Future Trends Series - GR:EEN Project

Title of the report

Foresight Analysis

Area

Science & Technology

Reporter

International Council for Science (ICSU)

Type of the Reporter

Non-Governmental Organisation

Periodically updated?

No

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2004

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2004

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Language available

English

Short summary

This report provides examples of key scientific developments and future challenges for the research community around the following topics: "i. Emerging' areas of science that are rapidly developing and promise to offer important opportunities for new understanding and application (nanotechnology, molecular biosciences, natural and man-made hazards, complex systems science, cognitive neurosciences). ii. Integrated studies of the interactions between human activity and the natural environment (global change and sustainable development), including several specific sectors of longstanding concern (water, energy, health, agriculture, and biodiversity). iii. Cross-cutting issues of interest to all fields of science (data and information; capacity building and investment in basic science; science, ethics, and society)." The report also attempts to evaluate the potential roles of ICSU in addressing these challenges.

Key trends

• "Assuring an equitable, sustainable, and healthy food supply for the world's growing population is a complex challenge that involves problems ranging from chronic malnutrition to epidemic obesity."

• "Developing sound policy strategies for the 21st century will require anticipating future changes in demographics patterns, human preferences, global/regional climate conditions, and a host of other factors."

• "Some of the exciting scientific and technical advances related to protection of human health that can be expected in the coming years include:

- Development of new pharmaceuticals and vaccines based on genetically modified organisms and natural products from plants, microbes, and animals;

- Elucidation of the molecular basis for an increasing number of diseases, and based on this understanding, the development of new drugs and disease treatment, including more successful gene therapy techniques for genetic diseases and cancer;

- Improved medical imaging technologies and biosensors for monitoring metabolites in the body;

- Better and faster disease diagnosis using advanced molecular biological and immunological techniques;

- Individualized drug therapy and better definition of genetic factors influencing responses to drugs."

• One key future challenge includes: "Meeting the future energy demands of the world's rapidly growing population; and simultaneously finding strategies to significantly reduce the emissions of carbon dioxide and other pollutants that result from the combustion of fossil fuels."

• "Meeting the water resource needs of agriculture, drinking water and sanitation, industry, ecosystems, and other purposes, presents vast challenges that will likely grow increasingly difficult to address in the face of population growth, economic development, and changing climatic conditions."

Suggestions

• "To promote more open access to databases, help develop international standards for database quality, and facilitate dialogue on ethics of personal information in databases";

• "To promote electronic and open access publication, including efforts to 'retro-digitize' existing scientific literature, and to promote international abstracting of developing country journals";

• "To help diffuse relevant new technologies to developing countries and canvas governments to reduce digital divides within and between countries";

• "Understanding and protecting the Earth's natural variety of genes, species, populations, and ecosystems requires actions such as:

- Documenting as comprehensively as possible the world's microbiota, for the purposes of identifying emerging microbial threats and new species of value for antibiotics, food production, and environmental remediation;

- Improving our understanding of the biodiversity of soil systems, and the potential changes in function and behaviour resulting from external stresses;

- Expanding our knowledge of aquatic and marine biodiversity;

- Developing a sound scientific basis for monitoring changes in the state of the living world, and for assessing global performance against the biodiversity-related targets set at the World Summit on Sustainable Development."

• "Disseminate technologies for achieving higher, more sustainable food production levels, including efficient irrigation technologies;

- Demonstrate best practices for precision farming, soil management, optimum use of land and water resources;

- Support research in developing fields such as agro-meteorology and agricultural social sciences;

- Evaluate the impacts of global climate changes on agricultural and fisheries sectors, and support the application of seasonal/inter-annual climate forecasting to agricultural management;

- Build understanding of the social and cultural factors affecting food choice and demand."

- "Improving energy efficiency and conservation;

    - Development of environmentally-friendly, renewable methods of energy generation that reduce dependence on fossil fuels (e.g., continued development of wind and wave energy, solar photo-voltaic, mini-hydro plants, gasifiers, and steam-driven plants);

    - Further studies of controlled thermonuclear fusion technologies, and development of next generation, intrinsically-safe nuclear reactors;

    - Assessing the feasibility of visionary new technologies, such as power generation by space-based solar cells and its transfer to Earth by microwave radiation."

- "Promoting water conservation, water-use efficiency technologies and recycling, including

    - Accelerating the development and application of efficient irrigation technologies;

    - Strengthening our understanding of processes at the interfaces in the hydrological cycle (e.g., among atmosphere, soil and land-surface, surface-water, ground water, ocean);

    - Understanding how water distribution, circulation, and availability is affected by human activities including land-use changes and consequences associated with global warming;

    - Studying processes and use of deep groundwater reservoirs;

    - Understanding the social and cultural factors that influence individual and institutional choices related to water resource use, adoption of conservation technologies, etc;

    - Applying emerging climate-forecasting capabilities to water resources management.

    - Energy-efficient technologies for treatment and re-use of waste water."

Methodology

Research from primary and secondary sources; modelling

Reference to other trends reports? If yes, which reports?

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