For example, before Cairo the U.S. National Academy of Sciences, the Royal Society of London, and the Indian National Science Academy all got together and looked at population in the context of science and technology. And before the World Food Summit starting on November 13, 1996, in Rome, we thought it was equally important that the scientific academies get together. They got together at our Foundation in Madras in July 1996. At this Science Academies Summit, food security was defined as follows:

- that every individual has the physical, economic, social, and environmental access to a balanced diet that includes the necessary macro- and micronutrients, safe drinking water, sanitation, environmental hygiene, primary healthcare, and education so as to lead a healthy and productive life.
- that food originates from efficient and environmentally benign production technologies that conserve and enhance the natural resource base of crops, animal husbandry, forestry, and inland and marine fisheries.

II. The 20th century: a balance sheet

As we approach a new century we can look back and draw a balance sheet of our achievements and failures. Spectacular progress in science and technology ranks first among our major accomplishments. Recent advances in biotechnology and genetic engineering, space technology, information technology, and new materials have opened up uncommon opportunities for a world where every individual can lead a healthy and productive life. The spread of democratic systems of governance, the breakdown of skin color-based apartheid and the advent of the information age have created the sociopolitical substrate essential for integrating the principles of intra- and intergenerational equity in public policy. The power of a right blend of technology and public policy is strikingly evident from the progress made in recent decades to keep the growth rate in food production above the rate of growth in population, thereby ensuring that the Malthusian prediction of population overtaking our ability to produce adequate food does not come true (International Commission on Peace and Food, 1994).

While the positive achievements are many and make us proud of the power of the human intellect, we will be entering the new millennium with some of the greatest social and scientific challenges humankind has ever faced. Several of these challenges have been articulated with great clarity in the Human Development Reports of the United Nations Development Programme (UNDP) of recent years.

Environmental degradation and increasing economic and gender inequality are among

the most serious problems we face today. The rich-poor divide is increasing at an alarming rate. The pattern of development adopted by rich societies is leading to jobless economic growth, pollution, and potential changes in climate. Unsustainable lifestyles on the part of the rich billion and unacceptable poverty on the part of another billion coexist. The absence of an educational and health environment, which is conducive to every child achieving his/her innate genetic potential for physical and mental development, leads to the spread of poverty in capability. UNDP has proposed indicators for measuring both human development and human capability (UNDP, 1996).

The U.S. National Academy of Sciences, the Royal Society of London, the Indian National Science Academy and 55 other scientific bodies in a statement made in 1993 pointed out "stress on the environment is the product of four interacting factors: population growth, consumption habits, technology and social organization." Concurrent attention is needed on all these four factors to promote sustainable development and sustainable societies. The report, "Sustainable America," indicates what an affluent society should do (The Presidents' Council on Sustainable Development, 1996). In poor nations, the social sustainability of the development process is as important as ecological and economic sustainability. Also, if the current pace of damage to the ecological foundations essential for sustainable advances in biological productivity—namely, land, water, flora, fauna, forests, oceans, and the atmosphere—continues, sustainable food and nutrition security cannot be achieved. Therefore, as we approach the new millennium, we need a broader concept of sustainability which encompasses environmental, economic, and social parameters. Among social factors, gross economic and gender inequity needs priority attention. If such a paradigm shift in developmental thinking and pathways does not occur, the successes achieved in the 20th century in abolishing skin color-based apartheid, in conquering space and in splicing genes will be overshadowed by the spread of technological and economic apartheid. If these forms of apartheid are allowed to grow and spread, social disintegration and ecological genocide will be the result.

III. Ecotechnology: the emerging solution

Technologies rooted in the principles of ecology, economics, and equity are now referred to as ecotechnologies. The United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Cousteau Foundation established by Commandant Jacques Cousteau are promoting ecotechnology networks in different parts of the world. The M.S. Swaminathan Research Foundation (MSSRF) at Madras is the coordinating center for the Asian Ecotechnology Network. A major purpose of this Network is the creation of ecojobs, which are economically viable, environmentally benign, and socially equitable. A multimedia database on opportunities for ecojobs is being developed, since the dissemination of information on ecojobs is essential for creating opportunities for sustainable livelihoods in rural and urban areas.

The most serious manifestation of poverty is hunger. It is now recognized that endemic hunger is largely the result of inadequate livelihood opportunities which in turn lead to inadequate purchasing power. Hidden hunger results from both micronutrient deficiencies and poor environmental hygiene, which impair the biological absorption and retention of food.

During the next three decades, population is expected to increase by another 2.5 billion people. Food requirements will grow due to increases in both population and per capita purchasing power. World grain production has grown from 631 million metric tons in 1950 to nearly 1,900 million tons in 1995. Such a phenomenal growth has had its environmental costs in terms of soil degradation, aquifer depletion, genetic erosion, and pesticide pollution. This is why we have to produce more in the coming decades but produce it differently. To achieve such a shift, the following basic ground rules must be followed in technology development and dissemination as well as in public policy.

First, production advances must be based on linking the ecological security of an area with the livelihood security of the people in a symbiotic manner.

Second, steps must be taken to create widespread awareness of the human and animal population supporting capacity of different ecosystems. Sustainable systems of management of soil, water, biodiversity, and forests should be internalized in rural societies.

Third, since the poor remain poor, because they have no productive assets and there is no value to their time, asset creation and value addition to time should receive high priority in poverty-alleviation programs. Women belonging to the economically underprivileged sections of the society, in particular, are often overworked and underpaid. What they need is a reduction in the number of hours of work and an increase in the economic value of each hour of work. This will call for massive efforts in information and skill empowerment of the poor, particularly women. The emerging technologies are largely knowledge-intensive and hence the transfer of knowledge and market-driven skills can become the most powerful instrument for fighting poverty and deprivation. Modern information technology affords opportunities for reaching the unreached and thereby achieving a learning revolution within a short span of time.

Four, equal attention is needed to the problems of the rural and urban poor. Lack of livelihood opportunities in rural areas leads to the proliferation of urban slums. Damage to common property resources in villages results in the growth of environmental refugees (Myers and Kent, 1995). Since in many developing countries agriculture—including crop and animal husbandry, forestry, fisheries, and agro-processing—provides most of the jobs and income in rural areas, the triple challenge of producing more food, income, and jobs from diminishing per capita land, water, and nonrenewable energy sources can be met only through agricultural intensification, diversification, and value addition. Integrated, intensive farming systems, which are ecologically sustainable, are needed for this purpose.

Finally, an evergreen revolution of the kind described above can be imparted a self-propelling and self-replicating momentum only if it is based on the self-mobilization of the people. In all externally funded and introduced development projects, there should be a built-in withdrawal strategy, so that the program does not collapse when the external inputs are withdrawn.

IV. Meeting the multidimensional challenges: the response of the M.S. Swaminathan Research Foundation

The responses being developed and field tested by MSSRF to identify implementable

approaches at the micro- and policy levels to meet the challenges outlined earlier are briefly described below:

A. Linking the ecological security of an area with the livelihood security of the local community: creating an economic stake in conservation

The community biodiversity program of MSSRF illustrates how such mutually beneficial linkages can be fostered in biodiversity-rich areas. It is a sad fact that the tribal and rural families who have conserved and enhanced biodiversity remain poor, while those who are utilizing the products of their efforts become rich. When the conservers have no social or economic stake in conservation, denudation of natural ecosystems becomes more rapid. MSSRF has adopted a three-pronged strategy for creating an economic stake in biodiversity conservation.

First, a transparent and implementable methodology has been developed for incorporating *sui generis* systems of plant variety protection procedures for recognizing and rewarding informal innovations in genetic resource conservation and enhancement (Swaminathan, 1996).

Second, a symbiotic social contract between commercial companies and tribal and rural families is being fostered for the purpose of promoting the cultivation by local communities of genetic material of interest to the companies on the basis of buy-back arrangements. Such a linkage will prevent the primary material being unsustainably exploited.

Third, local women and men are trained in the compilation of biodiversity inventories and in bio-monitoring, so that they themselves become custodians of their intellectual property. Such trained women and men constitute an Agrobiodiversity Conservation Corps and will be able to help their respective communities to deal with issues such as "prior informed consent" in the use of genetic resources.

For assisting the community biodiversity movement, MSSRF has established a Technical Resource Centre for the implementation of the equity provisions of the Convention on Biological Diversity. Since this is the first Technical Resource Centre of its kind in the world, the six major components of the Centre are described below.

i. Chronicling the contributions of tribal and rural families to the conservation and enhancement of agrobiodiversity through primary data collection in the states of Tamil Nadu, Kerala, Andhra Pradesh, and Orissa as well as in the Lakshadweep and Great Nicobar group of islands.
ii. Organization of an Agrobiodiversity Conservation Corps of young tribal and rural women and men, who have a social stake in living in their respective villages and who, with appropriate training, can undertake tasks such as compilation of local biodiversity inventories, revitalization of the in situ genetic conservation traditions of their respective communities, monitoring of ecosystem health with the help of appropriate bio-indicators and restoration of degraded sacred groves. The members of the corps will be able to assist their respective communities in dealing with the "prior informed consent" provision of the Convention on Biological Diversity in the use of genetic resources.
iii. Development of multimedia databases documenting the contributions of tribal and rural families in the conservation and improvement of agrobiodiversity, for the purpose of

enabling them to secure their entitlements from National and Global Community Gene Funds.

iv. Maintenance of a Community Gene Bank and Herbarium A Community Gene Bank with facilities for medium-term storage has been established to conserve farmer-preserved and -developed seeds from the tribal areas of South India. The material will be cataloged and linked to the Technical Resource Centre database. The Herbarium serves as a reference center for the identification of landraces, traditional cultivars and medicinal plants conserved by tribal and rural families.

v. Revitalization of genetic conservation traditions of tribal and rural families through social recognition of their contributions and the creation of an economic stake in conservation. For this purpose, replicable models of private-sector engagement in contract cultivation by tribal and rural families of plants of commercial value are being developed.

vi. Legal advice cell to make available to tribal and rural families appropriate legal advice in matters relating to intellectual property rights and plant variety protection.

B. The population-supporting capacity of ecosystems: local-level socio-demographic charter

In order to help internalize an understanding of the vital need to restrict population growth within the supporting capacity of land, water, forests, and the other components of the ecosystem, training modules have been developed to enable the female and male members of village-level democratic institutions to prepare socio-demographic charters for their respective villages. A gender code is an important component of the charter. Such socio-demographic charters will help local communities to view population issues in the context of social development and to ensure that children are born for happiness and not just for existence.

C. Information and skill empowerment

For this purpose, the concept of Information Villages has been developed (Swaminathan, 1993). Trained rural women and men will operate Information Shops where generic information on the meteorological, management, and marketing factors relevant to rural livelihoods will be converted into location-specific information. Trained farm women and men themselves become trainers. The computerized extension system adopted in the Information Shops also helps to sensitize local families on their entitlements from government and other programs. Information technologies provide considerable opportunities for value-added jobs in rural areas. While new technologies are important, folk media are often even more effective in reaching the unreached. Hence, folk plays and folk art and theater are fully mobilized for achieving information empowerment. For ensuring the success of information empowerment programs, the information disseminated should be demand-driven and should be locale-specific.

D. Agricultural intensification, diversification and value-addition

This is achieved through participatory research with farm families. Ecotechnologies like integrated pest management and integrated nutrient supply are used. Ecotechnology development involves the blending of the best in frontier technologies with traditional wisdom and practices.

Modern science and the ecological prudence of the past can thus be combined (Swaminathan, 1994).

Ecotechnologies are also practiced in aquaculture. Integrated agriculture and aquaculture techniques enhance both farm income and the nutrition security of the household. Whole villages are being enabled to adopt such integrated, intensive farming systems (IIFS). Since this approach is essential for meeting the triple goals of more food, income, and jobs from the available land and water resources, the seven basic principles guiding the IIFS movement are described below:

i. Soil health care
   This is fundamental to sustainable intensification. IIFS fosters the inclusion of stem-nodulating legumes like *Sesbania rostrata*, incorporation of *Azolla*, blue-green algae and other sources of symbiotic and non-symbiotic nitrogen fixation and promotion of cereal-legume rotation in the farming system. In addition, vermiculture composting and organic recycling constitute essential components of IIFS. IIFS farmers are trained to maintain a Soil Health Card to monitor the impact of farming systems on the physical, chemical, and microbiological components of soil fertility.
ii. Water harvesting and management
   IIFS farm families include in their agronomic practices measures to harvest and conserve rainwater, so that it can be used in a conjuctive manner with other sources of water. Where water is the major constraint, technologies which can help to optimize income and jobs from every liter of water are chosen and adopted. Maximum emphasis is placed on on-farm water use efficiency and on the use of techniques such as drip irrigation, which help to optimize the benefits from the available water.
iii. Crop and pest management
   Integrated Nutrient Supply (INS) and Integrated Pest Management (IPM) systems form important components of IIFS. The precise composition of the INS and IPM systems will depend on the components of a farming system as well as on the agro-ecological and soil conditions of the area. Computer-aided extension systems will provide farm families with timely and precise information on all aspects of land, water, pest, and post-harvest management.
iv. Energy management
   Energy is an important and essential input. Besides the energy-efficient systems of land, water, and pest management described earlier, every effort will be made to harness biogas, biomass, solar, and wind energies to the maximum extent possible. Solar and wind energy will be used in hybrid combinations with biogas for farm activities like pumping water and drying grains and other agricultural produce.
v. Post-harvest management
   IIFS farmers will not only adopt the best available threshing, storage, and processing measures, but will also try to produce value-added products from every part of the plant or animal. Post-harvest technology assumes particular importance in the case of perishable commodities like fruits, vegetable, milk, meat, egg, fish, and other animal products and processed food. A mismatch between production and post-harvest technologies adversely

affects both producers and consumers. Growing urbanization leads to a diversification of food habits. Therefore there will be increasing demand for animal products like milk, cheese, eggs, and processed food. Agro-processing industries can be promoted on the basis of an assessment of consumer demand. Such food processing industries should be promoted in villages in order to increase employment opportunities for rural youth. In addition, they can help to mitigate micronutrient deficiencies in the diet.

Investment in sanitary and phytosanitary measures is important for providing quality food for both domestic consumers and export. To assist the spread of IIFS, government should make a major investment in storage, roads, transportation, and on sanitary and phytosanitary measures.

vi. Choice of the crop and animal components of farming systems

In IIFS, it is important to give very careful consideration to the composition of the farming system. Soil conditions, water availability, agro-climatic features, home needs, and above all, marketing opportunities will have to determine the choice of crops, farm animals, and aquaculture systems. Small and large ruminants will have a particular advantage among farm animals since they can live largely on crop biomass. Backyard poultry farming can help to provide supplementary income and nutrition.

vii. Information, skill, organization and management empowerment

IIFS is based on the principle of precision farming. Hence, for its success, the IIFS system needs a meaningful and effective information and skill empowerment system. Decentralized production systems will have to be supported by a few key centralized services, such as the supply of credit, seeds, biopesticides, and animal disease diagnostics. Ideally, an Information Shop will have to be set up by trained local youth in order to give farm families timely information on their entitlements as well as on meteorological, management, and marketing factors. Organization and management are key elements and, depending on the area and farming system, steps will have to be taken to provide to small producers the advantages of scale in processing and marketing.

IIFS is best developed through participatory research between scientists and farm families. This will help to ensure economic viability, environmental sustainability, and social and gender equity in IIFS villages. The starting point is to learn from families who have already developed successful IIFS procedures.

It should be emphasized that IIFS will succeed only if it is a human-centered rather than a mere technology-driven program. The essence of IIFS is the symbiotic partnership between farming families and their natural resource endowments of land, water, forests, flora, fauna and sunlight. Without appropriate public policy support in areas like land reform, security of tenure, credit supply, rural infrastructure, input and output pricing and marketing, small farm families will find it difficult to adopt IIFS.

E. Increasing farm and nonfarm employment

The biovillage program addresses three key areas—preventing resource degradation, improvement of crop and animal productivity, and alleviation of poverty. The biovillage program in progress in villages in the Pondicherry area of India places equal emphasis on off-farm

livelihood opportunities and on-farm jobs. This program avoids a patronage approach to poverty alleviation.

It regards the poor as producers and innovators and helps to build their assets through value addition to time and labor. The basic approach is on asset building and sustainable human development leading to the growth of entrepreneurship.

The programs are designed on a pro-nature, pro-poor, and pro-women foundation. By placing emphasis on the strengthening of the livelihood security of the poor, the biovillage model of sustainable development revolves around the welfare of the economically and socially underprivileged.

It is thus a human-centered pattern of development. The enterprises chosen are based on marketing opportunities. The technological and skill empowerment of the poor is the major approach. Because of the market-driven nature of the enterprises, the economic viability of the biovillage approach is assured. Production and post-harvest technologies and farm and non-farm occupations are brought together in a manner that benefits both producers and consumers.

Biovillages around biosphere reserves would help in providing alternative sources of meeting the day-to-day needs for food, fuel, fodder, and other commodities of the families living near such biodiversity-rich areas. Also, biovillages near urban areas help to link the rural producer and the urban consumer in a mutually beneficial partnership. By producing the processed and semiprocessed food products needed in urban areas in the villages around towns and cities, the need for the rural poor to migrate to urban centers for livelihood opportunities is minimized. Also, food processing can be used as a method of providing the needed micronutrients by including millets and grain legumes in the food.

F. The final milestone: a hunger-free world

The above represent some of the approaches adopted at MSSRF to overcome the challenges of jobless growth, feminization of poverty and environmental degradation. The Tamil Nadu Government has recently decided to introduce a Hunger-Free Area Programme to end poverty-induced hunger in association with MSSRF.

Studies at MSSRF have shown that by adding a horizontal dimension to numerous vertically structured programs and by promoting a coalition of all concerned with ending hunger and deprivation, it is now possible to provide opportunities for a healthy and productive life for all.

The problem of food and nutrition security at the level of the individual has to be viewed in three dimensions. First, inadequate purchasing power leads to calorie-protein undernourishment. Second, the lack of the needed quantity and variety of micronutrients and vitamins in the diet leads to several nutritional disorders, including blindness caused by Vitamin A deficiency. This kind of problem is referred to as "hidden hunger," a problem which today affects more than two billion people in the world. Third, lack of environmental hygiene and sanitation leads to a low biological absorption and retention of food, due to intestinal infection and diarrhea. Thus, both food and nonfood factors assume importance in determining the nutrition security of an individual. Concurrent action at all these levels is necessary in a Hunger-Free Area Programme.

Development that is not equitable will not be sustainable in the long term. A hunger-free and more equitable world is essential for our planet remaining ever blue. Given appropriate ecotechnologies and public policies, there are now great opportunities for a better common present and future for all members of the human family. It is to serve this cause that MSSRF will utilize the funds associated with the Blue Planet Prize.

V. Research strategies and results: some examples

A. Coastal systems research: conservation and development of mangrove ecosystems

The area of the Pichavaram mangrove forest, degraded over a period of 100 years, was estimated using remote sensing techniques. Between 1897 and 1994 nearly 63% of the mangrove forest cover became degraded.

Year	Area	Source
1897	700 ha	Forest Department, Government of Tamil Nadu
1994	260 ha	Remote Sensing Unit, MSSRF

A major cause for such large-scale degradation of the Pichavaram mangroves has been identified. Structural changes in the mangrove wetlands, particularly development of trough-shaped topography, due to reduced inflow of fresh water and the consequent impoundment of tidal water, increase soil and ground water salinity. High salinity was responsible for nearly 70% of the degradation. Grazing and felling for fuel were responsible for only 30% of the degradation.

Techniques to restore the areas degraded due to the formation of trough-shaped topography were developed and successfully demonstrated. The government management agency is now adopting this technique for the restoration of another 100 ha of the degraded area of the Pichavaram mangroves.

To arrest degradation due to felling and grazing, an agroforestry system was introduced. Techniques of growing fodder species in the coconut and casuarina groves, the major agriculture plantations in the coastal areas, were successfully demonstrated with the participation of the local communities. These techniques are now being replicated by the farmers themselves.

On the basis of the experience gained, a project titled "Coastal Wetlands: Mangrove Conservation and Management" is being implemented in the major mangrove wetlands of the entire east coast of India. This project is supported by the India-Canada Environment Facility. The goal of this project is to enhance the capacity of the local communities, voluntary organizations, grass-roots democratic institutions and government agencies to conserve, restore, and sustain mangrove wetlands through participatory research, training, and extension.

B. Biodiversity and biotechnology

i. Conservation

The main objective of this program is Conservation of Endangered Plant Species. For this purpose eight key areas ("hot spots") have been identified from the southern Western Ghats,

such as Siruvani Hills, Gudalur Gene Pool Reserve, Kulathupuzha R.F. Kakki Hills, and Sholayar.

The activities of this program include systematic collection, detailed description, *ex situ* preservation of sample materials, storage of voucher specimens (herbarium) and micropropagation.

The results of the study are as follows:

- Collection of over 120 rare or threatened flowering plants including 20 species which are listed in various Red Data Books.
- Assessment of the status and distribution pattern of these plants by using IUCN-revised threat status guidelines.
- Development of a database for the rare and threatened plants collected (Rare Angiosperm Plant Database)
- A herbarium for threatened/rare, medicinal, and traditional crop varieties.
- Two species have been rediscovered (*Sageraea grandiflora* and *Euonymous serratifolius*) and a new range of distribution for the species *Crotalaria speciosa, Hydnocarpus pendule*, and *Piper barberi* has been recorded.
- Successful micropropagation of five endangered plant species collected.

During 1995, the Siruvani Hills have been periodically surveyed for monitoring of population dynamism of selected endangered plant species (e.g., *Vateria macrocarps, Indigofera constricta, Anaphyllum wightii, Crotalaria speciosa,* and *Anectochilus elatior*).

ii. Value addition through information

In southern India certain interesting characteristics accompany the tribal utilization of plants. Often, many plants are used for a single purpose although other parts of the plants may have potential utility values. For example, the following plants are used almost exclusively for their edible fruits and seeds: *Bredelia retusa, Canthium dicoccum, Ficus racemosa, Madhuca longifolia var lalifolia, Palaqium ellipticum, Polyalthia cerasoides, Scnlieichera oleosa,* and *Xylia xylocarpa*. These plants are not used for construction or making agricultural implements or other such uses.

Tribal use of plants is also characterized by diversity of choice. The majority of the human population depends on fewer than 100 plant species for most of their requirements. In contrast, the tribal people living in southern India use several hundred. Thus a variety of plants are used as edible greens: *Amaranthus spp., Cansjeera rheedii, Colocasia esculenta, Lycianthes laevis, Mukia maderaspatana, Talinum cuneifolium,* and *Trichosanthes nervifolia*. Similarly, fruits of many plant species, to name a few like *Carissa carandas, Cordia obliqua,* and *Memecylon edule*, are eaten by them.

This approach not only increases the choice of plants and hence the nutritional value but also prevents overexploitation of any single or a few species. Ethnobotanical studies conducted in Tamil Nadu by MSSRF reveal that the tribal communities use 223 plant species for various purposes, of which 88 plants are of edible value, 149 plants are used for medicinal purposes, and 53 plants for other material purposes.

Tribal communities show prudence and ecological wisdom in resource utilization.

The Kadars of Tamil Nadu, for example, select only mature plants of the yam *Dioscorea* for harvesting the tubers. They first examine the vine and choose only those whose leaves are yellow, which is an indication of maturity. Tubers of young green vines are never dug out. After harvesting the mature yams they cut off the upper portion of the tuber along with the vine and replant it in the pit. They cover the pit with loose soil to allow the tuber to regrow for whoever may harvest it in the future. The community as a whole shares the harvest thus avoiding overexploitation. Part of the collection is stored for consumption during the off-season.

Medicinal properties of plants have been recognized and utilized by tribal communities traditionally over thousands of years. Knowledge of some common local medicinal plants is available from all members of the community. However, the elderly members possess a great deal of knowledge of medicinal plants as well as of medicines for curing certain life-threatening diseases. Tribal people use plants exclusively or in combination. Some plants may be used for different disorders: for example, *Calotropis gigantea* is used as vermicide and for chest pain, *Centella asiatica* for gynecological problems and for jaundice, *Dodonaea viscosa* for headache, stomachache and piles, *Wrightia tinctoria* for treating mumps and as a lactagogue. In certain cases a combination of different plants may be used in the treatment of specific diseases. For example, *Albizia lebbec* together with *Cassia fistula* and *Euphorbia hirta* is used for urinary disorder. *Capparis zeylanica* with *Toddalia asiatica* is used for venereal disease. Each tribe has its own method of collecting the plants as well as preparation of medicines. Dosage and duration of medication depend on the age of the patient and the intensity of disease. Tribal people collect the plant part used for medicine at a particular time, such as either before flowering or fruiting, or in a particular season.

iii. Traditional agricultural practices of tribal communities

Tribal communities like Irulas, Malayalis, and Muthuvas inhabiting Tamil Nadu have been cultivating the traditional cultivars such as paddy, millets, pulses, and vegetable crops. Nearly 58 traditional cultivars have so far been identified from the tribal communities, of which 21 are minor millets. Their subsistence lifestyle, local dietary habits and dependence on rain-fed irrigation have influenced them to cultivate and conserve the traditional cultivars or landraces. Many crops such as *Panicum miliaceum*, *Echinocloa colona*, *Paspalum scrobiculatum*, and *Setaria italica* are now cultivated and conserved only by the tribal people in many parts of southern India. By selecting and conserving the seeds from one season to the next, they have been able to sustain the cultivation. For example, healthy cobs are left in the field so as to allow them to dry for several days to make sure that no moisture is left in the seeds. The selection of large and healthy seeds and the selection based on the color of the seeds (e.g., in the case of Castor seeds) have also helped them to ensure seed viability. The tribal communities prefer to continue the cultivation of traditional cultivars as these are ecologically adapted and economically viable. The landraces and traditional cultivars cultivated by tribal families are also drought- and disease-tolerant.

Community cooperation and participation prevailing particularly in the Malayali

tribal community have helped them in conserving the traditional landraces. The practice is such that every family in the community will contribute a stipulated amount of their harvest to the community granary maintained and managed by the chieftain of the hamlet. During important occasions like marriages, social events, and festivals and also when someone needs them for regular consumption, grains can be borrowed on loan and later returned. This system has enabled the tribe to conserve the seed material even if the produce in a particular season is less or if the grains stored for domestic consumption are exhausted.

Seed material for sowing and the grains for consumption are preserved in traditional granaries. These granaries are made of bamboo and coated with red soil. The roof is conical and is thatched with local grass. There is a free flow of air in the granaries, which may be one of the reasons why the seeds remain viable until used the next time. The seeds are also stored in earthen pots covered with a cotton cloth. This indigenous practice has saved many varieties of cereals, millets, and legumes in Tamil Nadu. This practice has enabled the community to maintain, preserve, and conserve the genetic strains. Leaves of plants such as neem and *Vitex* are used in the granaries as insect and pest repellents.

iv. Patterns of distribution of vertebrate diversity on the Great Nicobar biosphere reserve

The Great Nicobar Island has been declared one of the eight biosphere reserves in India. This island is unique for its endemic species. The MSSRF has taken up a three-year project in which the island is being mapped systematically for distribution and diversity of vertebrates. This is being attempted for the first time in the history of the island.

More than 100 species of vertebrates including birds, mammals, reptiles, amphibians, and inland fish have been identified and their distributions recorded. The island has been divided into 55 grids of five kilometers by five kilometers. Apart from the distribution of vertebrates, the human impacts on each of these grids have been assessed. The various human impacts have been scored appropriately. Simultaneously, the availability of well-preserved habitats has also been assessed. Using this information, about 50% of the island

Conservation Value Based on Habitat Information

					4		
					7		
2					5		
7					7		
	7			7	9		
		2			9		
	4			1	0		
				–2			
				1			
		3	1				
		3	1				

that has already been mapped has been assigned conservation value. The numbers given in the following grid map of the Great Nicobar Island suggest that the grids marked 9 are the best in terms of habitat quality and those marked 0 and -2 are the most disturbed areas on the island. It is envisaged that the information on vertebrate distribution and diversity will be superimposed on this map for better understanding of ecological problems the island is facing and for recommendation of management of the biosphere reserve.

v. Biodiversity and molecular biology

Genetic characterization of a species and assessment of degree of polymorphism within it are the basic prelude to any meaningful conservation program. Conventional genetic studies are difficult in mangroves, and so far no worthwhile studies have been carried out on this group of plant species. Published accounts are few and largely restricted to some stray reports on chromosome analysis and enzyme studies. Based on the available information, it is not possible to partition with a reasonable degree of confidence the observed phenotypic variability in mangroves into environmental and heritable components. In view of the delay and difficulties in conventional genetic analysis, studies on genetic polymorphism, relationship, and diversity are being undertaken using molecular markers. Unlike morphological markers, molecular markers are not prone to environmental fluctuations. In addition, studies on identification, characterization, and isolation of novel genetic traits such as salt tolerance from this group of species are under way.

Objectives

- Documentation of chromosome number and preparation of chromosome atlas for Indian mangrove species
- Analysis and assessment of the nature and extent of intra-site and inter-population genetic diversity in different mangrove species
- Development of species-specific genomic clones
- Establishment of genetic relationships and evolutionary trends among mangrove species
- Identification and isolation of novel genetic combinations (e.g., salt-tolerant genes)

Mangrove species offer several physical and systemic constraints. They often occupy inaccessible habitats and there have been no proper identification criteria for different species/varieties. The leaf and other tissues are rich in phenolics and other secondary metabolites and mucilages.

Results obtained so far

- Somatic chromosome numbers have been determined for 12 mangrove species.
- Species-specific protocols for isolation of enzyme-digestible genomic DNA have been established for about 25 species.
- Genetic relationships have been established among species belonging to 21 mangrove genera using molecular markers.
- Genetic polymorphism at inter- and intra-population level have been worked out in 12

mangrove species. The number of populations for each species ranged from six to 12.

- More than 1,500 low-copy genomic clones have been identified from the partial genomic library of six mangrove species.
- Di-, tri- and tetra-nucleotide repeat positive clones have been identified and sequenced to design species-specific flanking primers.
- A cDNA library is being constructed for isolation of salt-tolerant genes. Variation in protein expression in response to stress is being studied.

Conclusions

- All the analyzed mangrove species are high polyploids.
- The observed genetic variability is species-specific and largely influenced by the climatic and other physical characteristics of the ecological zones the species inhabit.
- Polymorphism is independent of the morphological variability and the sexual nature of the species.
- Molecular markers could be used for delineating the species at population level.
- The 21 mangrove genera could be grouped into five distinct clusters. Within each cluster, the species show overall genetic similarity.
- It would be possible to use molecular markers for species identification.
- A few clones identified from the genomic libraries show the presence of sequences homologous to stress-induced gene sequences.

Species under study

The mangrove species under study include *Avicennia marina, A. officinalis, Acanthus ilicifolius, Rhizophora apiculata, R. mucronata, R. lamarckii, Excoecaria agallocha, Lumnitzera racemosa, Ceriops decandra, Bruguiera cylindrica, Aegiceras corniculatum, Kandelia candel*, etc. All these species were assessed for their intra-specific genetic polymorphism. In all these species, protocols for quality and enzyme-digestible DNA were developed. The presence of large amounts of secondary metabolites like phenolics, mucilage, and latex in these species complicate the process of purification as they co-precipitate along with the nucleic acids during the isolation steps. However, species-specific protocols developed gave pure DNA/RNA preparations in these plants.

Both the random amplified polymorphic DNA (RAPD) and restriction fragment length polymorphism (RFLP) fingerprinting pattern are being used to assess the intra- and inter-specific and intra- and inter-population genetic polymorphism in individual species. In all these species distinct populations were selected both from the eastern and western coasts of peninsular India. The samples collected from these locations were used for isolation of DNA and further subjected to RAPD and RFLP analysis. About 10-15 plants from each population were used to account for the intra-population variations. Detailed RAPD analyses were carried out on all the important genera using as many as 10 populations in each species depending on their distribution and occurrence.

Our results show that the variation in the polymerase chain reaction (PCR)-based RAPD profile with the use of both 10 random primers and simple sequence repeats is

species-specific and largely influenced by the climatic conditions and ecological zones the species occupy. The variations observed are independent of the morphological variability and also the reproductive nature of the plants. Population-specific markers have been developed in *Acanthus ilicifolius*. RFLP analyses were carried out in these species using the genomic clones developed from the respective mangrove species. The results also reflect a similar trend as observed in the case of RAPD analysis.

The genetic relationship between 20 mangrove species has been established using molecular markers through PCR-generated random amplified polymorphic DNA profiling. In all, 10 random primers were used that produced 172 amplification products. The presence and absence of these markers in 20 mangrove and one nonmangrove species (*Rauvolfia tetraphilla*) were scored and used for construction of a dendrogram for depicting the genomic relationship between the species. These species formed five distinct clusters with the nonmangrove species forming a separate operational taxonomic unit (OTU). This is the first time a genetic relationship between a number of mangrove species has been established using molecular markers. All 20 species taken up in this study include all the species in the Pichavaram mangrove forest, Tamil Nadu.

Species-specific clones/ DNA probes from mangroves

PCR-generated clones and clones developed by genomic libraries were used for our RFLP studies. Genomic clones have been developed in the following mangrove species: *Acanthus ilicifolius, Avicennia spp., Excoecaria agallocha, Rhizophora spp., Ceriops decandra, Bruguiera cylindrica,* and *Lumnitzera racemosa.* The 1,000-plus clones including all the above species are being maintained in pUC plasmids and selected clones are being used for our RFLP experiments as DNA probes.

By screening all the clones using different microsatellites few DNA repeat-positive clones were obtained. Characterization of these positives by double-stranded DNA sequencing is under way in order to synthesize species-specific flanking primers for these repeat sequences to analyze polymorphism profiles in these species more precisely.

Screening of the available clones and also generation of cDNA clones by cDNA library construction is under way in order to isolate salt-stress induced genes. Promising clones shall be transferred to other plant species by transformation to look for its functional capability to provide enhanced osmotic stress tolerance in the target plant.

C. Internalizing the gender dimension in development programs

The basic aim of the program area is advocacy to bring gender-related concerns to the forefront of the development process. Advocacy is at two levels—both to influence the policy process and to create a climate of supportive public opinion. These findings are applicable to networking, training, and development of instructional materials.

The major research studies in the last two years relate to gender roles—one on the child care needs of women working in the unorganized sector, and the other on women's multiple roles and the management of breast-feeding. We have brought to light important findings about the way women handle their multiple roles, and these are being actively used for promoting

woman-friendly policies in the economic arena, as well as for creating awareness among different interest groups like employers, professionals, and the media.

Communication draws on a wide range of approaches, from traditional folk performing arts which are utilized to convey messages of sustainable development, to contemporary theater forms which are being used in an interactive and participatory way to give expression to women's own voices through their own cultural idioms, as well as to explore the attitudes and values underlying social problems related to gender inequity and to bring these into the arena of public discussion.

Electronic media (radio, TV, and video) are used both for training and dissemination of ideas as well as for "social marketing," that is, through repeated short messages on gender-related themes. Journalism, literature, databases, documentation, and campaign materials are also utilized to create wide awareness on these issues, while training materials are produced to help the groups engaged in public education.

D. Information empowerment

The Informatics Centre in the Foundation has twin goals:

1. It functions as a service unit for all the laboratories and field units of the Foundation by offering high-quality and consistent access to electronic databases and to the Internet.
2. It conducts design jobs that aim at use of modern information technology as a key technology in promoting learning and information dissemination for sustainable agricultural and rural development and sustainable management of biological diversity.

The Informatics Centre was established in December 1993 with a collection of personal computers, scanners, back-up devices, and printers with a rudimentary e-mail connection to Internet. It had a collection of CD-ROM databases published by CAB International. In the three years since inauguration, the hardware has been reasonably updated to keep pace with the very rapid changes and developments resulting in the availability of a good laboratory for design of multimedia, navigable databases. The CD-ROM collection is considered to be the largest in this country in the broad area of agricultural sciences, covering nearly 3.7 million records. Since late 1995, full access to the Internet has been provided on a dial-up basis. In terms of coverage, the CD-ROM facility is used by hundreds of visiting scientists from all over India every year.

The multimedia databases include the following:

- Mangrove Ecosystems Information Service (MEIS)
- Farmers' Rights Information Service (FRIS)
- Ecological Farm Families of India

The MEIS is a collection of databases with global coverage: its experts' directory covers 62 countries, its bibliography covers the period starting from 1975 (complementing the UNESCO bibliography, 1600-1975), its sites and resources databases cover 22 sites in nine countries in detail and 1,100 sites in 42 countries in a limited fashion. More than 700 visuals are available in a separate database.

The FRIS is a pilot multimedia database which functions as a component of the Technical Resource Centre for implementing the equity provisions of the Convention on

Biological Diversity. The FRIS contains data in various forms (audio/video, text/numbers, photos/diagrams) relating to tribal lifestyles, use of plant genetic resources, sacred groves, rare angiosperms, and related details for the states of Tamil Nadu and Orissa. Besides original data, the FRIS provides detailed pointers to secondary information that is known but scattered.

The multimedia database on ecological farm families covers both technological and economic details of farms that use ecological techniques with high biological productivity. This contains animations of technical processes.

E. Looking ahead

The above are some aspects of the studies in progress. They all have the goal of harnessing modern science for solving problems of importance to improve the quality of life of the socially and economically underprivileged sections of rural and tribal communities. The challenges are great but so are the opportunities for meaningful work. Whatever work has been done so far indicates that we now have uncommon opportunities for a better common present.

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II. "Questionnaire on Environmental Problems and the Survival of Humankind" Five-Year Summary

Introduction

The resolution of environmental problems is one of the most important issues facing all people today, so that our shared home of planet Earth may continue to sustain future generations. In 1992, the year that the Earth Summit was held in Rio de Janeiro, the Asahi Glass Foundation began conducting a survey to find out how people in different countries felt about the current state of the environment and what measures they deemed necessary to counter environmental problems. In 1996, the Foundation held its fifth annual "Questionnaire on Environmental Problems and the Survival of Humankind." The following is a compilation of the results of the first five years of the Foundation's questionnaire.

The people chosen as respondents for the survey are members of international environmental organizations, employees of the environmental divisions of national and local government organizations (GOs), faculty members of universities and university-affiliated research institutes, members of nongovernmental organizations (NGOs) involved with environmental conservation, and environmental journalists. During the past five years, more than 3,000 people have participated in this questionnaire.

The topics covered by the survey have changed in part from year to year, but some questions have been asked every year, thus enabling comparisons. Each survey also featured several questions on specialized areas and topics of particular significance for that given year.

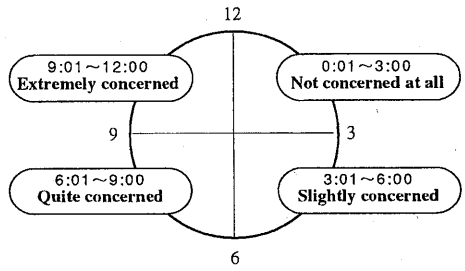
The resolution of global environmental problems, which threaten all humanity's existence, can only be attained through the combined efforts of people around the world overcoming boundaries and differences to work toward a common goal. It is the Foundation's sincere hope that the results of its questionnaire may serve a purpose in setting goals and carrying out measures toward the resolution of these problems.

1. When Will Humankind's Crisis of Survival Come?

1.1 Humanity in Crisis

"Indicate with a time your concern about the survival prospects of humankind in light of the deterioration of the environment, taking into consideration the times and associated concern levels shown on the clock below."

This question, asked in every survey, asks respondents to express their concern about humankind's survival in terms of a time on a clock. This clock shows twelve hours from noon to midnight, divided into four areas. The first area, from 12:01 to 3:00, is described as "Not concerned at all." The second, from 3:01 to 6:00, is "Slightly concerned," and the third, from 6:01 to 9:00, is "Quite concerned." The last segment of the clock, from 9:01 to 12:00, is labeled "Extremely concerned."



The results of this question are shown in Figure 1-1. In the questionnaire's first year, the average time indicated by respondents was 7:49, well into the parameters of "Quite concerned." In each of the following years, the average time response has grown later, advancing nearly one and a half hours in total. In 1996, the average time moved to 9:13, entering the area of extreme concern.

Figures 1-2 and 1-3 show results by region for 1993 and 1996. In 1993, the first year of the questionnaire, about 50% of respondents from all areas—with the exceptions of Japan, Eastern Europe & the former Soviet Union, and the Middle East—chose a time within the range of extreme concern. Three years later, up to 70% of respondents from Asia, the United States & Canada, Latin America, Western Europe, Africa and Oceania indicated a time in the area of extreme concern.

In a comparison of responses from men and women, shown in Figure 1-4, women indicated greater concern than men overall. In 1996, more than one-quarter of women chose 12:00, the time indicating the most extreme concern.

1.2 Which Generation Will Face the Crisis?

"In which generation do you think humanity will become unable to maintain its existence based on the mass-production and mass-consumption standards of present-day civilization?

In the 1996 questionnaire, respondents were asked to choose a generation—their children, their grandchildren, their great-grandchildren, or subsequent generations—that they felt was most likely to face the crisis. The results are shown in Figure 1-5.

The largest number of respondents indicated that they believed it would be in their grandchildren's generation that the full consequences of environmental problems would be

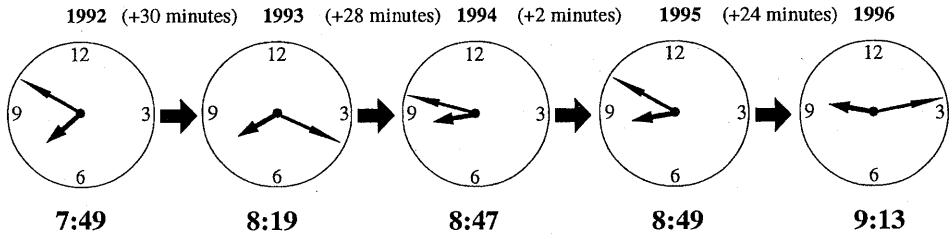


Figure 1-1 Changes in Time from Year to Year

felt. The second largest number chose their children's generation. By adding the responses for these two groups, we see that more than 70% of respondents believe the crisis will come during the middle of the 21st century.

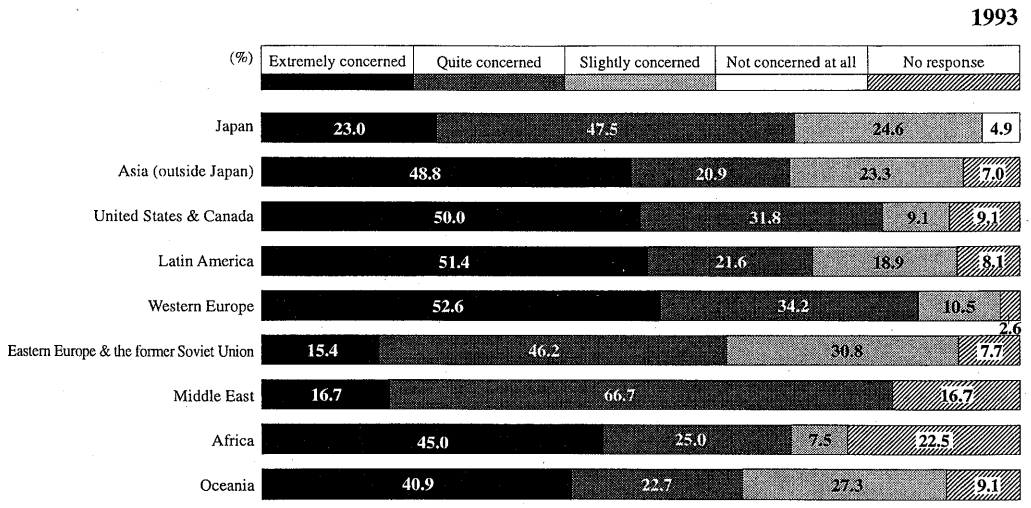


Figure 1-2 1993 Results by Region

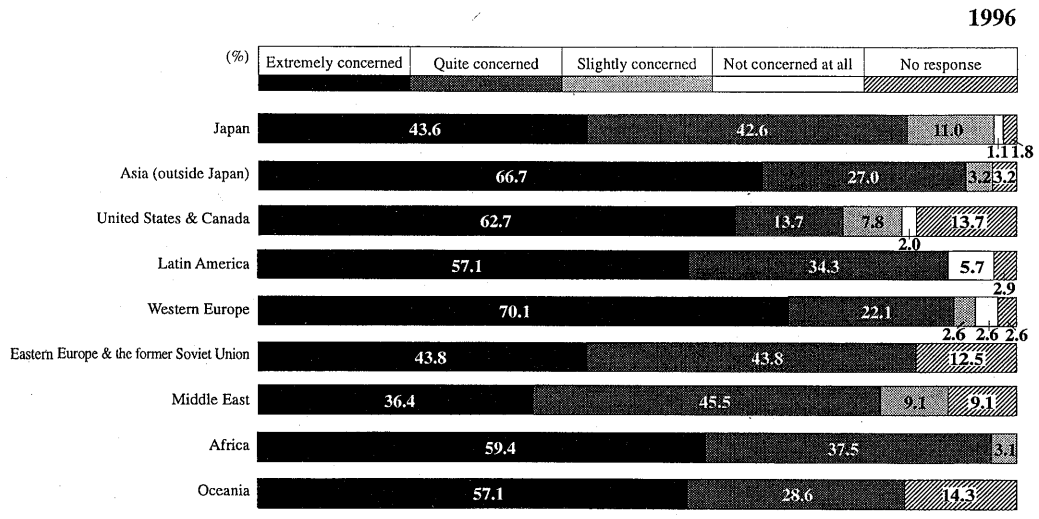


Figure 1-3 1996 Results by Region

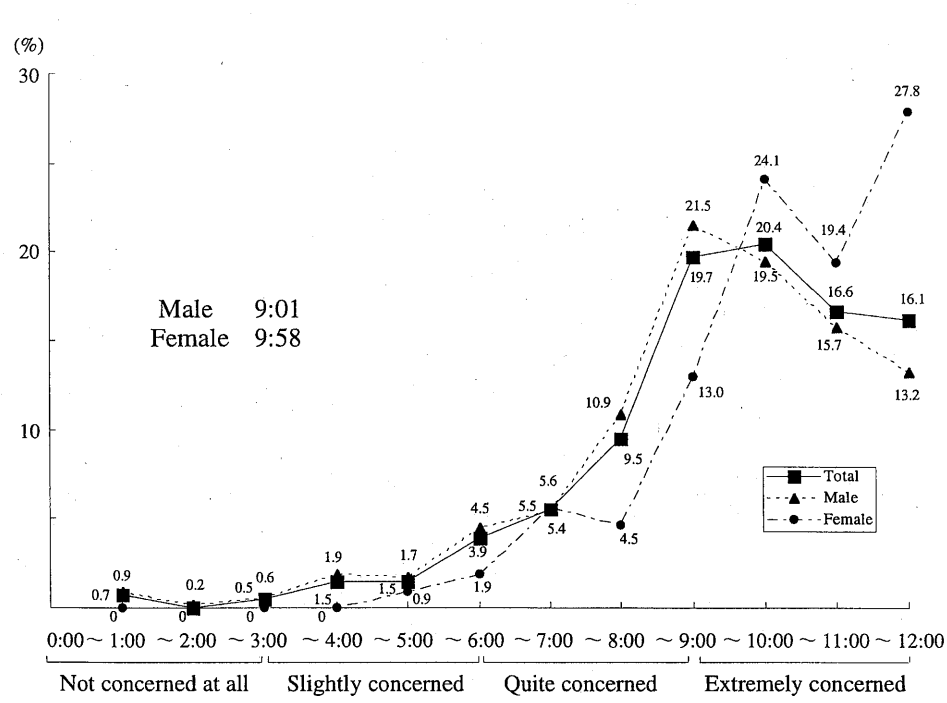


Figure 1-4 Concern about the Survival Prospects of Humankind 1996

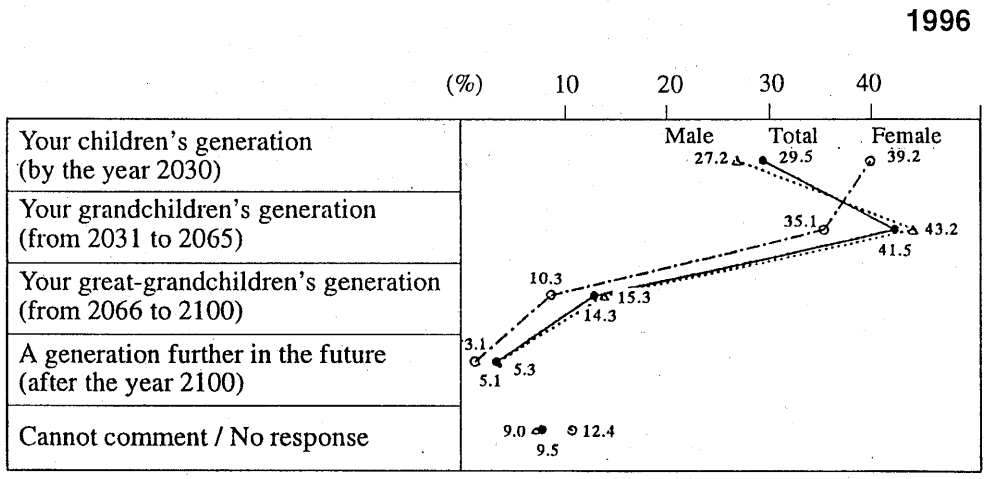


Figure 1-5 When Will the Crisis Come?

2. Averting the Crisis

2.1 Lifestyle Changes

"Lately there has been a growing consensus that we should change our overconsumption, throwaway lifestyle. How do you feel about adapting a more frugal lifestyle, e.g., using less electricity, purchasing products that are environmentally sound, or reducing the amount of household garbage?"

To avert a crisis of survival, one possible measure would be altering present-day overconsumption, throwaway lifestyles. New ways of living that would reduce the burden on the environment could be carried out by individuals making changes in their daily lives.

The results of this question, which was asked in each of the three years from 1994 to 1996, are shown in Figure 2-1. Approximately 80% of respondents showed a belief in the possibility of change by answering that they "already have adapted/can adapt" or "could adapt to some extent."

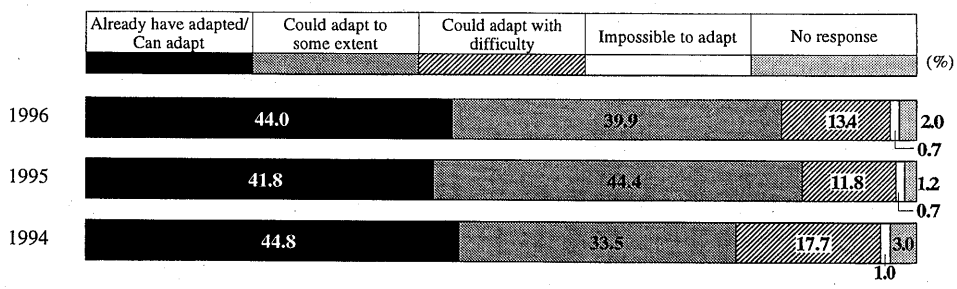


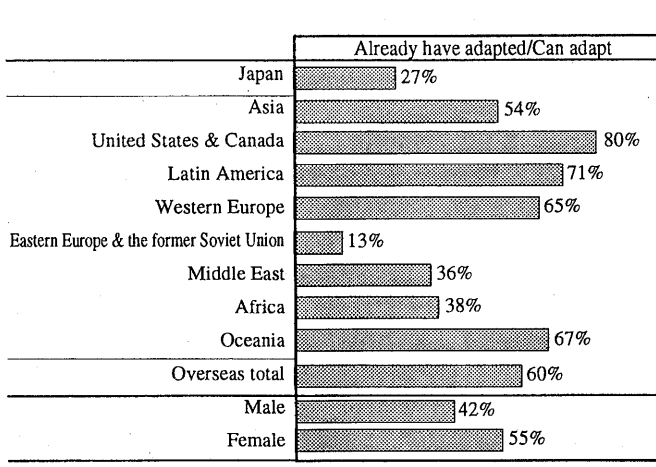
Figure 2-1 Lifestyle Changes, 1994-1996

Presented in Figure 2-2 are data on a regional basis. The bar graph shows the percentage of "already have adapted/can adapt" responses for 1996. This percentage is relatively low for Japan, Eastern Europe & the former Soviet Union, the Middle East, and Africa. However, for all other regions more than 50% of respondents answered "already have adapted/can adapt," with the greatest percentage from the United States and Canada, followed by Latin America, Oceania, Western Europe and Asia. In addition, women gave a higher percentage of "already have adapted/can adapt" responses than men.

Respondents were also asked to give examples of how they are changing their lifestyles. A selection of their answers, in their own words, are given below.

- We have just one child. We take the bus to work. We do not use fertilizer/pesticides. We buy what we need, and we don't shop aimlessly. (Canada)

- Reduced energy consumption by 50%, sold one car and reduced use of the other by 50%;



(%)

	1996		1995		1994	
	(1)	(2)	(1)	(2)	(1)	(2)
Japan	27	53	23	65	29	59
Asia	54	30	53	34	58	9
United States & Canada	80	16	92	8	83	4
Latin America	71	23	75	15	53	25
Western Europe	65	25	63	29	50	32
Eastern Europe & the former Soviet Union	13	56	7	36	29	24
Middle East	36	46	50	31	-	-
Africa	38	47	39	36	45	17
Oceania	67	14	46	41	73	14
Overseas total	60	28	56	29	55	18
Male	42	42	38	48	42	36
Female	55	34	56	33	55	26

Notes: Column (1) indicates percentage of "already have adapted/can adapt" responses.
Column (2) indicates percentage of "could adapt to some extent" responses.

Figure 2-2 "Already Have Adapted/Can Adapt" Responses by Region

do not fly anymore; use regional products if possible; invest in ecological projects; use 20% of income for environmental organizations, etc. (Germany)

- Own no car. Do not heat all rooms in winter. Do not cook for one person only. Recycle as much as possible. (Switzerland)

- Giving up a second car in our family and using public transport, saving and reusing wrappings, recycling everything possible and conforming to local regulations for waste disposal. (United Kingdom)

- Have a kitchen garden for family meals, avoid buying newspapers and paperbacks, write on both sides of paper, avoid incinerating domestic waste. (Latvia)

- In India and other developing countries, particularly in South Asia, it is estimated that more than 520 million people are living below the poverty line and need major help from the industrialized nations to alleviate their poverty and improve their lives. It is the lifestyles and patterns of over-consumption in affluent nations that are causing the greatest problems globally. It is they who should reduce their consumption and waste. Seeing and experiencing may be a better mode of change than merely trying to raise the awareness of the people. Affluent people should experience the lifestyle of poor nations in small groups for a period of 2-3 months. Upon their return home, they would become very effective agents of change in their society, helping to bring a perceptible change in lifestyles and consumption patterns. (India)

2.2 Contributions of Science and Technology

"The activities below are considered key to enhancing science and technology's ability to contribute to the resolution of environmental problems. Which do you think are the most important in this respect?"

Probably few would disagree that our present-day civilization is built upon science and technology and their major advances in the modern era. Science and technology have made possible mass production, although this has spurred higher levels of consumption and waste disposal and led to environmental problems. On the other hand, the latest scientific advances are also important to the measurement of changes in the global environment and to making predictions about the future. In addition, they have contributed to the formulation of environmental measures, including emissions controls, recycling, and cleanup efforts for pollutants. Depending on its application, modern science is a double-edged sword. In 1993, respondents were asked how they felt about technology's role in the search for solutions to environmental problems. Their answers are shown in Figure 2-3.

Respondents were asked to choose four activities and rank them from one to four. Examining the total of items ranked one to four, the item selected most often was activating an interdisciplinary cultural and natural sciences' approach toward the environment. The item that was ranked number one by the most respondents was establishing clear strategies and goals for science and technology. The third most popular answer was establishing methods of evaluat-

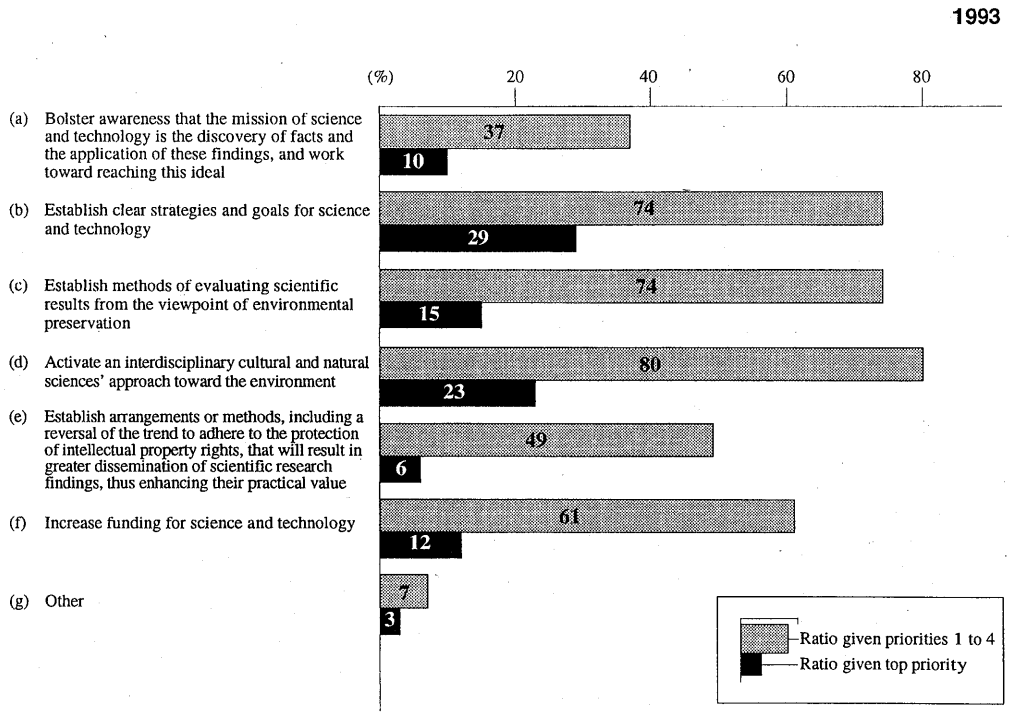


Figure 2-3 Contributions of Science and Technology

ing scientific results from the viewpoint of environmental preservation, and the next most common response was increasing funding for science and technology.

2.3 Effective Measures for Solving Environmental Problems

"From among the following economic measures and regulations aimed at solving environmental problems, which would be most effective in your country? Choose four."

To find solutions to complex environmental problems, various measures need to be undertaken on a national and international basis. Since 1993, this questionnaire has asked respondents to select the measures they feel to be most effective. The results are shown in Table 2-1.

During the three years that this question was asked, the top three responses were, in

Table 2-1 Economic Measures Aimed at Solving Environmental Problems

1993-1995

		1. Industrial regulations	2. Self-monitoring	3. Environmental taxes	4. Emission permit system	5. Financing for R&D strategies	6. International technological aid	7. Abolishing environmentally unsound aid	8. Financial incentives	9. Discriminatory pricing	10. Refund and recycling programs	11. Land utilization restrictions	12. Extending information disclosure	13. Other
														(%)
Japan	'93	(57)	46	(56)	12	54	-	-	-	18	(56)	-	20	2
	'94	(59)	32	(62)	10	33	22	14	(51)	24	39	16	23	6
	'95	(49)	29	(52)	10	21	35	12	47	16	(58)	17	28	3
Asia (outside Japan)	'93	(74)	19	(70)	12	30	-	-	-	(42)	35	-	21	12
	'94	(63)	20	(46)	7	41	25	24	(50)	30	29	41	11	5
	'95	(61)	29	39	8	23	29	18	(55)	(40)	23	24	26	7
United States & Canada	'93	(73)	9	(73)	18	9	-	-	-	(46)	32	-	27	18
	'94	(57)	4	(78)	26	17	4	39	(78)	44	13	17	13	9
	'95	(52)	24	(64)	8	12	-	20	(60)	40	36	24	8	4
Latin America	'93	(65)	27	(57)	11	57	-	-	-	50	(60)	-	11	8
	'94	42	11	28	8	(50)	17	39	(58)	28	42	(44)	14	6
	'95	(56)	8	31	6	35	29	19	(69)	31	38	(40)	6	6
Western Europe	'93	(63)	29	(71)	29	16	-	-	-	(53)	32	-	21	5
	'94	(52)	16	(73)	15	21	7	24	(69)	50	15	16	10	7
	'95	(47)	10	(70)	13	15	19	18	(76)	43	22	24	10	10
Estern Europe & the former Soviet Union	'93	(77)	8	(77)	8	31	-	-	-	39	(54)	-	31	8
	'94	(65)	18	(59)	24	35	(53)	24	(53)	29	18	18	6	-
	'95	36	14	(86)	7	50	43	7	(57)	14	(57)	7	7	-
Middle East	'93	-	-	-	-	-	-	-	-	-	-	-	-	-
	'94	-	-	-	-	-	-	-	-	-	-	-	-	-
	'95	(69)	38	19	13	25	25	19	(44)	25	(50)	(44)	25	6
Africa	'93	(70)	33	(53)	15	(55)	-	-	-	20	38	-	38	5
	'94	(49)	9	36	6	(51)	34	38	(51)	23	23	40	15	6
	'95	36	16	31	5	(45)	36	24	(55)	29	32	(42)	29	7
Oceania	'93	(86)	18	(41)	9	23	-	-	-	(41)	32	-	(41)	9
	'94	(50)	23	(77)	27	23	9	18	(55)	32	41	27	9	9
	'95	46	18	36	5	32	23	(50)	(50)	27	32	(50)	14	14

Note: The circles indicate items with the top three percentage figures per region.
The No.1 response for each region has been marked with a double circle.

order from one to three, regulations to limit harmful industrial activities, environmental taxes, and financial incentives to encourage environmentally friendly activities. In particular, the first and third of these items were chosen by more than half of respondents from almost every region. However, the second item, environmental taxes, was chosen most often by respondents from economically developed regions, including the United States & Canada, Western Europe, Japan, and by Eastern Europe & the former Soviet Union as well. Among respondents from developing regions such as Latin America, Africa, and the Middle East, as well as from Oceania, regulations to limit the way land can be utilized were regarded as very important.

Respondents were also asked to comment on their opinions about economic measures and regulations. Fundamental differences in views between developing and economically mature regions are clearly shown in the following selection of these comments.

- Regulatory processes combined with financial incentives could make the difference at all levels. (Niger)

- Regulations are necessary, but we must employ economic measures that will raise people's consciousness about the need to solve environmental problems. (Japan)

- I support the "polluters pay" principle. (Philippines)

- Business and trade organizations should supervise their members' activities and monitor for potential harm to the environment. (Turkey)

- I think ecological tax reform is the thing we have to do. (Switzerland)

- Heavy penalties and taxes should be imposed if rules of environmental conservation are not followed. Industrialists should install waste treatment plants and, if they do not, then their rights to operate should be revoked. (India)

- Efforts are necessary to establish more efficient control mechanisms to ensure that existing regulations will be kept. (Germany)

2.4 Environmental Education

"Of the following strategies for the promotion of environmental education, which are given the highest priority in your country?"

Environmental education is one of the measures looked to with the greatest of hopes for the future. In 1993, this questionnaire examined the priority given to various facets of environmental education. The results are shown in Figure 2-4.

The most commonly chosen response was the need to develop educational resources

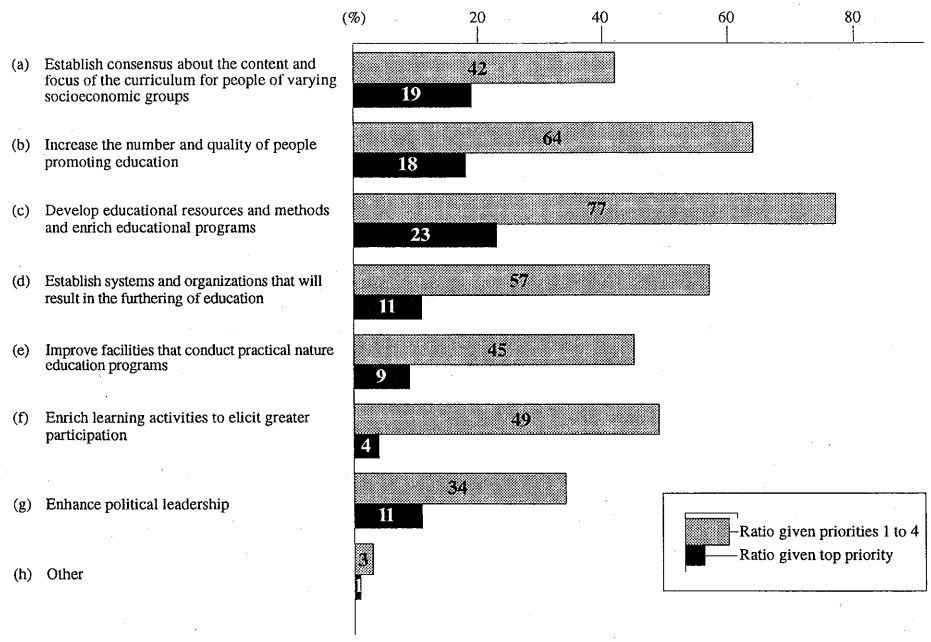


Figure 2-4 Environmental Education

and methods and enrich educational programs. This perhaps indicates the relative newness of these programs and the need for their further elaboration. The items ranked next in importance by respondents were the need to increase the number and quality of people promoting education, establish systems and organizations that will result in the furthering of education, and establish consensus about the content and focus of the curriculum for people of various socioeconomic groups.

2.5 Coping with Overpopulation

"Among the many possible solutions to overpopulation, which do you think should be given the highest priority?"

If environmental problems are to be examined with any seriousness, then it becomes necessary to consider the global problem of overpopulation. The surveys conducted in 1993 and 1994 contained a question about overpopulation, the results of which are shown in Figure 2-5.

The solution chosen by more than 70% of respondents was to increase education in developing countries. The next most popular measures were family planning, raising the economic growth and standards of living in developing countries, and heightening the status of women.

Respondents were also asked to give their personal opinions about the population problem.

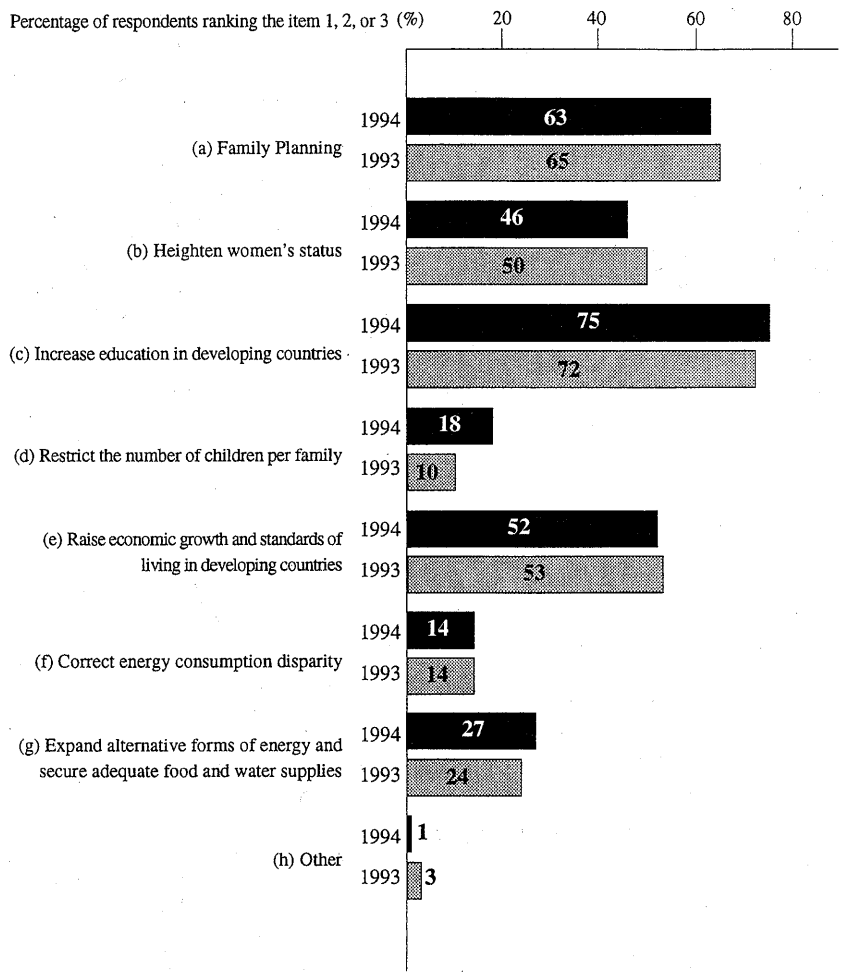


Figure 2-5 Solutions to Overpopulation

Many respondents emphasized the need to provide better education for women in developing countries and raise standards of living. The following is a selection of some of these comments.

- Limiting population growth can be achieved by increasing general awareness and heightening women's status in society. However, the energy consumption disparity which exists between the developed and developing countries needs to be balanced. (India)

- Good education, fair standards of living and effective family planning are interrelated. (Madagascar)

- If the overall standard of living in developing countries is improved, this could go far in reducing population growth. It is the poor in the developing countries who have the most children. Reduce poverty and we are on our way! (Jamaica)

- The world must try to overcome ignorance in the developed countries because more than 70% of the world's people are illiterate. The minority of the world's population living in the developed countries use 80% of the world's resources. (Benin)

- Although the best way of confronting overpopulation is to heighten women's status and increase the general level of education, these things take a long time. Until they can be realized, national restrictions on children per family are useful. (Iran)

- Solutions to the problem of overpopulation must not lose sight of human dignity and an individual's personal and moral right to determine how he or she should form a family. (Philippines)

- For a developing country like Nicaragua, the most important thing is to educate people, in this case girls, because most mothers with big families are poorly educated and have no means of supporting themselves. (Nicaragua)

2.6 Measures for Dealing with Global Warming

"What will be the most effective measures for dealing with global warming?"

Opinions on the subject of global warming differ widely, both among people in economically advanced countries and between developing and economically developed countries. This is because factors contributing to global warming include both the burning of fossil fuels in developed countries, which results in emissions of carbon dioxide, and the cutting down of forests in developing countries, which leaves fewer trees to absorb excess carbon dioxide.

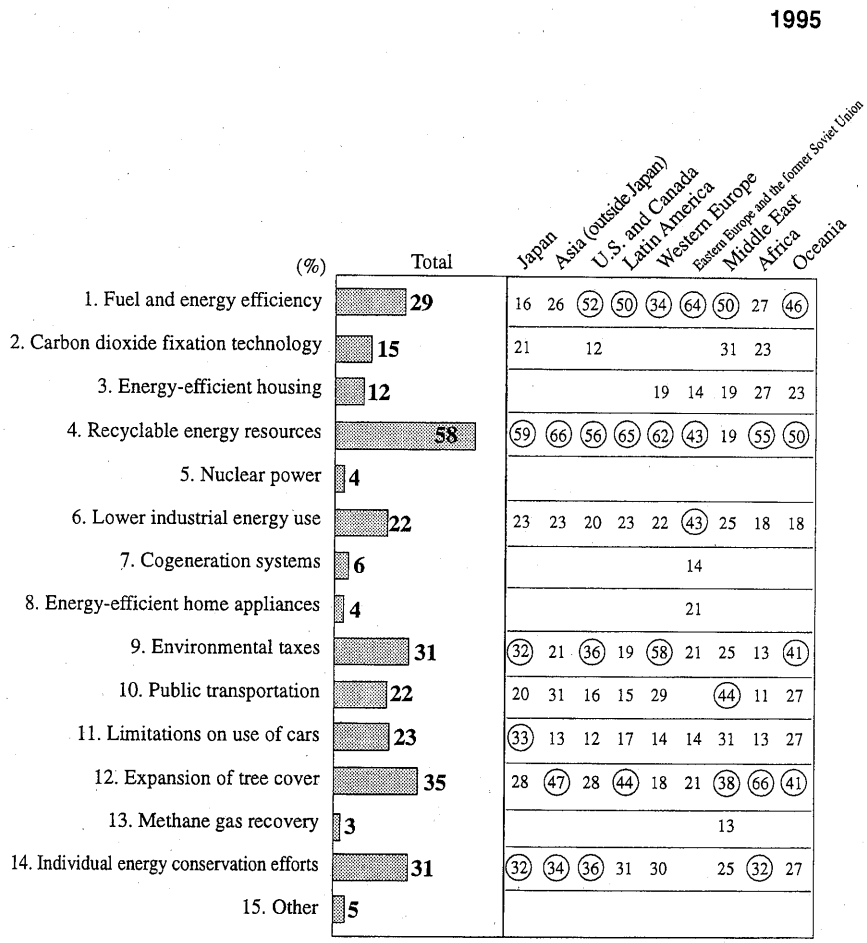
Questionnaire participants were asked their opinions about global warming in 1995 and 1996. The answers to the survey in 1995, which asked about effective measures for dealing with global warming, are shown in Figure 2-6.

Respondents rated recyclable energy resources as the most effective way to counter global warming. With the exception of the Middle East, more than half of respondents from nearly all regions chose this solution. Opinions on the other measures were sharply divided by region. Specifically, economically advanced regions such as the United States & Canada, Western Europe, and Japan rated environmental taxes highly, while respondents from Africa, Asia, and Latin America supported the expansion of tree cover. Both measures received high marks in Oceania.

In 1996, questionnaire respondents were asked their opinions about the United Nations Framework Convention on Climate Change (FCCC). The objective of the FCCC is to stabilize

concentrations of greenhouse gas in the atmosphere at safe levels. As the first step toward this objective, the FCCC calls for developed countries to stabilize their emissions of carbon dioxide at 1990 levels by the year 2000. Respondents were asked to evaluate the attainability of this targeted first step.

The combined total of "attainable" and "partially attainable" responses was nearly 40%. However, the combined total of "probably difficult to attain" and "completely unattainable" responses was greater than 55%, showing that more than half of the respondents are pessimistic about progress on this issue.



Notes: 1) Only percentages above 10% are recorded.
2) The circles indicate items with the top three percentage figures per region.

Figure 2-6 Important Measures for Dealing with Global Warming

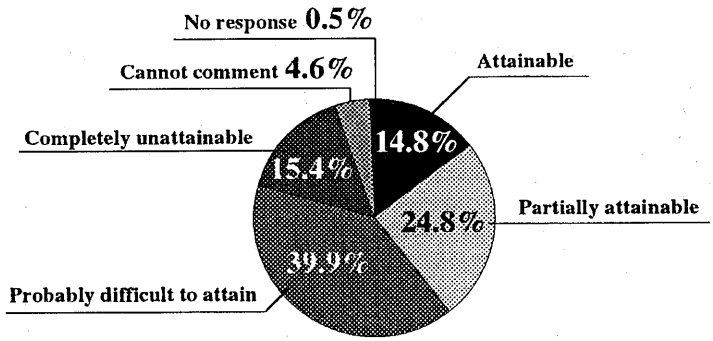


Figure 2-7 Evaluation of Attainability

3. Agenda 21

Agenda 21, an international action plan for the environment and development, covers a broad range of issues ranging from combating pollution to dealing with overpopulation and eradicating poverty. As such, Agenda 21 represents an important first step for humankind.

In each of the past five years, this questionnaire has surveyed respondents' opinions on the significance of Agenda 21 and on progress made on environmental issues covered by the plan. These results are detailed below.

3.1 Evaluation of the Significance of Agenda 21

"How important are the items contained in Agenda 21, the action plan adopted at the Earth Summit?"

Responses to the above question for 1994 are shown in Figure 3-1. Of the total, 59% of respondents answered that Agenda 21 is extremely important as a plan for humanity to follow into the next century, and 32% stated that it is quite important. The combined total of 91% shows an overwhelming majority of support for the plan.

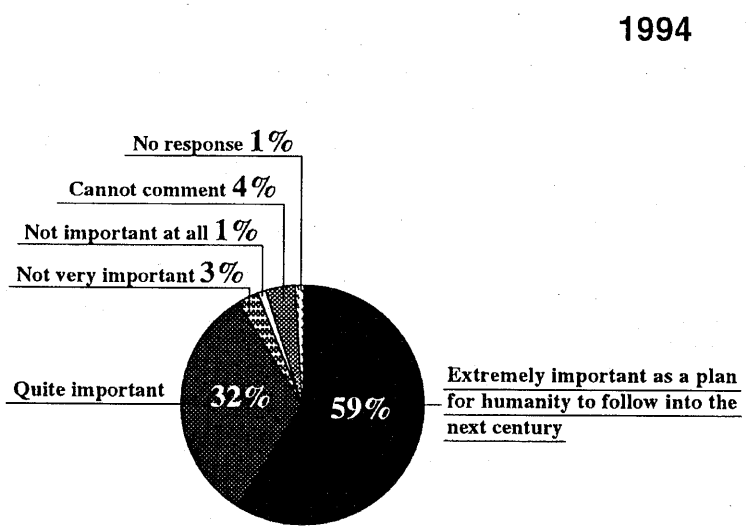


Figure 3-1 Importance of Items Contained in Agenda 21

3.2 Progress on Environmental Issues

"Since the Earth Summit, to what extent has progress been achieved in your own country in the following areas covered by Agenda 21?"

This question has been included in the questionnaire every year from 1993 to 1996. From the second year onward, not much change has been reported by respondents, and this trend is also reflected in the responses for 1996. Figure 3-2 shows the latest data, for 1996, and also depicts the direction of the overall four-year trend with an arrow.

During the past four years, a high percentage of respondents indicated that local GO and citizen's group activities as well as environmental education showed "significant progress" or "some progress." Other areas for which progress was evaluated favorably were NGO activities, ozone layer protection measures, international cooperative efforts to promote sustainable development, scientific and technological advancement, and industrial sector policies.

Areas showing an upward trend over the past four years include items that reflect the involvement of individuals. These include NGO activities and the establishment of recycling systems. On the other hand, items showing a downtrend tended to involve complex problems requiring social change for their resolution or problems related to destruction of the environment. These included poverty and overpopulation, changes in lifestyles and consumption patterns, and forest conservation, desertification, and protection of freshwater resources.

3.3 Important Issues by Region

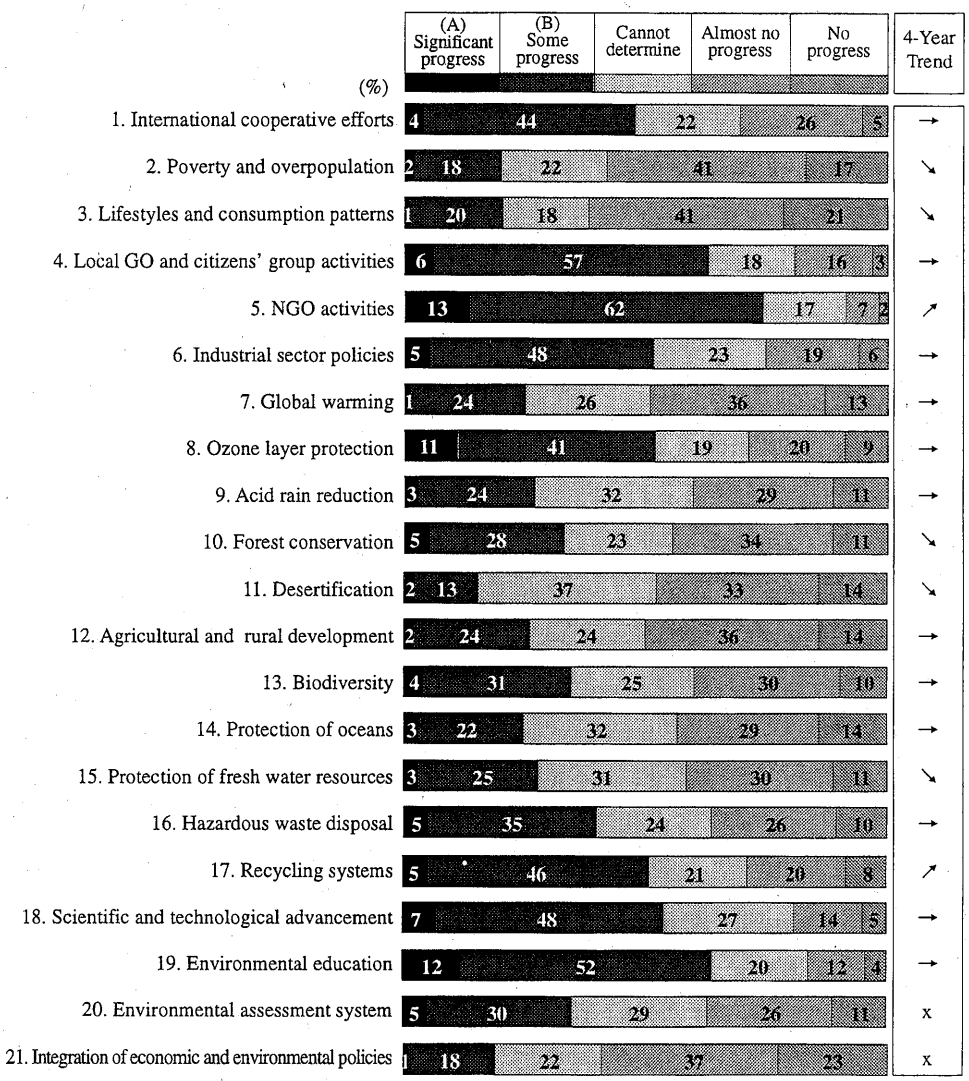
"What do you believe are the most important environmental issues in your own country?"

In 1995 and 1996, respondents were asked an additional question about which environmental issues are most important in their own countries. The results for both years are recorded in Table 3-1. One item that was viewed as important by respondents from all regions is item number 19, environmental education.

Respondents from developing regions such as Asia, Latin America, and Africa placed greater significance on poverty and overpopulation as well as sustainable agricultural and rural development. For the developed regions such as the United States & Canada, Western Europe, and Japan, items rated most important were changes in lifestyles and consumption patterns and the integration of economic and environmental policies. These differences in responses highlighted the variances in regional viewpoints on environmental problems.

The following is a sampling of comments from respondents about Agenda 21.

- Crucial in Agenda 21 was the establishment of open communication on environmental problems by governmental organizations (including municipalities) with factories and citizens. Only together can we solve the problems. (Netherlands)



Notes: In cases where no answer has been indicated by a respondent, a response of "cannot determine" has been recorded.
An "x" indicates an item added to the Questionnaire in 1996.

Figure 3-2 Progress on Environmental Issues since the Earth Summit

- It is important for all the Earth's countries to stay focused on environmental protection collectively and similarly—much like the agenda outlined in Rio. We must all actively work on the objectives we set out at the Earth Summit, but we must remain realistic in doing this—sticking to our deadlines and communicating through internationally circulated "progress reports." (U.S.A.)

- International cooperation, based on global partnerships, must be strongly promoted. We

Table 3-1 Areas Most Important in Respondent's Own Countries by Region

1995-1996

	(%)	Japan	Asia (outside Japan)	U.S. and Canada	Latin America	Western Europe	Eastern Europe and the former Soviet Union	Middle East	Africa	Oceania
1. International cooperative efforts	'95	17				10	(21)		18	18
	'96	21	13		14		13	-	13	14
2. Poverty and overpopulation	'95		(42)	20	(35)	10	(14)	(19)	(53)	(23)
	'96	12	(44)	(24)	(51)	13	13	(27)	(63)	19
3. Lifestyles and consumption patterns	'95	(47)	16	(36)	10	(51)		13		(23)
	'96	(44)	21	(43)	26	(55)	25			(29)
4. Local GO and citizens' group activities	'95		15		13	13	(14)	(19)		14
	'96		16	10	11	12	-			14
5. NGO activities	'95		11							14
	'96	14						(27)		10
6. Industrial sector policies	'95	19		(24)		14				
	'96	22	13	22		17	(44)	18		14
7. Global warming	'95	15				15		13		
	'96	11		10	-	18	-	-	-	10
8. Ozone layer protection	'95									
	'96			-			-	-		
9. Acid rain reduction	'95						(14)			
	'96			-	-			-	-	-
10. Forest conservation	'95		18	(24)	10		(14)		23	
	'96		19		11		19	18	16	14
11. Desertification	'95							(31)	24	
	'96			-						-
12. Agricultural and rural development	'95		(29)		(38)	(20)	(21)	(19)	(45)	18
	'96		(30)	14	23	25	(31)		(44)	24
13. Biodiversity	'95		10	16				13		
	'96		13				-	-		
14. Protection of oceans	'95			20						
	'96			-			-			-
15. Protection of fresh water	'95			12			(14)	(19)		14
	'96		13	14		10	19	(27)		
16. Hazardous waste disposal	'95						(14)	13		14
	'96			12	-		19	(27)		
17. Recycling systems	'95	(35)						13		
	'96	28				13	19	18	-	-
18. Scientific and technological advancement	'95	-	-	-	-	-	-	-	-	-
	'96	15		12		10				
19. Environmental education	'95	(23)	(40)	12	(42)	(29)	(14)	(50)	(47)	(36)
	'96	(30)	(37)	(24)	(46)	(26)	(31)	(36)	(38)	(53)
20. Environment asssesssment system	'95	-	-	-	-	-	-	-	-	-
	'96	12	13	16	14		13	27	16	10
21. Integration of economic and environmental policies	'95	-	-	-	-	-	-	-	-	-
	'96	(42)	24	(51)	(40)	(46)	(31)	18	25	(29)

Notes: The above figures show the number of times the item was chosen as a percentage of total responses.
The circles indicate items with the top three percentage figures per region.
The No. 1 response for each region has been marked with a double circle.
Percentages of less than 10% are indicated by blank cells in the table.

must seek not to contribute to global well-being through donations but to seriously consider the world's problems as our own. (Japan)

- Indigenous healing culture fits with the cycle of water distilled by the sun from the sea, soaked up by forests and redistributed by rivers, lakes, and springs, and also with the carbon cycle, the biological cycle, and the cycle of birth and death of civilizations such as the West's. They need our respect and support for us to survive. (Australia)

- We should always remember the evolution of nature. We are developing together—nature and humankind. Therefore, our main task is to understand the process better and prevent abrupt changes in our activity, including emissions, discharges, global interferences, etc. We must also correct problems in our environment to provide valid living conditions. (Russia)

Closing

Since it was first carried out in 1992, the Asahi Glass Foundation's "Questionnaire on Environmental Problems and the Survival of Humankind" has attracted interest from general and environment-specific newspapers and magazines in Japan and overseas. In addition, the survey, as a compilation of the opinions of international specialists concerned with global environmental problems, has also been mentioned in the Environment Agency of Japan's annual white paper on the environment.

In particular, the survey's question about humanity in crisis, which uses a clock to gauge levels of concern, has been featured by the print and television media. This clock has served as a symbol of the urgency with which we must endeavor to resolve environmental problems. The survey's findings on issues concerning individuals, such as lifestyle changes, as well as issues concerning nations, such as Agenda 21, have also been cited in the press, and the questionnaire has come to be regarded as a reliable index of opinion on environmental issues.

Thanks to members of the media, our "Questionnaire on Environmental Problems and the Survival of Humankind" has helped generate worldwide interest in environmental issues and their resolution. The Asahi Glass Foundation will continue to carry out this survey and focus attention on the opinions of people working to solve environmental problems around the world.

Information about the "Questionnaire on Environmental Problems and the Survival of Humankind"

	Response Period	Questionnaires Returned	Response Rate
1992	6/29-8/17	1,054	28.3%
1993	5/6-6/30	282	11.0%
1994	4/1-7/8	504	20.8%
1995	4/1-7/10	576	21.7%
1996	4/1-7/10	589	18..4%

The questionnaire respondent pool is selected from members of GOs and NGOs in the Asahi Glass Foundation database.

Number of Questionnaires Returned by Region/Sex

Region	1992	1993	1994	1995	1996
Japan	877	61	189	248	282
Asia (outside Japan)	30	43	92	62	63
United States & Canada	49	22	23	25	51
Latin America	11	37	36	48	35
Western Europe	39	38	62	79	77
Eastern Europe & the former Soviet Union	13	13	17	14	16
Middle East	9	6	4	16	11
Africa	N/A	40	53	62	32
Oceania	9	22	22	22	21
Other	17	0	6	0	1

Sex	1992	1993	1994	1995	1996
Male	995	195	390	444	470
Female	44	61	110	119	108
No response	15	26	4	13	11