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**Northeastern Forest
Experiment Station**

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Humans, Forests, and Global Environmental Change: Planning a Social Science Research Agenda

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NORTHERN
GLOBAL CHANGE
RESEARCH PROGRAM

Humans, Forests, and Global Environmental Change: Planning a Social Science Research Agenda

Sponsored by
USDA Forest Service
Northern Global Change Program

"We must never forget the human and the economic dimensions of these [forest resource] problems."

President Clinton
Forest Conference
Portland, OR

"Underlying all such studies is the recognition that forests are social as well as biological systems and that people are integral parts of the definition and use of the forest ecosystems.

Our efforts to understand how people think about and act on forests have been minimal, and yet most controversies and shortages ultimately arise from human activity."

Forestry Research: A Mandate for Change
National Research Council

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Executive Summary

In early 1995, the USDA Forest Service's Northern Global Change Program (NGCP) convened two meetings—one in Cambridge, Massachusetts, and the other in Pittsburgh, Pennsylvania—to advance its commitment to human dimensions research by clearly defining the scope of a research program appropriate to its mission and objectives. This report presents the conclusions and recommendations of those meetings.

Cambridge Conference

The Cambridge conference entitled "Humans, Forests, and Global Environmental Change: Planning a Social Science Research Agenda" was held at Harvard University's John F. Kennedy School of Government from February 27 through March 1, 1995. Its charge was to identify critical global environmental change issues where human needs, expectations, and values meet forest ecosystems and natural resource policy.

Conference participants were drawn from both academia and the Forest Service and included scientists, managers, and policymakers. In their discussions, the participants recommended that the research goals of the NGCP should include:

- **Collection of Baseline Social Science Data for Policy and Management Decisions**

- **Integration of Information on Social, Physical, and Biological Systems**

Six research agendas on the human dimensions of global environmental change, developed by national and international committees since 1990, provided a foundation for the conference. Using research categories suggested by these earlier efforts, the NGCP conference identified specific topics relevant to forests, particularly those of the North Central and Northeastern United States. A partial list of those recommendations includes:

- **Policy and Management**
  Effects of policy and management actions
  Triggers to action on environmental change

- **Perceptions and Behaviors**
  Interactions of values, beliefs, perceptions, and behaviors
  Anticipating social responses to landscape changes

- **Valuation**
  Sources of environmental values
  Identifying and quantifying winners, losers, and tradeoffs of policy and management options

- **Environment - Culture - Technology Systems**
  Cultural definitions of forests and their effects on uses
  The impact of technologies on management options

- **Population Trends and Resource Use**
  Trends in human uses of forests and their effects on ecosystems
  Effects of population trends and human migration

- **Social Structures and Institutions**
  Identifying social structures and issues across forests
  Impacts of Forest Service and other organizations on forests

Pittsburgh Meeting

Results of the Cambridge conference were presented at a NGCP Review in Pittsburgh on March 14-16, 1995. A small group of scientists and managers in attendance developed researchable questions while making some modifications to the topics identified at the earlier conference. In addition to expressing their support for the Harvard results, Pittsburgh participants suggested that research should address a variety of social scales in both urban and rural forests. The group further proposed that NGCP human dimensions research address the following questions:

- **Behaviors and Demography**
  What are the effects of human actions on forested ecosystems?
  How do demographic trends affect forest use?

- **Social Impacts of Forest Ecosystem Management and Policy**
  What are the intended and unintended consequences of management and policy?
  What are the differential effects of forest management actions and environmental changes across social groups and time?
  What methods can be used to evaluate social impacts of changes in forested ecosystems?

- **Technology**
  How do various technologies affect the ways people use forests?
  How will changes in forested ecosystems affect technologies?

- **Human Response Thresholds to Environmental Changes**
  What triggers human responses to changes in forested ecosystems?
  How do people respond to changes in forested ecosystems?

- **Stakes and Stakeholders**
  Who are the relevant stakeholders and communities of interest at various scales?
  What are the tradeoffs among benefits and costs of management and policy options for various stakeholders?
  What methods can be used to identify stakeholders and communities of interest at various scales?
  What methods can be used to identify and evaluate tradeoffs among benefits and costs of management and policy options for various stakeholders?

- **Values and Social Constructions**
  What are the sources of environmental values?
  What are the interactions between environmental values and changes in forested ecosystems?
  How do social constructions of the relationships between nature and humans affect options for responding to change in forested landscapes?
  What are the relationships among values, beliefs, perceptions, and behaviors?

Background

To meet the scientific challenges associated with global change, the Forest Service has initiated a nationally coordinated, long-term research program. This program is fully integrated into the overall U.S. Global Change Research Program developed under the direction of the Office of Science and Technology in the Executive Office of the President, through the Federal Coordinating Council on Science, Engineering, and Technology and its Committee on Earth and Environmental Sciences.

The general objective of the Forest Service Global Change Research Program (FSGCRP) is "to provide a sound scientific basis for making regional, national, and international management and policy decisions regarding forest ecosystems in the context of global change challenges." At the end of the 1980's, three broad questions were selected to form the framework for FSGCRP research:

- What processes in forest ecosystems are sensitive to physical and chemical changes in the atmosphere? (i.e., Is there a problem?)
- How will future physical and chemical climate changes influence the structure, function, and productivity of forest and related ecosystems? (i.e., How serious is the problem?)
- What are the implications for forest management and how must forest management policies be altered to sustain forest productivity, health, and diversity? (i.e., What can be done about the problem?)

Scientific Challenges

Global change research challenges Forest Service and other scientists to understand earth systems at multiple scales—temporal and spatial—as well as ecosystem responses to multiple interacting stresses. It requires interdisciplinary team approaches to solve complex problems. Networks for exchanging scientific information have been created to meet this need, such as GCTE (Global Change and Terrestrial Ecosystems) and the CIESIN (Consortium for International Earth Science Information Network) Human Dimensions Electronic Kiosk. International dimensions can also be compelling, and FSGCRP scientists are cooperating with colleagues in other nations and with international scientific organizations.

Customers

The customers for global change research include national and international policymakers and regional and local land managers, such as:

- Congress;
- The President and executive branch departments and agencies (e.g., the Department of Agriculture, the Department of Energy, the Environmental Protection Agency);
- Other nations' governments and organizations;
- Electric utility companies and other greenhouse gas emitters;
- State resource managers;
- Conservation organizations; and
- Consultants.

Why Conduct Global Change Research?

As a leader in forestry research, the Forest Service supports and conducts research for its customers for many reasons including:

- To reduce uncertainties;
- To predict impacts;
- To identify and implement mitigation responses (reduce or offset emissions);
- To help in adaptation for change, e.g., to manage for an uncertain future and to ensure sustainability of our ecosystems;
- To prepare for possible catastrophic forest health impacts and their effects on social values of forests; and
- To minimize the impact of global change on people.

Results to Date

Examples of products resulting from U.S. global change research are:

- The Climate Change Action Plan for the United States (under the United Nations Framework Convention),
- The Resource Planning Act (RPA) Assessment,
- A regional response analysis for New England and Eastern Canada,
- The Office of Technology Assessment study on adaptation responses, and
- Studies on environmental impacts (e.g., investigation of sources of high lead levels in maple syrup).

How Does NGCP Fit in FSGCRP?

The Northern Global Change Program (NGCP) is one of four regional components of the Forest Service Global Change Research Program (FSGCRP). A joint program of the Northeastern Forest Experiment Station (NEFES) and North Central Forest Experiment Station (NCFES), the NGCP covers 20 States: Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin. The region is unique in the United States in that:

- It has the highest population density;
- It contains the highest proportion of forest land;
- It has the greatest mixture of urban, agricultural, and forest cover; and
- There is a close association among large cities, smaller communities, and forest values such as recreation, hunting, and forest products.

Current NGCP Research

Current NGCP research is focussed in the following areas:

- Physiological processes of trees
- Ecosystem processes
- Landscape-scale studies
- Social interactions and economics
- Assessment and Policy
- Model development and application

It is conducted through:

- Thirty Forest Service research work units (involving about 40 Scientists);
- Cooperative agreements with 22 universities (involving about 35 scientists);
- Cooperative agreements with the National Aeronautics and Space Administration, United States Geological Survey, and the Environmental Protection Agency; and
- Miscellaneous contracts, grants, and cofunding (e.g., with NCASI, EPRI, and other institutions).

Planning a Social Science Research Agenda

Since the early 1990s, the scientific community has called for the incorporation of human dimensions into forestry and global change research (e.g., Jacobson and Price 1990, National Research Council 1990, Stern et al. 1992). As the opening quotations of this report suggest, people are at the heart of forestry. Our needs, values, and actions are major determinants of the current and future state of forests. Humans are central to global change. We are both major causes of alterations to earth systems and subject to their effects. Clearly, then, any program of research on forests and global change must include a human dimension.

Once this imperative has been recognized, the more difficult task of defining and implementing such a research program must be faced. Thus in early 1995, the USDA Forest Service's Northern Global Change Program (NGCP) convened two meetings—one in Cambridge, MA, and the other in Pittsburgh, PA—to advance its commitment to human dimensions research by clearly defining the scope of a research program appropriate to its mission and objectives. This report presents the conclusions and recommendations of those meetings.

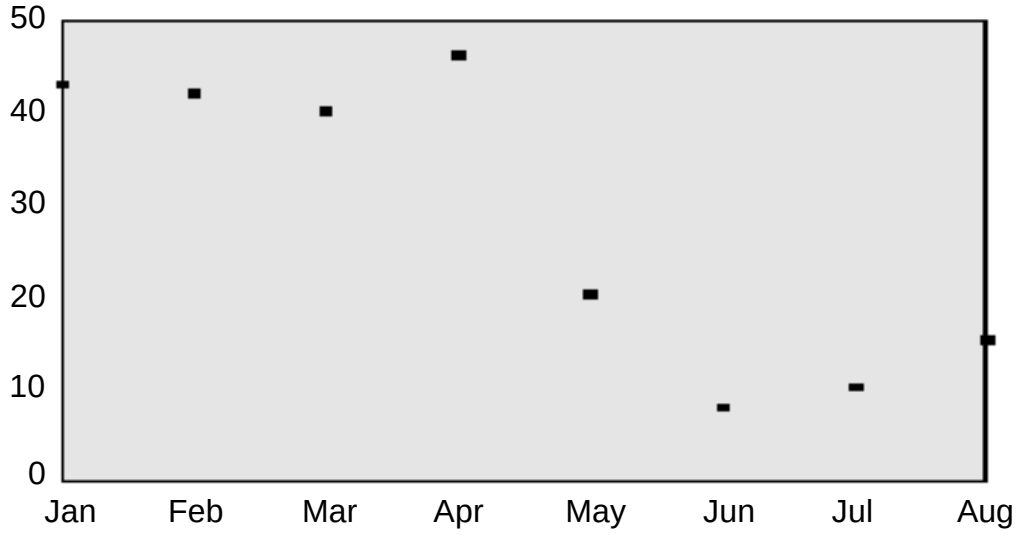
Cambridge Conference

Land managers, policymakers, and scientists from both academia and the Forest Service met to help plan a social science research agenda for the NGCP. The conference "Humans, Forests, and Global Environmental Change: Planning a Social Science Research Agenda" took place in late winter 1995 at Harvard University's John F. Kennedy School of Government. Participants were charged with identifying critical social science issues where human needs, expectations, and values meet forest ecosystems and natural resource policy.

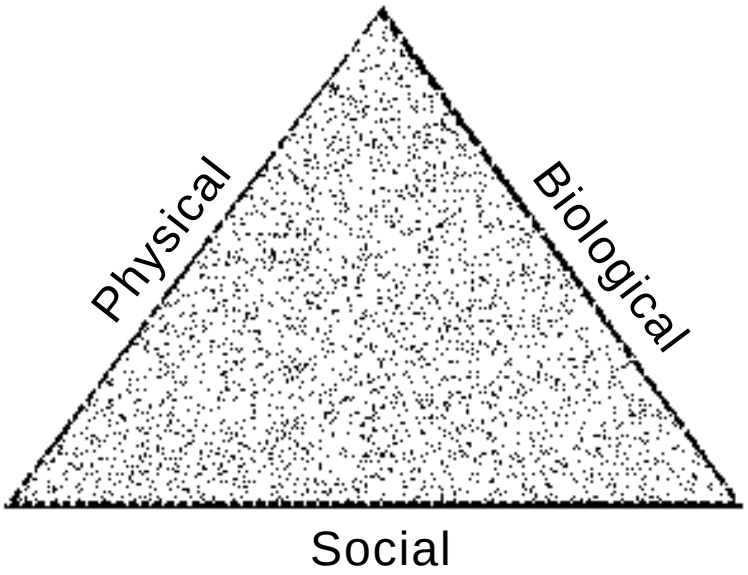
Six broad categories of social science research, developed by national and international committees since 1990, provided a foundation for the conference. A white paper (Carr et al. 1995, see Appendix A) describing the Forest Service's current social science research and future research needs was distributed prior to the conference and served as a reference point for discussions. Building on the white paper, conference participants generated a list of possible topics for future research.

At the outset, participants emphasized the need for NGCP to support and conduct two types of research:

- **The collection of baseline social science data for policy and management decisionmaking**



Human dimensions research should include collection of baseline social science data.



Human dimensions research should integrate social, physical, and biological information.

- **The integration of information on social, physical, and biological systems**

Within this framework, the group suggested six broad research categories with examples of topics relevant to northern forests, shown in the synthesis that follows.

Policy and Management

Research on policy and management would examine the evolution of laws, policies, and management institutions and their response to social and environmental change. Potential topics within this area include:

- **Social impacts of forest management.** Forest management affects social as well as biological systems. This research should identify and evaluate the social impacts of management actions taken as a result of changing forest environments.

- **Social impacts of environmental changes.** The effects of environmental changes are not uniform throughout society or over time. The agency needs to know what these differential effects are and how various social groups will be affected by changes in forested environments and management responses to them in both the near and distant future.

- **Triggers to action on environmental change.** Many scientists predict extensive changes in forested ecosystems as a result of global environmental change. Where these involve undesirable effects such as extensive mortality, we can expect people to call for or take action. Research should address the types of changes that will trigger action and ways of anticipating these demands.

- **Unintended consequences of policy.** Forest management policies often have social and biological effects not anticipated in the original planning process. There is a need to study the likely secondary consequences of policy responses to changing forest environments for both stakeholders and ecological processes.

- **Opportunity costs of policy and management options**. Policy and management decisions have both short-term and long-term effects. We must understand how decisions made in response to changing forest ecosystems will affect future options.

- **Role of conflict in forest management.** Forest management has long tried to satisfy conflicting and mutually exclusive objectives, and global environmental change is likely to provoke new

controversies. Research is needed to identify how conflict shapes management policy and its results for forested ecosystems.

- **Ecological and social effects of conflicting policies and goals.** Policies and goals formulated in separate contexts are often in conflict. There may be, for example, an apparent contradiction between the goals of one program that plants trees to sequester carbon and another that burns trees to restore grassland ecosystems. Research is needed to identify potential conflicts in policies designed to respond to changing forested ecosystems.

- **Forest Service and public interactions.** The Forest Service and the public interact and communicate through a variety of modes including ranger-visitor contacts, public meetings, and written material. Research is needed to determine what types of information exchanges are characteristic of these interactions and how these exchanges affect public attitudes and agency responsiveness in a changing environment.

- **Alternatives to face-to-face exchange.** Forests are increasingly viewed as national and international patrimony as well as local and regional resources. With stakeholders in dispersed and often distant locations, face-to-face exchanges with managers and policymakers are clearly impossible. New technologies should be explored for their potential capacity to overcome these limitations and enhance information exchange.

- **Urban forest stakeholders.** Urban residents have a stake in the tree-covered landscapes —traditional forests, parklands, greenspaces— of both cities and rural areas. For urban and urbanizing landscapes, research needs to determine how these stakes will be affected by environmental change and policy responses.

- **New institutional forms.** Existing institutions and organizations may not be capable of meeting the challenges of changing forest environments. There is a need for research on new institutional and organizational forms to meet the challenges of changing forests and their effects at all scales— from individual to international.

- **Resilience.** Individuals, institutions, and ecosystems have varying abilities to adapt to change. Research on this topic would address the resilience of social and biological systems at varying scales and how these interact.

Perceptions and Behaviors

Because perceptions and behaviors have a profound impact on human-environment interactions, it is important that we understand past and present attitudes toward environmental change, cultural knowledge of the environment, the relationship between individual and collective behavior, and historic adaptation to environmental stress. Research topics in this area could include:

- **Models of knowledge transfer.** There are at least three models for transferring knowledge between institutions and communities: 1) institution to community through institutional agents, 2) institution to community through community leaders, and 3) community to institution through community organizations or individuals. Studies of the effects and effectiveness of each model are needed to determine what types of knowledge transfer will be most useful in adapting to environmental stress and change.

- **Relationships among values, beliefs, perceptions, and behaviors.** The interplay between humans' values, beliefs, perceptions, and behaviors is complex and defies simple categorization. These relationships, however, form the social context within which decisions about changing forests will be made. Research is needed to further our understanding of the ways in which values, beliefs, perceptions, and behaviors interact and their effects on policy and management.

- **Impact of people on forests.** Human actions have shaped forested ecosystems for centuries and will continue to do so in a changing environment. Research on the historical impacts of people on forests will assist scientists and managers in projecting future impacts during global change.

- **Relationship of infrastructure and behaviors in forests.** Transportation networks, recreational facilities, and other amenities affect human behaviors in forests by providing access and promoting particular activities. How existing infrastructure and attendant behaviors will be affected by environmental change and how infrastructure will need to be modified because of a changed forest landscape must be studied.

- **Mechanisms for changing behavior in forests.** Changing forest environments may require changes in human behavior. We need to know the relative effects and effectiveness of education, regulation, economic incentives, and other mechanisms to promote desired behaviors.

- **Characterizing landscape transformation and human response.** Forested landscapes can be expected to undergo significant changes with global environmental change. There is a need for research to answer the following: How can these transformations be characterized? Can human responses to changing forest landscapes be similarly characterized?

- **Differential impacts of behavior on forests.** The effects of industrial, governmental, and individual actions on forests can vary widely. Equitable and efficient management requires an enhanced understanding of power, control, and access and how these correlate with environmental impacts.

- **Effects of institutional behavior on individuals.** Individuals are influenced by the institutions and organizations to which they belong. Research in this area should address the ways in which organizations such as the Forest Service and timber industry affect the responses of their employees and others to changing forest environments.

- **Individual perceptions of and behaviors related to the future.** There are a variety of ways to theorize individual perceptions of and behaviors related to the future. Additional research is needed on concepts such as altruism and discounting and how these may assist in anticipating and planning for the future of forested ecosystems.

- **Individual perceptions of institutional power to intervene.** Perceptions condition what individuals feel an organization can, will, and should do. Studies in this topic area should address the ways that public trust and expectations shape the social context within which decisions regarding changing forested landscapes must be made.

Valuation

This research area encompasses the costs and benefits of specific courses of action and the study of how humans value the environment and the consequences of environmental change. Examples of the topics and questions that might be addressed include:

- **Identifying stakeholders and their values.** From individuals to organizations, people have a wide variety of expectations about and hold many different values for forested landscapes. The full range of stakeholders and their values must be identified, defined, and classified. Research must also examine the potential effect of global environmental change on these stakeholders and values.

- **Distributional implications of costs and benefits**. The costs and benefits of management policies in a changing environment will not be evenly distributed. Sound decisionmaking will require an understanding of who benefits from management responses to global environmental change and who pays the costs.

- **Risk assessment.** People are often unaware of risks to themselves and their property by their actions in forested landscapes. As the environment changes, these risks may vary. We must develop methods to analyze and quantify these risks to understand future impacts, trends, and vulnerabilities. In addition, scientists must study forest residents' and visitors' perceptions of risk and their priorities for and willingness to pay for reducing risk.

- **Risk communication.** Once both actual risks are assessed and perceptions concerning risk and risk abatement are known, prevention specialists can target programs to help residents and visitors mitigate hazards and/or reduce potential threats to property and safety. Research can help in the development of optimal ways to communicate risk as the environment changes.

- **Identifying and quantifying winners, losers, and tradeoffs of management and policy options**. As forests respond to global environmental change, many difficult management decisions will have to be made. Managers will need a full understanding of the winners, losers, and tradeoffs implied by their decisions.

- **Social processes to discover values and promote productive exchanges.** Changing environmental conditions will lead to new sets of complementary and competing demands from forests. Effective and equitable management will require the development of methods to discover and accommodate the full range of human values for forests, to avoid unnecessary conflicts, and to foster productive communities.

- **Feedback mechanisms.** Values and policies will change in response to changes in forested ecosystems. Managers and policymakers will need information on how these factors interact and produce new contexts for decisionmaking.

- **Balance of power between stakeholders and value systems.** Power and social relationships between stakeholders are often expressed as competing value systems. Managers and policymakers must have information on these dynamics in order to make effective and equitable decisions in a changing environment.

- **Relationships among supply, demand, markets, and values.** Forest values are affected by supply, demand, and market conditions. Research is needed to provide a better understanding of these interactions.

- **Environmental costs and benefits of policy and management actions.** Policy and management actions in response to global environmental change may have environmental costs as well as benefits. Research is needed to identify these tradeoffs.

- **Identifying mute stakeholders.** Not all stakeholders in wildland areas can or will speak for themselves, yet they should not be overlooked in the decisionmaking process. Research must assist in the identification of mute stakeholders such as future generations, individuals who do not commonly participate in review processes, and sacred sites.

- **Sources of environmental values.** Environmental values have many sources including humans' everyday experiences, community norms, and educational influences. Research is needed to identify these sources and their implications for management and policy in changing forest ecosystems.

- **Methods of valuing environmental characteristics, commodities, and/or resources.** Environmental characteristics, commodities, and resources may be valued differently at various times and places. Managers and policymakers need methods to identify and assess stakeholder values in particular circumstances.

Components of values derived from ecosystems

Environment - Culture - Technology Systems

Research in this area examines such issues as the historical social response to environmental and technological changes and the development of technologies to exploit resources valued by particular cultures. Topics appropriate to forested ecosystems include:

- **Technology diffusion.** Technologies—from timber harvesting and processing machinery to recreational equipment—affect forest use and ecosystem characteristics. Research should examine the way that forest technologies spread and are adopted and the resulting effects on social and biological systems.

- **Social impacts of management to address industrially-generated concerns.** Management practices adopted in response to industrially-generated impacts such as increased greenhouse gases will impact individuals and social groups as well as forested ecosystems. Research is needed to identify these impacts so that they can be factored into the decisionmaking process.

- **Forest products technologies.** Technologies such as recycling and biomass production affect forested ecosystems and human uses. Research is needed to better understand this interaction and anticipate the effects and responses of changing forested landscapes.

- **Technological forecasting.** Technologies affect forested ecosystems and their uses. Managers need information that will help them anticipate the development of technologies and their impacts on forests.

- **Effects of transportation technologies and networks on forest uses and ecosystem characteristics.** Transportation systems have long been recognized as a principal determinant of forest characteristics and uses. Information on potential interactions of new transportation technologies and networks and changing forested ecosystems will be needed for effective management and policymaking.

- **Proactive marketing of environmental technologies and management.** Environmental technologies and management need not be purely reactive. Research could be instrumental in developing and promoting new technologies and management strategies that would prevent environmental problems as well as respond to them.

- **Impact of technologies on management options.** The availability of technology influences management choices and will affect our ability to adapt to and mitigate changes in forest ecosystems. Research is needed to examine how technologies impact our flexibility for adaptation and mitigation.

- **Ecosystem restoration.** Changing forested landscapes are likely to lead to calls for increased ecosystem restoration. Research should examine the social values expressed in such restoration projects and their social impacts in conjunction with their biological ramifications.

- **Role of forests in historical evolutionary processes.** Forests have played a key role in the evolution of both biological species and social structures. Research on historical processes will contribute to our ability to anticipate future conditions.

- **Mapping uses and ecological characteristics.** Maps of uses and ecological characteristics may reveal information on changing social and biological dimensions of forested landscapes that would otherwise be missed. Research should explore the potential uses of maps in analyzing medium- to large-scale processes and building management practices.

- **Effect of technology on forests and cultures.** Technology affects such forest-community relations as the number of people making a living in forest-product-related activities and regulation of access to forested landscapes. Research should examine historic and contemporary forest-technology-community interactions and seek to anticipate how these will be impacted by global environmental changes.

- **Technology and social constructions of natural resources.** A biological or physical substance becomes a natural resource only when it has some human use. Research is needed to understand the role of technology in converting such things as previously unmarketable trees and slash into commodities. Once this role is understood, research is also needed to determine attendant social impacts of these technologies.

- **Social constructions of forest meaning and their effects on uses.** At various places and times, forests have been conceived of as dark and threatening places, as inexhaustible material resources, and as spiritual refuges. Each of these concepts dictates a range of acceptable and unacceptable human uses that affects forest management. Research is needed to understand social constructions of forest meaning, how they are influenced by global environmental change, and their implications for future management options.

- **Social constructions of forest systems in urban areas.** Because of the nature and size of our urban populations, a majority of forest values is, in fact, formed in urban environments. Thus, management would be enhanced by research on the conceptions and values concerning forests held by diverse cultural groups in both cities and rural areas. In addition, research is needed concerning the role of natural systems in urban culture and society.

- **Social constructions of human impacts on ecosystems.** Just as social concepts are fundamental to the way we define forests and natural resources, they are also basic to our perceptions of the impact of human actions on forested ecosystems. Whether a human action is identified as beneficial, neutral, or negative or whether it is recognized at all may be as much a function of social construction as actual environmental impact. Because many forest management decisions hinge on assessments of the impact of human actions on ecosystems, global change research must include studies of these concepts and their effects.

- **Correlating historical social constructions of nature with ecosystem structure and function.** An increased understanding of the correlation between historical social concepts of nature, population trends, and historical ecosystem structures and functions would be valuable in anticipating future forest concepts and conditions. Research on this subject should examine social constructions of nature and their relationships to ecosystem conditions at a variety of times and places.

Population Trends and Resource Use

Research in this category emphasizes the size and distribution of human populations over time and how they use natural resources. Resource-use studies would be both historical and contemporary and would include social institutions and technological development. Topics might include:

- **Trends in human uses of forests and their effects on ecosystems.** Changing trends in humans' uses of forests, including such activities as commercial mushroom and ginseng extraction,

have a largely unexamined effect on forested ecosystems. Research is needed to identify these trends and anticipate their interactions with global environmental changes.

- **Population trends, expectations, and desires for forest use.** Changes in such population dynamics as age, ethnicity, and educational background contribute to changes in expectations and desires for forest use. Managers need information on how populations are changing and how these will interact with changing forested ecosystems.

- **Effects of human migration on forest use.** Migration into forested areas brings with it an infusion of new values, behaviors, and constructions of nature. Because both international and intranational migration is expected to increase with global environmental change, managers must have information on how this will affect the social context within which they must make decisions.

Social Structures and Institutions

This area focuses on relationships among social structures, institutions, and the environment at scales from local to international. Among the particular items it addresses are political systems and institutions ranging from the family to national governments; systems of production and consumption; and historical treatment of common resources. Topics for Northern Global Change Program research include:

- **Impact of the Forest Service and other organizations on forests.** Policy and management actions of organizations such as the Forest Service have been key forces shaping forested ecosystems. The effectiveness of future policies would be enhanced by a deeper understanding of the historical and projected impacts of organizational behavior on forests.

- **Social movements and their impacts on forests and policy.** Social groups such as the "wise use" and "deep ecology" movements exert powerful and often conflicting demands on forest management policy. Research is needed to illuminate how they arise, are structured, and will affect debates about changing forest ecosystems.

- **Role of National Forests in global environmental change.** With 191 million acres of forests and grasslands, National Forests have the potential to play an important role in responding to global environmental change. Research is needed to identify effective and appropriate roles for the Forest Service in regional, national, and international mitigation and adaptation strategies.

- **Social structures and issues.** Social structures and critical issues vary from forest to forest and region to region. Research is needed to identify and compare these structures and issues at local and regional levels.

- **Forests and changes in economic structures.** Northern forests will affect and be affected by changes in global ecosystems, national and global environmental regulation, and industrial restructuring. Research is needed to anticipate the impact of these changes on both social and biological environments.

- **Social impacts of changing disturbance patterns.** Research to date predicts that global environmental change will cause changes in forest disturbance patterns such as fire and insect outbreaks. Research is needed to identify and anticipate the social impacts of these changes.

Participants in the Cambridge Conference

"Humans, Forests, and Global Environmental Change:
Planning a Social Science Research Agenda"
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Pittsburgh Recommendations and Research Questions

On March 14-16 in Pittsburgh at a meeting of the Northern Global Change Program (NGCP), another group of individuals interested in the human dimensions of global change research met. The group at Pittsburgh built on the results from the "Humans, Forests, and Global Environmental Change: Planning a Social Science Research Agenda" conference held at Harvard University's JFK School of Government to develop and prioritize researchable questions appropriate to the scope and intent of the NGCP.

Pittsburgh participants underscored the earlier group's recommendation that the NGCP support both the collection of baseline social science data and research that integrates information on social, physical, and biological systems. They further suggested that research should address a variety of social scales in both urban and rural forests. Using the topics generated at Harvard, they suggested minor changes to the research categories and two to four researchable questions in each:

Behaviors and Demography

1. What are the effects of human actions on forested ecosystems?

2. How do demographic trends affect forest use?

Social Impacts of Forest Ecosystem Management and Policy

l. What are the intended and unintended consequences of management and policy?

2. What are the differential effects of forest management actions and environmental changes across social groups and time?

3. What methods can be used to evaluate social impacts of changes in forested ecosystems?

Technology

1. How do various technologies affect the ways people use forests?

2. How will changes in forested ecosystems affect technologies?

Human Response Thresholds to Environmental Changes

1. What triggers human responses to changes in forested ecosystems?

2. How do people respond to changes in forested ecosystems?

Stakes and Stakeholders

1. Who are the relevant stakeholders and communities of interest at various scales?

2. What are the tradeoffs among benefits and costs of management and policy options for various stakeholders?

3. What methods can be used to identify stakeholders and communities of interest at various scales?

4. What methods can be used to identify and evaluate tradeoffs among benefits and costs of management and policy options for various stakeholders?

Values and Social Constructions

1. What are the sources of environmental values?

2. What are the interactions between environmental values and changes in forested ecosystems?

3. How do social constructions of the relationships between nature and humans affect options for responding to change in forested ecosystems and landscapes?

4. What are the relationships among values, beliefs, perceptions, and behaviors?

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Humans, Forests, and Global Environmental Change: Continued Planning for a Social Science Research Agenda
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March 15-16, 1995
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Appendix A

Human Dimensions of Global Change Research Within the USDA Forest Service*

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> "Concern for [humans] and [their] fate must always form the chief interest of all technical endeavors...Never forget this in the midst of your diagrams and equations."
>
> Albert Einstein 1931

Introduction

The Forest Service, the largest agency in the U.S. Department of Agriculture, provides leadership in the management, protection, and use of 191-million acres of the Nation's forests and grasslands. With 156 national forests and 19 grasslands in 42 states and Puerto Rico, the agency acts as a steward to a wide range of ecosystems from ice caps and boreal rain forests in Alaska to sub-tropical forests in Puerto Rico, and from the eastern hardwood forests of the Northeast to the chaparral and desert areas of the Southwest. The agency operates under the conditions of multiple use, providing sustained yields of renewable resources such as water, forage, wildlife, wood, and recreation. It is committed to the preservation of wilderness, biodiversity, and landscape beauty as well as the protection of the basic resources of soil, water, and air quality in its management of these lands.

As the largest forestry research organization in existence, the mission of Forest Service Research is to serve society by developing and communicating the scientific information and technology needed to protect, manage, and use the natural resources of forests and grasslands. It has and will continue to provide the scientific basis for the formulation of sound policies that balance societal needs with environmental concerns.

The Forest Service Global Change Research Program (FSGCRP), conducted under the auspices of the U.S. Global Change Research Program, is designed to provide a sound scientific basis for making regional, national, and international management and policy decisions regarding forest ecosystems in a context of global change. The study of global change includes climate change issues as well as a variety of other challenges related to forest and rangeland ecosystems such as changing land use patterns and loss of biodiversity. The FSGCRP consists of four focus areas:

1) Atmosphere/Biosphere Gas and Energy Exchange Research, which examines the way in which climate and atmospheric chemistry shape and are shaped by the biological world;

2) Disturbance Ecology Research, which examines how fire, insect, and disease disturbances affect the health and productivity of ecosystems;

3) Ecosystem Dynamics Research, which focuses on the response of terrestrial and aquatic ecosystems to global change; and

4) Human Activities and Natural Resource Interaction Research, which focuses on the ways in which global change affects human activities and how human activities affect global change.

Setting the context for discussing current and future research under the human activities and interaction program element requires an exploration of both why a federal land management agency is concerned with human issues as well as what the agency's unique qualifications are for pursuing human dimensions of global change research.

The Forest Service has long been guided by a mission of caring for the land and serving the people. This mission establishes the centrality of the role of people in the agency's concerns. Historically, the focus has been on serving the commodity or resource utilization needs of the American public. As the scope and complexity of natural resource issues facing the Forest Service have grown and diversified, so too has the definition of serving the American public. People are now seen as an "important part of all ecosystems and societal processes as important ecosystem mechanisms" (Bormann et al. 1993). "Forests are social as well as biological systems" (National Research Council 1990). Under this evolving perspective, serving people requires a "better integration of knowledge of behavioral science and social-cultural systems into biological conceptions of forests" (National Research Council 1990). Clearly, as the agency conducts research to address the policy and management implications of global change, it must focus on physical, biological, and human dimensions.

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*From the 1995 Preprint Volume of the 6th Symposium on Global Change Studies. Boston, MA: American Meteorological Society: 49-53.

The Forest Service's mission also points to the agency's unique qualifications to pursue human dimensions of global change research. The Forest Service established a strong social science program based on its long-standing commitment to serving the American public and its commitment to scientifically-based management of lands. The social science research program, consisting of diverse disciplinary, subject matter, and geographic expertise is supported by an infrastructure available to the entire research organization. This is exemplified by research labs located on college campuses throughout the United States. Because they serve a land management organization and its constituents, the agency's social scientists are highly experienced in addressing the human dimensions of a variety of environmentally-based issues and questions.

Lastly, and perhaps most importantly, the agency's substantial land base provides the linkage between large-scale, ecosystem dynamics and change and people. For example, natural scientists are now able to assemble information about the relationship of humans to the earth—95 percent of the earth consists of human-adapted ecosystems; non-renewable energy supplies 80 percent of human energy needs; and 40 percent of the earth's net primary production is being consumed by humans (Renn, 1994). How do we begin to understand these figures and their significance for human survival and quality of life? For ecological sustainability? It is only through our connection to the land base that we can understand and explore the effects of these conditions. Forests and grasslands, for example, are among the most productive ecosystems in the world. They are also human-adapted ecosystems. Questions of whether a forest's resiliency is impacted (either positively or negatively) by human-adaptation are central to understanding how a system will respond to changing environmental conditions as well as how human welfare may be impacted. Clearly, the 191-million acres managed by the Forest Service provide ample opportunity to explore in detail the relationship between global change and humans.

Global change research within the Forest Service is conducted in four regional research programs: the Northern, Southern, Interior West, and Pacific programs. A description of current human dimensions research within these programs provides further examples of how the Agency's tie to the land base facilitates an understanding of the relationship between large-scale global change and humans, as well as setting the stage for a discussion of future research needs.

Current Research

In the southern U.S., researchers are attempting to link climate projections with forest biology models and these, in turn, with economic models in order to determine how human welfare will be affected if global climate change alters the productivity of forests in the southeastern U.S. Studies include:

- Modeling the economic impacts of potential climate change scenarios on southern commercial forest inventories, using different modeling approaches.

- Examining non-market impacts by exploring the effects of global change on aesthetic forest resources.

- From a broad, philosophical perspective, exploring the suitability of existing economic criteria for assessing global change damage to forests.

In the northern U.S., scientists are trying to understand the effects of land use and management intensity on regional carbon dynamics. The history of land use in the North is an important determinant of recent and projected changes in carbon storage, especially in the soil. Most current forests have had some history of intensive agriculture or logging, and these intensive disturbances have long-lasting effects on carbon dynamics. The northern landscape continues to change as population increases in rural areas, farmland continues to revert to forest, and forest use shifts to recreation and other non-timber activities.

The Forest Service initiated a series of studies to quantify how carbon in forested landscapes changes over time. Attempts to quantify the role of northern forests in the global carbon cycle and to understand the effects of alternative management activities on carbon storage have been hampered by a lack of quantitative information; these studies are intended to fill this knowledge gap.

In the Rocky Mountain West, Forest Service scientists and their cooperators are assessing the impacts of humans on ecosystems and landscapes and evaluating management options (economically, ecologically, and socially) to maximize the possibility of sustaining both the human population and ecosystems.

Research underway includes:

- Assessing the impacts of ecosystem management policies and practices on economic stability and development.

- Improving understanding of the environmental history of the Rio Grande Basin, the historic and contemporary human role in basin ecosystems, the nature and extent of anthropogenic disturbances to the basin, and the sustainability of cultural diversity.

- Synthesizing literature on suburban and rural land-use change in a wildland setting to produce a scheme for classifying human development near forests based on density and type of development.

The Forest Service is also working in partnership with the Terrestrial Ecosystems Regional Research and Analysis (TERRA) Laboratory to:

- Develop an initial understanding of the social forces affecting land owners' land-use decisions in northeastern Colorado.

- Determine the relative significance of enterprise, socio-cultural, and political-economic factors needed for an economic model that, in turn, is linked to an ecological model. Linking social and ecological models will enable examination of both social and ecological causes and responses to environmental change and extrapolation of the effects of those changes and responses.

This partnership represents an initial attempt to link land-use patterns, driven by a variety of social causes, to land-cover changes that affect biodiversity, water and radiation budgets, trace-gas emissions and other factors that, cumulatively, affect global climate and the biosphere. This work is a critical step in developing an understanding of how humans influence global climate and what might be done to mitigate their adverse impacts.

Future Research

The agency's current human dimensions of global change research program provides an excellent starting point for understanding and exploring the relationship between global change and humans. If, however, research is to provide a comprehensive, timely, and policy-relevant body of information in this area, additional research is necessary. As the Forest Service seeks to further develop its human dimensions research program, several items must be addressed—including what the agency's opportunities are, future research needs identified by other organizations, and constraints to further development.

Opportunities—Timing is perhaps the greatest opportunity presented to the Forest Service's social science research program. Throughout the environmental and natural resource communities, the centrality of people to understanding and addressing current natural resource issues is widely documented (c.f., National Research Council 1990; Society of American Foresters 1993; Consortium for International Earth Science Information 1992). Support for increased attention to the human dimensions of global change comes from a variety of sources ranging from the current administration and Congress to the National Academy of Sciences and National Center for Atmospheric Research. Many policymakers and managers have arrived at a point of understanding the importance of human dimensions research. The Forest Service's adoption two years ago of an ecosystem-based management policy with its emphasis on a long-term, large-scale, interdisciplinary approach to land stewardship provides an ample opportunity for an even stronger tie between the agency's mission and human dimensions of global change research program.

Research Needs—Many organizations have turned their attention to developing research agendas for future human dimensions research of global change**. A survey of these existing research agendas reveals six broad categories of social science research topics necessary to address human dimensions concerns. These six areas of research can act as both a tool for evaluating the FSGCRP and as building blocks for consideration of future directions for the program.

1) Population Trends and Resource Use: Proposals for research in this area address the size and social structure of human populations, their distribution, and land-use strategies. Critical population characteristics include gender and age distribution, workforce participation, fertility rates, and migration. Recommended land-use studies would be historic and contemporary and would address both social institutions and technological development. Research on qualitative variables and feedbacks of population, environmental systems, and economic systems is also proposed. FSGCRP funds are supporting related research on land use in the Rocky Mountain region. Efforts are also underway to incorporate sociocultural and

** The International Social Science Council Standing Committee on the Human Dimensions of Global Change (ISSC) (Jacobson and Price, 1990), the National Research Council's Committee on Global Change (NRC CGC, 1990), the National Center for Atmospheric Research's Environmental and Societal Impacts Group (ESIG) (Price, 1990), the NRC's Committee on the Human Dimensions of Global Environmental Change (NRC HDGEC) (Stern, Young, and Druckman, 1992), the Consortium for International Earth Science Information Network's Human Interactions Working Group (CIESIN, 1992) and the U.S. federal government's Subcommittee on Global Change Research (SGCR, 1994).

political factors into an economic model and link it with an ecological model.

2) **Perceptions and Behaviors:** Whether individual or collective, the proposed research agendas recognize that perceptions and behaviors have a profound impact on human-environment interactions. Recommended areas of study include past and present attitudes toward environmental change, cultural knowledge of the environment, the relationship between individual and collective behavior, and historic adaptation to environmental stress. At present, FSGCRP research on these topics is evaluating frameworks for understanding adaptive cultural change.

3) **Social Structures and Institutions, Including Economic and Political Systems:** This area focuses on relationships between social structures, institutions, and the environment at scales from local to national. Among the particular items it addresses are political systems and institutions ranging from the family to national governments; systems of production and consumption; and historic treatment of common resources. FSGCRP research in this area includes efforts to understand the social forces affecting land-use decisions in northeastern Colorado and the historic and contemporary role of humans in the Rio Grande Basin.

4) **Environment - Culture - Technology Systems:** Research in this area examines such issues as the historic social response to environmental and technological changes and the development of technologies to exploit resources valued by particular cultures. Special considerations include energy intensity and factors of production and technology such as labor, land, capital, and raw material. While the FSGCRP funds research on forest ecosystems and management technologies, it does not presently support any studies on the relationships between environment, culture, and technology.

5) **Valuation:** The proposed research on valuation encompasses the costs and benefits of prospective courses of action as well as valuing the consequences of environmental change. Particular emphasis is placed on valuing consequences not well reflected in market prices—social, cultural, political, and environmental at scales from the individual to the international. FSGCRP research in the southern states examines the effects of global change on aesthetic forest resources and the philosophical bases of current economic criteria for assessing global change damage to forests.

6) **Policy and Management:** Proposed basic policy and management research would address issues such as the evolution of laws, policies, and management institutions in response to social or environmental change. Specific policy questions identified by the various agendas include: effects of large-scale, debt-for nature swaps; effects of political and economic liberalization on the use of environmental goods; and mechanisms to build an international coalition for stabilization of greenhouse gas concentrations. The FSGCRP conducts research in this area with particular focus on strategies for carbon sequestration and forest management effects on economic stability.

Constraints—Finally, while opportunities and information needs are great, the challenges facing further development of the human dimensions of global change research program cannot be ignored. Four challenges face the agency:

1) Support for human dimensions research within and outside the agency is growing, but much work needs to be done, within the Forest Service at least, to carefully identify what and how the social sciences can contribute policy-relevant information about global change.

2) With the limited resources available and the burgeoning need for social science research, Forest Service Research needs to carefully define its niche in the broader scientific community, e.g., what social science research is it uniquely capable of doing? What research should the agency choose to do and not do and why? Answers to these questions will allow the agency to better focus its resources and select those research problems it is best suited to answer.

3) The agency needs to enhance its visibility and participation in the larger social sciences community to increase awareness of the skills and research products we have to offer as well as increase our knowledge about what others have to offer and to work in unison with other scientists pursuing human dimensions of global change research.

4) The Forest Service needs to discover how and in what ways we can facilitate the integration of social and natural sciences within the agency. We also need to enhance research and management collaboration in order to devise processes and policies that better integrate the views and needs of diverse publics into the solutions and future conditions found on the landscape.

Conclusion

The need for timely, comprehensive, policy-relevant research on the human dimensions of global change presents both opportunities and challenges to the Forest Service. The Agency's tie to the land base and its existing social science research program provide unique qualifications for addressing human dimensions issues. It is only by reaching out and joining forces with the larger social and natural sciences communities that these opportunities can be capitalized upon and challenges overcome.

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Appendix B

Facts, Values, and the Human Dimensions of Global Change

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At a recent meeting of the American Fisheries Society in Halifax, one keynote speaker took the scientists in the audience to task. The fishery off the banks of Nova Scotia and Newfoundland is functionally dead, he claimed, with the result that unemployment is running at 11 percent in Halifax, 20 percent in Nova Scotia as a whole, while in Newfoundland an astonishing 80 percent of all jobs are in the public sector. The speaker blamed the scientists for this situation. He argued that the scientists had seen this coming but had failed to speak out—they developed their facts, wrote their reports, published in their obscure refereed journals, but failed to speak out in any meaningful way. In the halls, the scientists demurred: "That's not our job," they claimed. "We stick to the facts. It's the managers and politicians who have to deal with real world actions."

Blame is not the crucial issue here—in a situation like this there is ample blame to go around. There is, however, a clear communication problem. While this problem may have various sources, I believe that one major source has to do with the uneasy relationship that exists between facts and values, between science and policy. Facts and values are often thought to be antithetical. Objective facts lie at the very heart of science, and scientists are often trained to deliberately exclude values in their pursuit of facts. Policy issues, on the other hand, tend to be more concerned with matters of value, so that many scientists can feel quite uncomfortable dealing with them. With facts, for example, we can describe the structure and function of an ecosystem in detail. But what are we to do when faced with questions not about structure and function, but about policy issues: e.g., Should it be left wild, managed to provide specific benefits, or turned into a shopping mall? These are not questions of fact but questions of value, and this is what makes them human dimensions questions. To understand the human dimensions of global change, we need to understand the nature of both facts and values as well as the relationship between them.

Facts are objective; that is, they inhere in the object and are considered to be independent of any particular observer. Your desk, for example, can be described objectively with certain facts—length, width, height, number of drawers, and the like. Assuming we agree on measurement, these facts are properties of the object that remain unchanged no matter who is sitting at it. But whether or not it is a good desk depends upon its relationship to you. That is, your desk is good or bad depending on the needs, requirements, plans, or goals of the person who is sitting at it. And this sort of value relationship can change across people. More technically, values are subjective, specifying the unique relationship between a person (the subject) and a particular object (More et al. 1995).

During most of the 20th century, the natural resource professions have prided themselves on their scientific (i.e., factual) basis. Values, with the possible exception of economic values, have been left to shift for themselves, receiving implicit rather than explicit consideration in most resource decisions. And yet it is values that constitute the essence of the human dimension. This was made clear to me once when I listened to a debate about daylight savings time. At any particular location on any given date, the length of the day is fixed. That is a simple, immutable fact. But there are some people—golf course owners, many retailers, etc.—who benefit from having daylight extend further into the evening. Others such as theater owners and restauranteurs would like to see the evening begin sooner. In this case, the fact—total daylight—is fixed, but the values are to be argued over; it is the values that set the facts spinning, that give them their human meaning. Much the same will be true in global change research. The facts themselves will be neutral, but their meanings will be charged differently for different sets of people with competing goals and values. When a new species invades an area, for example, there may be some people who find the change desirable (given their goals and objectives), while others (with different goals and objectives) will find it undesirable. Part of the essence of human dimensions research will be to understand the relationship of the global changes that are occurring to the goals and objectives of different kinds of people.

The relationship between facts and values is particularly tricky because it impacts management issues and decisionmaking. In natural resources, we often call for more facts in hopes that greater knowledge will make it more clear what we ought to do. Yet this is never really the case. It was David Hume, the great Scottish philosopher, who, in modern times, first pointed out that facts themselves never define values. What Hume noticed in the writings of his 18th century contemporaries was a tendency to make a subtle, almost imperceptible shift from "is" statements (facts) to "ought" statements (values). That is, Hume would note someone

describing a situation in factual terms and then gradually shifting into value terms to specify what ought to be done. Hume questioned this shift, arguing that the values (oughts) had a different origin from the facts. His conclusion has held up to the present day: Under standard systems of logic, you cannot derive values from facts. In other words, facts alone never tell us what we ought to do. The "ought" derives from considering the facts in the light of human goals and objectives.

What this suggests is that we must begin to work with values more explicitly. Values may be defined, at least informally, as criteria or standards that we use to make decisions (More, et al. 1995). The category of value that many of us are the most familiar with (at least on a professional level) is economic value. Economic values are clearly important in our society, providing the basis for the exchange of most goods and services. There are, however, decisions to be made that have little to do with economic issues and require other sorts of values. For example, we often have to decide about means and ends, about the validity of an idea, or about the beauty of a painting or landscape. Such decisions are based upon values other than economic values. One classification of values includes rational values, moral values, aesthetic values, economic values, and spiritual values. Put simply, rational values are the standards by which we judge truth, moral values are standards for conduct, aesthetic values are standards for appreciation, economic values are standards for choice among goods and services, and spiritual values are standards for meaning. Each of these values can be expected to play an important role in determining human response to changing global conditions. And this generates a whole host of human dimensions questions. For example, with most management decisions there will be winners and losers. We must be concerned with establishing policies and solutions that are not only biologically consistent, but which are also just and fair, both in the present and for future generations. We need to understand who reaps the benefits and who pays the costs. To answer these and other human dimensions questions, we will need facts. But we will also need more. The facts will require sophisticated interpretation in the context of human values and goals. For example, is carbon retention good or bad? What about methane production at given levels? These kinds of value questions tend to make scientists quite uncomfortable. Yet this kind of information is essential for us to reach management decisions. What is truly necessary, then, is an interdisciplinary approach to global change research—we must begin to talk together much more than we have in the past.

In this paper, I have been primarily concerned with evaluating the effects of global change on people. But the situation is really much more complex than this. In addition to being impacted by global change, humans are causal agents as well. We stand linked to the world by our values. The same values determine not only how we respond to change, but how we act upon it as well. In a world approaching 10 billion people (Kennedy 1993), we can no longer afford to separate science and values. We do not need any more dead fisheries.

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Presents conclusions and recommendations from two meetings convened by the USDA Forest Service's Northern Global Change Program (NGCP). The Cambridge conference entitled "Humans, Forests, and Global Environmental Change: Planning a Social Science Research Agenda" was held at Harvard University's John F. Kennedy School of Government, February 27 - March 1, 1995. Results of the Cambridge conference were presented at a NGCP review in Pittsburgh, Pennsylvania, on March 14-16, 1995.

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