

## **IR-2 International Comparative Study on Fundamental Structure of Socioeconomic System for Conserving Global Environment**

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### **Abstract**

As the level of environmental impacts of global problems are closely related to the basic structure of socioeconomic systems it is necessary to investigate the relationships between environmental impacts and socioeconomic structures.

The role of this study is to make an international comparison of the state of socioeconomic structures that comprise the foundation of global environmental conservation, and to clarify strategies for responding to these problems.

First, we designed a study framework and set more than 100 assumptions and scenarios in these fields to explain the relationships between these systems and global environmental issues. Various studies and data were reviewed to test these assumptions and scenarios. Also, in cooperation with the ZUMA Institute of Germany, attitudes to the environment were investigated. Japanese have more information about the environment, but take less action than Germans. As well, relationships between land-use and energy consumption were analyzed. A decentralized distribution of compact cities is the most energy efficient.

Using this analysis, proposals for social system changes to promote environmental conservation were described. Also, more concrete ways to change lifestyle, urban structure and information systems etc were proposed to reduce the impact of global warming.

**Key Words** Sustainable Development, Framework Model, Global Circulation, World Economic Model, Macro-economic Impact

### 1. Introduction

As the level of environmental impacts of global problems are closely related to the basic structure of socioeconomic systems, such as urban and rural land use methods, lifestyle, energy use patterns and industrial structure, it is necessary to investigate the relationships between environmental impacts and socioeconomic structures.

The purpose of this study is to make an international comparison of the socioeconomic structures that should make up the base of global environmental conservation, and to clarify the strategies required to change the situation.

It is now recognised that technology has clear limits in solving global environmental problems. These issues are extremely complex, and adopting a narrow 'technological fix' approach for one problem may magnify the difficulties associated with others as it is likely to not have considered the linkages to other issues.

As such, it is necessary to use a more sophisticated approach. This is the 'social breakthrough' approach which seeks to change fundamental social structures in a way that will allow sustainable development within the context of sound environmental conservation and reduced environmental impact.

## 2. Framework of the Study

There are many socioeconomic systems that have an influence on the global environment, e.g. economic and financial systems, technology systems, lifestyles, energy systems, agricultural systems, urban and transport systems, legal systems and the cultural and ethical systems.

From these systems, we selected three major fields - the economic system, the urban and transport system, and lifestyle - which have strong linkages to global environmental problems. Table 1 shows the various items within these systems that are important for analyzing these problems.

To describe the relationships between these 100 items and global environmental problems many assumptions were made and scenarios were developed. Figure 1 is one of the assumptions which shows the relationships between national land-use and global environmental issues. The size of a city will be closely related to CO2 emissions, and the design of the city will have some impact on energy consumption levels. Lifestyles need to be analysed not only in relation to people's consciousness of environmental problems, but also in relation to the relationships within families and companies, the criteria for happiness and religion.

Many scenarios were prepared on the relationships of the financial and economic systems and environmental problems, as well as the forest and agricultural management systems.

## 3. International Comparative Analysis on Social Structure and Environment

### (1) Data Collection and Overviews

In order to test assumptions and scenarios for more than 100 socioeconomic items shown in Table 1, various data and research outcomes were reviewed and prepared as a guidebook for tackling the issue of 'social breakthroughs'. Figure 2 is one of the scenarios tested using the collected data. It describes the relationship between diet and global environmental problems. The figure has two characteristics - increasing food quality caused by rising income, and 'eating out' because of increased leisure time. Such trends lead to increased waste of natural resources as well as food, and increased transport energy consumption. These kinds of scenarios were tested with various data.

### (2) International Comparison of Environmental Attitudes and Perceptions

Lifestyles differ among nations and are strongly linked to the global environmental burden, so it is very important to analyse their international differences. As such, we took part in the International Social Survey Program on Environmental Attitudes and Perceptions, promoted by the ZUMA Institute in Germany. German and Japanese citizens were surveyed on the issues listed in Table 2. The same survey was conducted in England, Ireland, the Netherlands and Italy, and the results are able to be compared with the Japanese survey.

Figure 3 shows the results of a comparison between Germany and Japan about the perception and behaviour of motor vehicle use. Japan and Germany do not have

Table 1 Keywords for Structuring Framework towards Social Expensive

Lifestyle	<p>1. Civilization Religion: Western/Eastern Civilization, Aboriginal Customs, Supremacy of Paternity, Religion and Non-Materialism, Pre-Modern Industrialized Civilization, Rule of Nature, Catholic &amp; Islam</p> <p>2. Values, Thought: Authoritarianism, Diversity in Values, Materialism/Belief in Technology, Supremacy of Money</p> <p>3. Information: Development of Information Service, Increase in Opportunity to Obtain Informations</p> <p>4. Education: Education for Women, International Exchange in Culture, Supremacy of Academic Career, Social Education, Education in Family, Environmental Education</p> <p>5. Labor: Working Hours, Flex-Time, Summertime, Promotion of Women</p>	<p>6. Food : Eating Meats &amp; Expensive Fishes, Local Foods, Gourmantization, Diversity of Diet Raw Foods, Processed Foods, Preference of Safer Foods, Dining-Out, Rice Crop/Wheat Crop Culture, Vegetarianism</p> <p>7. Clothing: Western Formality, Fashion Consciousness, Preference to Natural Fiber, Orientation toward Luxurious Goods</p> <p>8. Housing: Lifecycle of House, Size of Family, Stand-Alone/Collective House, Owned/Rented House</p> <p>9. Leisure Life: Travelling, Luxurious Leisure, Activities in Local Community</p> <p>10. Eco-Movement: Recycle Movement, Participation in Environment Protection Movement</p> <p>11. Others: Awareness of Local History &amp; Area, State of Local Environment</p>
Politics, Economy and Others	<p>1. Political System: Decentralization of Power, Political Decision-Making Process, Flow of Funds to Governmental Sectors, Environmental NGOs, Citizens Movement</p> <p>2. Economic System: Planning Economy V.S. Market Economy</p> <p>3. Price Mechanism: Market Failure(External Diseconomy), Tax, Subsidies</p> <p>4. Stage of Economic Development: Trade-Off between Economic Growth &amp; Environmental Protection, Effects of Rapid Economic Growth to Environments, Level of Income &amp; Phase of Environmental Problems</p> <p>5. Energy: Energy Efficiency &amp; Level of Per Capita Income, Structure of Industries</p> <p>6. Production System: Management Philosophy &amp; Corporate Strategy, Production System for Various Goods in Small Quantity, Frequency of Modal-Change of Products</p>	<p>7. Military Expenses: Military Activities &amp; Destruction of Environment</p> <p>8. Income Distribution: Redistribution of Income</p> <p>9. International Relationship: International Leadership</p> <p>10. Ethnic Problems: Ethnic Problems &amp; Process of Political Decision</p> <p>11. Aging Society: Aging Society &amp; Process of Political Decision Aging Society &amp; Energy Consumption</p> <p>12. Forestry: Ownership Type of Forest, Increase of Population, Agriculture, Usage of Forest</p> <p>13. Land Usage: Ownership Type of Land, Agriculture System, Land Productivity</p>
Urban Structure	<p>1. Structure of National Land: Allocation of Cities, Urbanization Ratio, Per Capita GNP, Bias in Distribution of Population, Level of Formation of Traffic System, Infrastructures for Information &amp; Tele-Communications</p>	<p>2. Urban Structure: Population Density, Allocation of Population &amp; Employment, Mixed Usage of Land, Restriction of Car Parkings, Public Mass-Transit System, Network of Roads, Size and Structure of Cities, Preference of Citizens, Suburbanization of Industrial Complex</p>

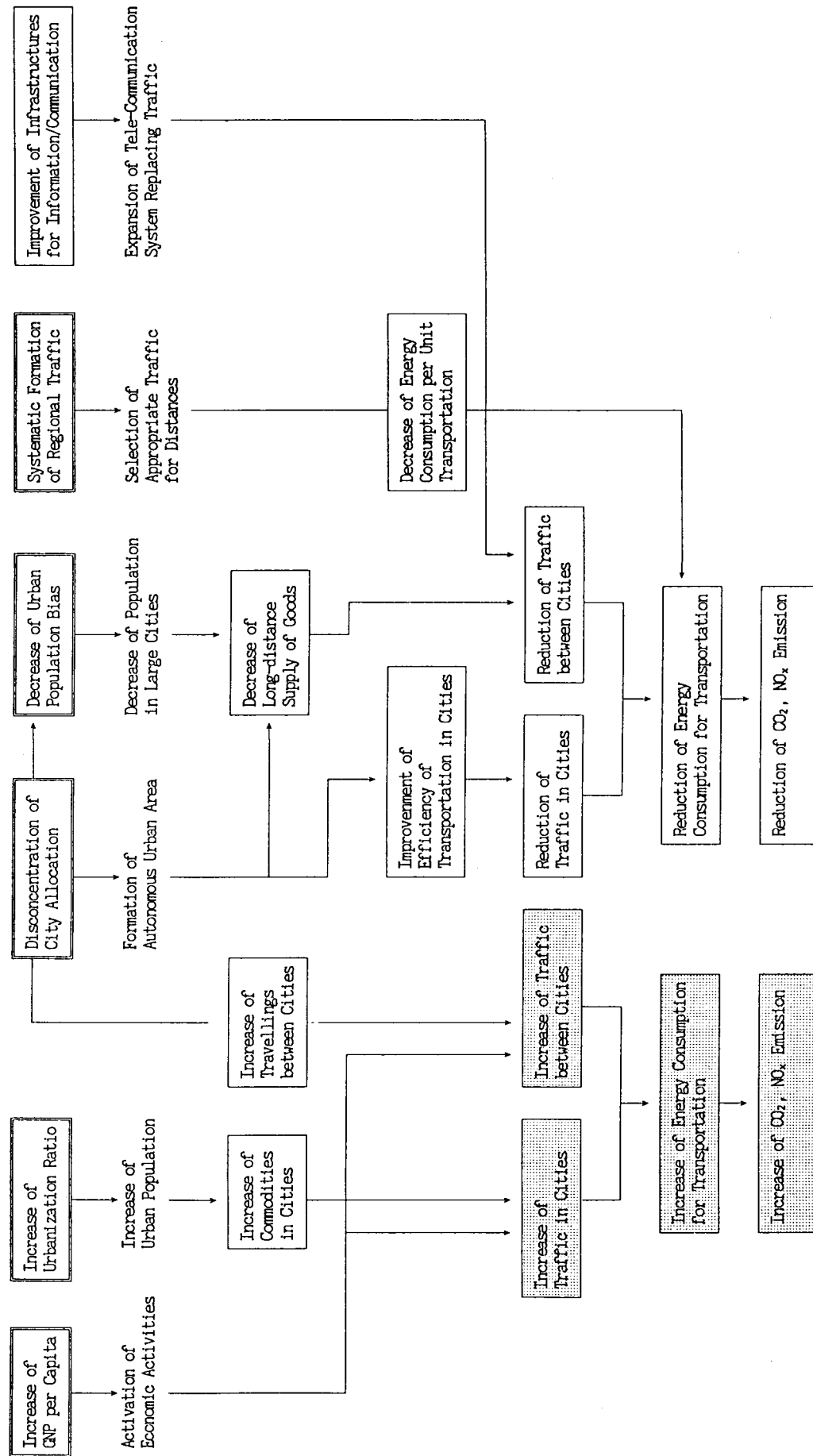


Figure 1 Relation between National Land Use and Global Environmental Issues

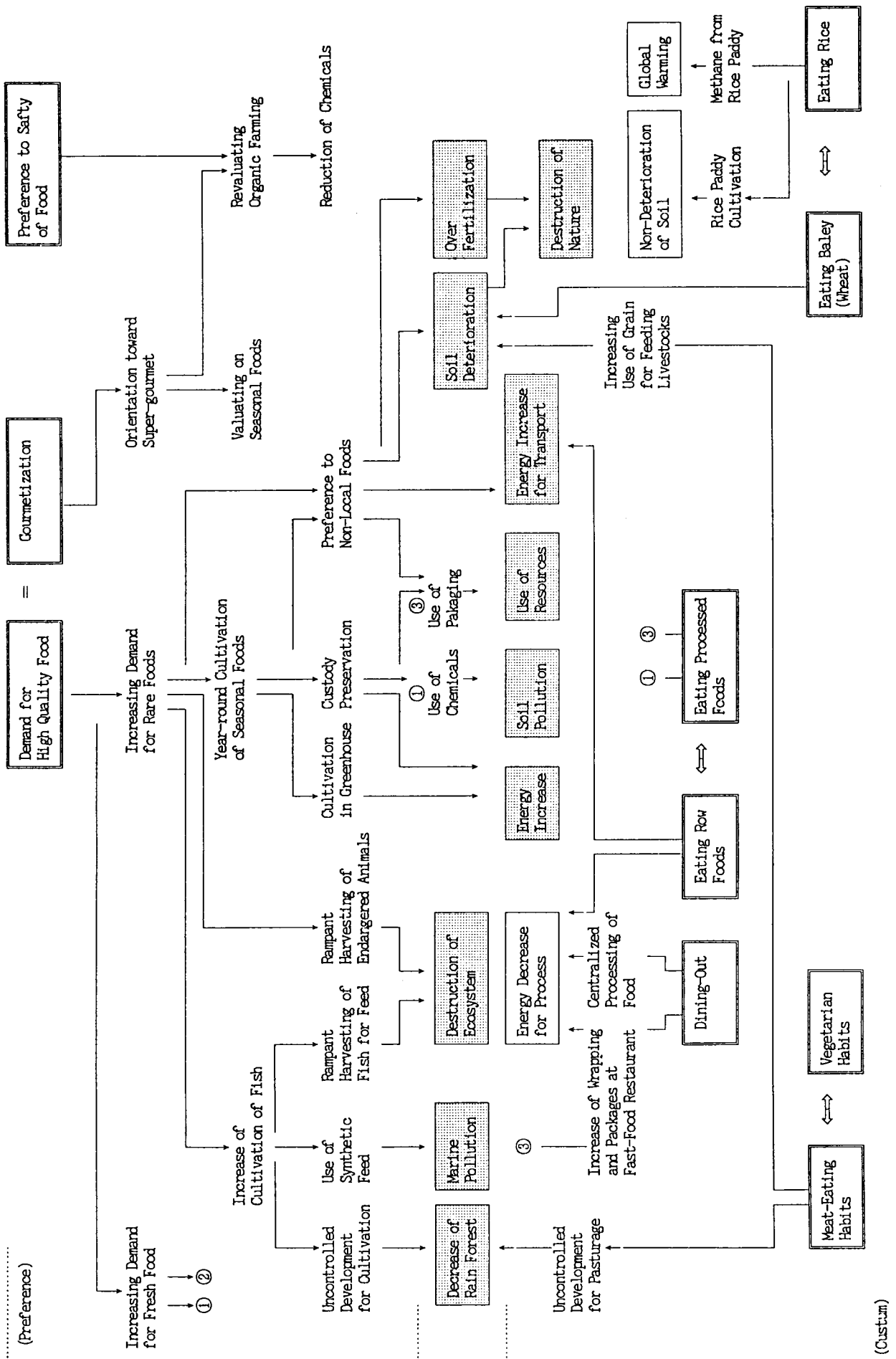
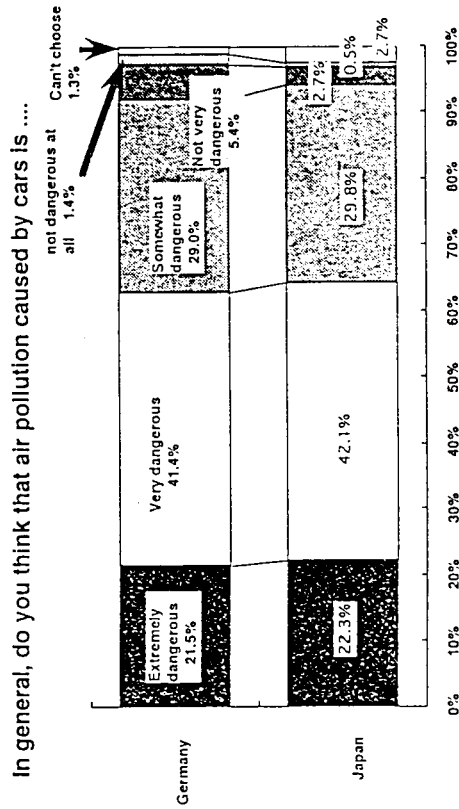


Figure 2 Relation between Diet and Global Environmental Issues



How often do you cut back on driving a car for environmental reasons?

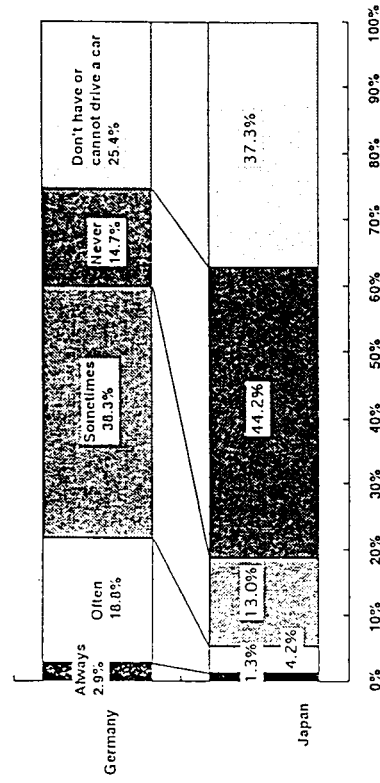


Figure 3 Recognition of Each Environmental Issues and Behavior

Table 2 The contents of International Social Survey Program 1993 module on Environment and its adjacent survey-Research into Environmental Attitude and Perception

Title	International Social Survey Program 1993 module on Environment (ISSP)	Research into Environmental Attitude and Perception (REAP)
Agents	(Japan)Japan Broadcasting Institute (Germany)ZUMA	(Japan)National Institute for Environmental Studies (Germany)ZUMA
Language	Japanese and German (Original text is written in British English)	
Population	All national individuals over 16 years old	All national individuals over 16 years old in Germany (Between 16 and 20 years old is under 1% of whole sample) and over 20 years old in Japan
No. of samples	1,800 (Effective samples are 1,014 in Germany, 1,310 in Japan)	1,800 (Effective samples are 1,014 in Germany, 2,000 (Effective samples are, 1,397) in Japan
Sampling method	2 stage stratified random sampling	
Year	May, 1993 in Germany, November 1992 in Japan	May, 1993 in Germany, April 1992 in Japan
Contents	1) The role of large firms and governments 2) The environment and Science and Technology 3) Economic Activity and the Environment 4) Religious, Religion and the Environment 5) The Facts and their Recognition of the Environment 6) Institutional Systems and Individuals' roles 7) Individuals' activities for the Environment 8) Background characteristics	1) The Energy Consumption in a Households 2) Usage of Cars and Bikes when shopping, commuting, etc. 3) Waste Problems 4) Environmental Labelling 5) Background characteristics

\*For the ISSP data, available from the Archive, KoIn University.

any significant differences in the perceptions about the impact of motor vehicle exhausts. However, Germany apparently has a positive attitude towards changing behaviour for environmental protection.

### (3) Impact of Urban Structure and Location on Energy Consumptions

The relationship between urban structure and energy consumption has been studied since the 1960s, and the potential for reducing energy consumption by many methods has been shown - e.g. population location change, land use change, introduction of public transport systems and changing city layout and shape.

In order to test the impact of changes in urban structures, we established a database to compare the urban structure of more than 3,000 cities with over 100,000 inhabitants. Using this data, we tried to statistically analyze the relationship between urban population density and CO<sub>2</sub> emissions. The relationship can be seen in Figure 4. The more compact the city, the lower the CO<sub>2</sub> emissions.

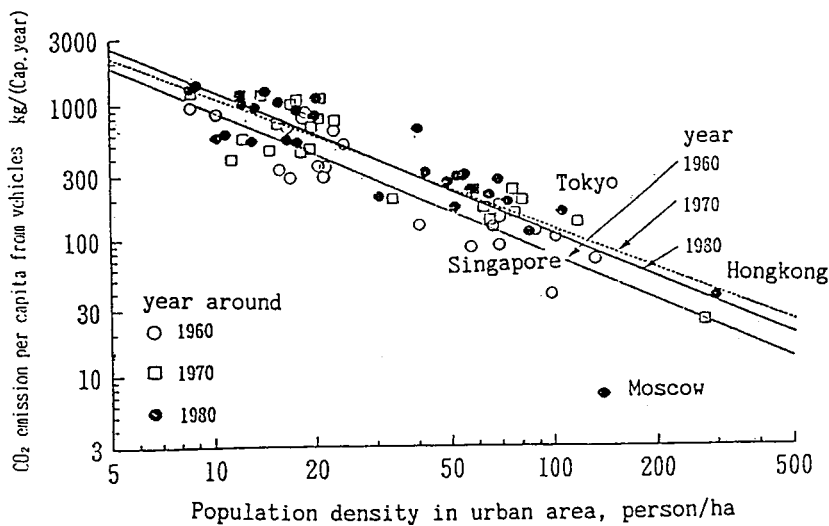


Fig.4 Relationship between urban population intensity and CO<sub>2</sub> emissions

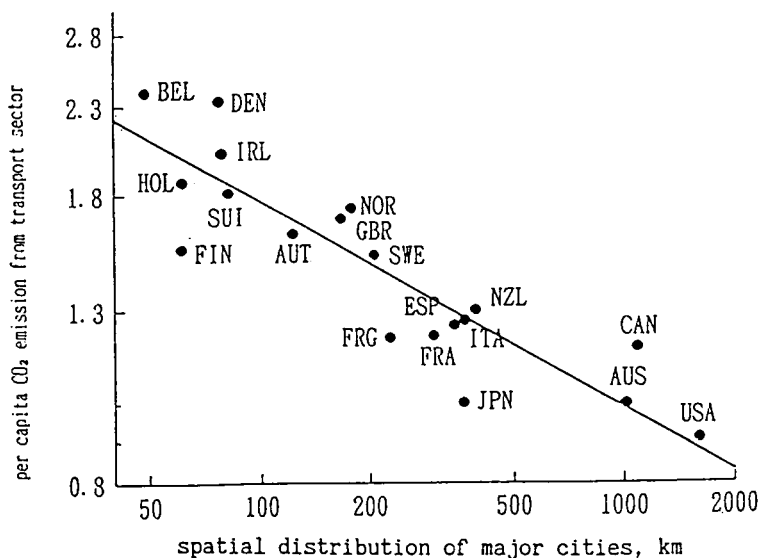


Fig.5 Relationship between spatial distribution of cities and CO<sub>2</sub> emissions

The spatial allocation of cities would also greatly change the traffic volumes between cities and have a great impact on energy consumption. In order to analyse the relations, we first defined 'the degree of decentralization of urban areas' as the index that presents the spatial dispersion of cities. To calculate this index, we determined the center of gravity of an area of land using its population distribution and then fixed the distance between the center of gravity and each city. The degree of decentralization of a city is defined as a standard deviation of the distances from the center. Figure 5 shows the relationships between CO2 emissions and the degree of urban decentralization after the influence of these effects was removed. As the Figure shows, it is clear that in developed countries, the more the cities are dispersed spatially, the more per-capita CO2 emissions from transport decrease.

Such a relation should be confirmed by simulation analysis as well as statistical analysis, so we developed a transport energy model to apply to the Japanese situation. Table 3 shows the potential reduction in annual energy consumption through the implementation of decentralization policies, as simulated by a non-linear optimisation model. Adopting the decentralized land-use scenario leads to a 20% reduction in total annual transport energy consumption. Long-distance transport energy consumption is reduced by 40%. The effects of such major structural changes can be input into the model, integrated with other data, and their influence on GHG emissions is calculated.

Table 3 Potential Reduction of Transport Energy by Decentralized Land Use in Japan

Name of Regional Block	Current Population Distribution (millions)	30% Decentralized Distribution (a) (millions)	Optimal Population Distribution (b) (millions)
Hokkaido	5.94	6.01	7.74
Tohoku	9.78	12.01	15.68
Kanto	38.00	28.62	16.92
Hokuriku	5.58	7.07	6.17
Chubu	17.11	17.11	14.19
Kinki	20.12	15.18	10.96
Chugoku	7.75	9.60	17.10
Shikoku	4.24	5.72	14.64
Kyushu	13.29	15.89	19.36
Total energy Consumption (c) (trillion kcal)	742	632	594

Note: (a) in the case of moving 30% of population in Tokyo and Osaka Metropolis Area to other regions.  
 (b) in the case of optimizing population distribution to minimize transport energy consumptions.  
 (c) energy consumption in transport sector only.



## 5. Proposals to Change Social Structure for Global Environmental Conservation

### (1) General Proposals

The above analysis concluded that proposals for changing social structure should focus on lifestyle and urban structure as shown in Table 4.

The most important strategy for changing lifestyles is to improve awareness of environmental problems and the need for conservation in all aspects of life. Twelve proposals should be followed if this direction is to be pursued.

The most important strategy for changing urban structure is to promote the allocation of urban functions and land use with lower environmental impact, and thirteen proposals were recommended.

### (2) Proposals for Stabilizing Global Climate

In order to stabilize the future climate of the earth, the socio-economic structure of contemporary society needs to be change. Fifteen proposals which would lead to the achievement of that goal are recommended.

#### (Citizen Life Styles)

Moving to environmentally sound life-styles may reduce energy consumption by 10-18% in Japan in the coming two decades, Dr.H.Tsuchiya has calculated the conservation potential of daily lifestyle changes, which our future society confront sooner or later. "Contest and Prize", "Subsidization" and "Tax and Penalty on the waste-inducing technologies" are the keys to reaching this goal.

Nearly 5% of carbon dioxide emissions in Japan could be reduced by a change in consumers' spontaneous activities. This is a result Dr.M.Aoyagi estimated from her survey of more than 600 families in Japan. This showed the practical effectiveness of environmental education, and the importance of fostering neighborhood environmental groups as they facilitate participation by local people.

A Mutually Symbiogenetic Society with a five step scenario is proposed in Professor T.Morioka's design of Ecopolis 21 & Ecolife 21, in which the key words are "seven R's" for energy saving and waste reduction, eco-labeling of products and adopting a physically simpler life.

#### (Urban Design, Transportation and Information Systems)

Decentralized compact cities are needed to achieve ecologically-sound land use and city design. That is the conclusion of Professor Y. Matsuoka, Dr. T. Morita and Mr. T. Arimura following completion of a statistical analysis of the energy consumption of world cities and their spatial distribution within each country.

A fair mechanism of apportioning the marginal profit from railway construction in developed countries and assistance for developing countries in introducing well designed mass-transport systems are required to reduce urban energy consumption. This depends on the compactness of urban structure and on the efficiency of the mass transit system. This is the conclusion of Professor Y. Hayashi's global comparison study of transport systems.

Newspaper size could be halved by utilizing facsimile and electronic data networks, resulting in the reduction of energy and forest resource consumption. This proposal by Professor K. Nawa and Mr. T. Nakazato places our trust in the

Table 4 Framework of Proposed Countemeasures for Protecting Global Environment

Strategy	Direction of Proposal	Example of Concrete Measures
<p>[LIFESTYLE]</p> <ul style="list-style-type: none"> <li>• Improve Awareness for Environmental Protection in Every Aspects of Life</li> <li>• Promote Lifestyle with Lower Environment Loads</li> </ul>	<p>[FOOD]</p> <ul style="list-style-type: none"> <li>• Establish High-Efficient Logistic System for Food Transportation</li> <li>• Establish Cyclic Production System with Used Materials</li> </ul> <p>[CLOTHING]</p> <ul style="list-style-type: none"> <li>• Establish High-Efficient Production System for Clothes</li> <li>• Promote Environmental Consideration in Raw Materials &amp; Production Process</li> </ul> <p>[HOUSING]</p> <ul style="list-style-type: none"> <li>• Adopt Houses with High-Efficiency of Energy/Resources Consumption</li> </ul>	<ul style="list-style-type: none"> <li>• Introduce Eco-Lavellings Indicating Loads to Environment</li> <li>• Reconsider Customs of Eating Foods-out-of-season</li> <li>• Introduce Eco-Cooking(Environmental Education about Food)</li> <li>• Develop Eco-Brand Fashion</li> <li>• Establish Recycle System of Clothes</li> <li>• Introduce Deposit System of Over Bearing Period of House</li> <li>• Introduce New Charge System of Non-Resident Houses</li> <li>• Adopt "Green-House" for Public House Supply</li> <li>• Introduce Eco-Holidays System</li> <li>• Promote Participation in Eco-Conscious Movement in Working Places</li> </ul>
<p>[LABOR, LEISURE]</p> <ul style="list-style-type: none"> <li>• Promote Participation in Eco-Movement by Increasing Off-time</li> <li>• Establish Information Support System by Environmental NGOs</li> </ul> <p>[INFORMATION SERVICE]</p> <ul style="list-style-type: none"> <li>• Develop Infrastructures for Environmental Information Service</li> <li>• Increase Supply of Environmental Informations</li> </ul> <p>[EDUCATION]</p> <ul style="list-style-type: none"> <li>• Promote Opportunity of Education for Women</li> <li>• Establish Environmental Education System</li> </ul> <p>[WOMEN]</p> <ul style="list-style-type: none"> <li>• Promote Making Society without Sexual Discrimination</li> </ul>	<p>[POPULATION DENSITY]</p> <ul style="list-style-type: none"> <li>• Introduce Urban Policy Based on Controlling Population Density</li> </ul> <p>[ALLOCATION OF POPULATION &amp; EMPLOYMENT]</p> <ul style="list-style-type: none"> <li>• Promote Habitation &amp; Restrict Concentration of Employment in Dometown</li> <li>• Allocate Population &amp; Employment in Suburbs</li> </ul> <p>[CAR PARKING]</p> <ul style="list-style-type: none"> <li>• Restrict Car Parking Areas in Dometown</li> <li>• Construct Large Sized Car Parking Areas at Fringe of Urban Area</li> <li>• Reconsider Compulsory Parking Lot Construction in Buildings in Dometown</li> </ul>	<ul style="list-style-type: none"> <li>• Introduce Environmental Virtual Reality Facility</li> <li>• Introduce Eco-Channel Telephone System</li> <li>• Discount Long-Distance Tele-Communication Charge</li> <li>• Introduce Eco-Index Showing Environmental Loads</li> <li>• Develop Environmental Simulation Software</li> <li>• Popularize Eco-Tour</li> <li>• Promote Outdoor-Life with Participation of Fathers</li> <li>• Dispatch Women NGOs Member to Developing countries for Women Education</li> <li>• Enhancement of Agricultural Education in Developing Countries</li> </ul>
<p>[URBAN STRUCTURE]</p> <ul style="list-style-type: none"> <li>• Promote Urban Functions &amp; Land Pressure to Environment Use with Lower</li> <li>• Introduce Growth Management for Cities</li> </ul>	<p>[POPULATION DENSITY]</p> <ul style="list-style-type: none"> <li>• Control Population Density in Large Cities</li> </ul> <p>[RESTRICTION OF OFFICE FLOOR]</p> <ul style="list-style-type: none"> <li>• Restrict Total Amount of Office Floor in Dometown</li> <li>• Promote New City Transit System in Core Area of Suburbs</li> </ul> <p>[PARKING RESTRICTION]</p> <ul style="list-style-type: none"> <li>• Promote Park-and-Ride System</li> <li>• Introduce Car Parking Restriction Zone in Dometown</li> </ul>	<ul style="list-style-type: none"> <li>• Control Population Density in Large Cities</li> <li>• Restrict Total Amount of Office Floor in Dometown</li> <li>• Promote New City Transit System in Core Area of Suburbs</li> <li>• Promote Park-and-Ride System</li> <li>• Introduce Car Parking Restriction Zone in Dometown</li> </ul>

(Continued)

<p>[URBAN STRUCTURE]</p>	<p>[LAND USE]</p> <ul style="list-style-type: none"><li>• Reallocate Urban Functions and Landuse for Lower Environmental Loads</li><li>• Introduce Environmental Assessment as a Basic Information Environmental Protection Policy</li></ul> <p>[AUTOMOBILE DRIVABILITY]</p> <ul style="list-style-type: none"><li>• Reduce Single-Occupied-Vehicle in Downtown</li><li>• Disperse Long-Term Vacation to Reduce Concentrated Traffics</li></ul> <p>[SYSTEMATIC TRAFFIC NETWORK]</p> <ul style="list-style-type: none"><li>• Promote Modal-Mix Transportation Facilities Based on Railway</li></ul> <p>[DIVERSIFIED CONTROL ON USAGE OF NATIONAL LAND]</p> <ul style="list-style-type: none"><li>• Promote Transfer of Administrative Power to Local Governments</li><li>• Establish Wide-Area Administration System in Local</li></ul>	<ul style="list-style-type: none"><li>• Establish New Landuse Scheme from Viewpoint of Lowering Environmental Loads</li><li>• Intensify Environmental Assessment on Traffics Induced by Large Development Projects</li><li>• Introduce Taxi-Sharing System</li><li>• Introduce Special Charge to Single Occupied Vehicles in Downtown</li><li>• Enact Act for Disperse Long-Term Vacations</li><li>• Establish Integrated Cargo Handling Company Covering Whole Nation</li><li>• Promote Autonomous Management of Local Governments</li><li>• Establish Cooperating Environmental Policy among Local Governments in a Region</li></ul>
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science, technology and human wisdom that form the basis of our contemporary highly networked society.

(Economic and Marketing Systems)

"Eco-management Cycles" with autonomous environmental checking systems may be one way of curtailing business activities that neglect their negative socio-environmental impacts. Ms. T. Kurasaka proposes to establish an environmental audit system comprising environment management control, periodic environmental audits and environmental reporting. Competitive bids to set the best available standard among companies is a powerful method for giving industries incentives to develop environmentally sound technologies. Using this mechanism a manufacturer who declares the highest attainable standard may be protected by law. Professor T. Suzuki also proposed an "Energy House Keeping Book" for home use and an "Energy Budget Account Information System" for energy conservation in manufacturing.

Emission permit rights with continuously discounting nominal value, which Professor H. Imura proposes, is one economically efficient, equitable, effective, inexpensive and acceptable incentive for reducing carbon dioxide emissions. In this system, the value of the initially allocated rights decrease annually to converge into a constant value over the long run.

(Agriculture and Forestry)

Establishing recycling and recirculation systems in local and regional material flows is essential for sustainable agricultural management, as is the matching of products with the local environmental capacity. Asian countries have increased their agricultural production by more than 30% during this decade, in many cases without the expansion of cultivated land but by the increased use of fertilizers. Dr. T. Udagawa indicates that mutually supporting rural and urban regions is crucial to sustain long-term agricultural productivity.

"Farmers' afforestation" that guarantee farmers long-term economic revenue is the key to preserving the carbon sink capacity of forestry systems. This is concluded by Professor M. Kumazaki, in his analysis of the cases of contract forestry in the Philippines and contract afforestation in Thailand. There is a clear capacity for combining forest preservation and the expansion of agricultural activities.

(Objectives, Organization and Research)

Expanding capital and human resources as a result of population control increases per capita income. This relationship is confirmed by Professor N. Ogawa in his examination of Asian demographic trends. Assistance for population control should urgently be strengthened and be integrated into the economic planning of developing countries.

Existing economic indicators should be modified to properly reflect the damage to the environment and the deterioration of environmental resources. Dr. T. Morita and Professor Y. Matsuoka propose that "co-existence and coprosperity", "intergenerational prosperity" and "regional participation" should be the main objectives of future societies, and these indicators should embody environmental and economic sustainability.

Establishment of an Asian Global Environmental Research Consortium that

endorses a cooperative research network among developed and developing countries is essential. Dr. S. Nishioka proposes this in order to reduce the uncertainties that prevent us from recognizing coming trans-generational environmental problems. This new science of global environmental research requires new management concepts which may be defined as "integrating autonomous research". This kind of cooperation would promote the early participation of developing countries into negotiations on international environmental policy.

## 6. Concluding Remarks

First, we designed a study framework and set more than 100 assumptions and scenarios in these fields to explain the relationships between these systems and global environmental issues. Various studies and data were reviewed to test these assumptions and scenarios. Also, in cooperation with the ZUMA Institute of Germany, attitudes to the environment were investigated. Japanese have more information about the environment, but take less action than Germans. As well, relationships between land-use and energy consumption were analyzed. A decentralized distribution of compact cities is the most energy efficient.

Using this analysis, proposals for social system changes to promote environmental conservation were described. Also, more concrete ways to change lifestyle, urban structure and information systems etc were proposed to reduce the impact of global warming.

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