



Towards a Systems Analysis Approach to Health and Wellbeing in the Changing Urban Environment: report of a CSPR *ad hoc* Scoping Group on Human Health

Summary

This scoping exercise was carried out to assess the possibilities for making use of the particular strengths available to ICSU to respond to important global scientific challenges relating to human health and wellbeing. A number of Unions and Interdisciplinary Bodies are already exploring diverse aspects of human health and so this was seen as a very timely opportunity to draw on their ideas and motivation. The aim at the outset was to try to define a unique niche and not to duplicate the many well-funded activities outside ICSU that address the prevention and treatment of specific global health emergencies, such as the AIDS pandemic, or national research programmes directed at medical diagnosis and treatment within primary or secondary health care systems.

Taking into account the ongoing activities and interests of the ICSU community, the Scoping Group has identified what it considers to be a potentially important niche in the current lack of understanding of how patterns of population health are shaped by complex systems of external influence often at the global level, which are themselves subject to change by human interventions and natural phenomena. Different diseases, nutritional status, water supplies, macro and micro environments, transport and infrastructure, and social and political perturbations all interact to influence each other often with health consequences which differ from one age group or social group to another.

These interactions are particularly concentrated in urban areas, which are rapidly expanding and becoming the focal points of the search for environmental and social sustainability. The prevailing approach to studying urban environmental influences on human health is predominantly piecemeal and reductionist. This has served us well in linking individual causal factors to specific disease outcomes but has severe limitations when extrapolated to the realities of urban living and the complexity of factors influencing population health and wellbeing. There is increasing recognition of the need to develop a more 'ecological' approach that takes account of longer causal chains and complex, non-linear, interactions between various different processes and factors. Not least, from the policy maker perspective, there is an urgent need for good scientific evidence that addresses the complex matrix of issues that influence human health and wellbeing in our cities.

It is proposed that ICSU explore the potential interest and usefulness of a *systems analysis approach to population health and wellbeing in the changing urban environment*. Such a systems approach, at the scale of individual cities, would be aimed at providing new scientific insights that can effectively inform sociopolitical policies. It would build on the ongoing interests and projects of the Unions and Interdisciplinary Bodies in both urbanization and health. Moreover, it could be considered as a logical extension for ICSU of its scientific synthesis and integrated assessment approaches used so successfully in other areas, most notably global environmental change. It should similarly expose important issues regarding population health on which reliable scientific understanding is particularly lacking and thus make an important contribution to setting the future global health research agenda.

.....

Background: ICSU and human health

ICSU has not been a major player in international health research and with some justification in that there are many other national and international bodies that focus on health research. At the same time, there is a growing awareness that human health is inextricably linked to the health of our planet and environmental change (areas in which ICSU has undoubted strengths). Similarly, it is difficult to envisage an integrated scientific approach to sustainable development that does not include human health issues. There is a wealth of expertise within the ICSU family on various aspects of health research, which needs to be more fully incorporated into ICSU's existing activities. There is also a need for new partnerships with the clinical research community. [ICSU Strategic Plan, 2006-2011]

Health was also recognized in the report of the Scientific and Technological community to the World Summit on Sustainable Development in 2002, as an area where existing scientific information was not being optimally exploited (ICSU, 2002). The need to integrate this information into the broader concept of, and scientific approaches to, sustainable development was highlighted. It was also recognised in ICSU's own preparations for the Summit, that whilst health research is certainly being conducted by ICSU Members, this is largely restricted to single or closely-related disciplines and there is no clear mechanism or focus for bringing this together.

Since 2002, a number of ICSU's Scientific Unions and Interdisciplinary Bodies have been developing an initiative on Science for Health and Wellbeing (SHWB). They submitted a successful grant application to ICSU for \$50k to organize meetings and workshops to further advance this initiative in 2006. Whilst being impressed by the commitment from a large number of Unions, the Committee on Scientific Planning and Review (CSPR) had some concerns about the scope of the proposal. As a condition of the funding award it was stipulated that the proposers should liaise with an *ad hoc* CSPR Scoping Group to help define a more specific integrated programme.

In parallel to the Union-led activity, the Earth Systems Science Partnership (ESSP) has been developing a new project on Global Environmental Change and Human

Health (GEC-Human Health). This also has been partially supported by the ICSU grants programme with a grant in 2004 to carry out a rapid assessment of Biodiversity Health and the Environment. GEC-Human Health also takes into account the Health Synthesis of the recently completed Millennium Ecosystem Assessment (MA). This specific synthesis was prepared by WHO, with ICSU being an institutional partner in the overall assessment. The final proposal for a GEC-Human Health project was launched at the ESSP Open Science meeting in November 2006 (Beijing).

The ICSU Regional Office for Africa has identified Human Health and Wellbeing as its highest priority and began the planning for a regional science programme in this area in April 2006. Several Interdisciplinary Bodies (IBs) also have specific activities relating to human health. For example, the Scientific Committee on Problems of the Environment (SCOPE) has carried out several assessments of the health and environmental risks of specific toxic chemicals.

ICSU strategy and the *ad hoc* Scoping Group

Human Health is an identified priority in the ICSU Strategic Plan 2006-2011 with the overall goal (p32-33):

“to ensure that health considerations are duly taken into account in the planning and execution of future activities by building on the relevant strengths of Scientific Unions and Interdisciplinary Bodies.”

And the associated specific action:

- *ICSU will establish an ad hoc Scoping Group to more clearly define how it might contribute to science for human health taking into account the ongoing development of two new research initiatives (SHWB and GEC-Health – see above)*

The establishment of a CSPR *ad hoc* Scoping Group on Human Health is the first step in defining a potential role for ICSU in a complex area, which is considered to be a very high priority by many Members. This Group had a dual role: 1. to liaise with and ensure coordination, as necessary, of the major health initiatives that are already being developed within the ICSU community, and: 2. to identify additional areas or approaches where ICSU might add value to these initiatives (see [annex 1](#) for the full Terms of Reference and membership). The expert Scoping Group was selected to ensure representation from the key initiatives, as well as disciplinary and geographical balance. It met on 2 occasions, for 2 days each, in Paris in June 2006 and January 2007. The Chairman and several other member of the Group also met with the Executive Committee of the SHWB Initiative in between the first and second Scoping Group meetings.

Key ICSU criteria

ICSU's role in planning and coordinating research is built around international and interdisciplinary collaboration and focuses on major scientific challenges of importance to society. Developing effective linkages between scientific knowledge and policy making is an integral part of the Council's vision. There is considerable

overlap between the mission and aims of ICSU and those of its individual Members and Interdisciplinary Bodies. However, there are also significant differences, for example the Scientific Unions approach issues mainly from a single disciplinary perspective and the IBs have their own limited thematic focus. Thus, it is reasonable to expect that potential ICSU interests in human health will not coincide completely with those of all of its individual Members and IBs. This was clearly acknowledged by the Scoping Group from the outset – there are many important health-related activities within the ICSU community that do not require any additional support or input from ICSU. At the same time it was recognized that there were likely to be some areas of shared interest where ICSU's involvement could be beneficial.

In responding to the SHWB proposal from a number of Scientific Unions and IBs, the ICSU Committee on Scientific Planning and Review (CSPR) had already defined a number of broad criteria for ICSU involvement. The Scoping Group further refined these to develop its own criteria for defining areas of health science of potential interest to ICSU.

An ICSU health initiative should:

- be international (relevant to more than one region) and interdisciplinary;
- build on the synergies between existing activities and interests of the ICSU membership;
- add value to other ongoing or planned activities;
- fulfill a unique niche that other international initiatives do not address;
- incorporate links with pertinent international bodies and/or networks outside the ICSU family, as necessary;
- generate new scientific insights of significant relevance to health (and other) policies, with the policy audience(s) clearly defined at the outset;
- focus primarily on population health/disease prevention and promotion of health and wellbeing rather than medical treatment and cures;
- fit within the context of the Millennium Development Goals and the broader agenda of science for sustainable development.

Given that ICSU does not have an established track-record or 'name' in the international health arena, it was also recognized that the rapid development of a major new research programme was unlikely and that a more cautious step-wise, iterative, approach was more realistic. Short, medium and long-term goals and actions for any new initiative should all be defined *a priori*. It was noted that ICSU's financial resources are limited and that, as in other areas, the main role for ICSU was in planning and initiating activities and not directly funding substantive new research.

A systems analysis approach

Considering both the ongoing and planned activities within the ICSU community and the defined criteria for ICSU involvement, the Scoping Group identified one area where ICSU might potentially make a unique contribution: a systems analysis approach to human health and wellbeing. This fits well with some of the ideas in the GEC-Health programme proposal and some of the individual SHWB project descriptions and could also be used to integrate the scientific knowledge coming from individual disciplines or areas of research. Such an approach was considered to be

relatively novel in the population health/ health promotion area (and is quite distinct but complementary to the burgeoning field of health systems analysis). Moreover, it is consistent with ICSU's established role in integrated assessments and synthesis of scientific knowledge to assist policy-makers.

Definition of Systems Analysis

For the purposes of this scoping report, systems analysis is defined as mathematical modeling of a complex system on the basis of a good understanding of key contextual factors and in such a way that it addresses the needs of an audience that has been defined *a priori*. Such analysis involves the mapping of processes and relationships and how they affect measurable end points. It brings out clearly the interactivity between variables and the processes, which are shaped by multiple factors.

An appropriate systems analysis model should permit the integration of existing (and new) data and information and lead to new insights as well as the identification of gaps in current knowledge. It should enable reasonable scenario projections which can be tested and refined experimentally.

A complex system may be made up of several sub-systems each of which might also be modeled separately and the appropriate linking of several models, based on an understanding of sub-system interactions, can give insights into the system as a whole.

The Group considered that there is potentially an important role for ICSU to play in leading the international scientific community in developing a systems analysis approach for addressing complex public health challenges. Such an approach would, by definition, build on a broad range of existing scientific information to generate new knowledge and insights. In addition to providing relevant information for a range of policy audiences, who deal with complex systems, it would also identify gaps in scientific knowledge. The development of a systems analysis approach would in itself involve trans-disciplinary collaboration building on the strengths of ICSU, e.g. the transfer of complex systems approaches from ecology to health science.

Urbanization as a theme

Taking into account the established criteria and the ongoing activities within the ICSU Unions and IBs, one particular subject was identified as a potential theme for a systems analysis approach: Urbanization, i.e. health and wellbeing in the changing urban environment.

Urban areas are expanding rapidly, and in many cases seemingly uncontrollably, in all regions of the World. In the past two centuries the proportion of humans living in cities or large towns has increased from approximately 5% to 50%. This social transition has, not surprisingly, been accompanied by a changing pattern of human health risks and consequent illness and disease. Numerous studies, from both natural and social sciences, have provided considerable insights into to what these changes are and why they are occurring. Thus far, however, it could be argued that science has generally failed to take account of the complexity of the urban environments. In so doing it has also failed to consistently provide useful evidence for the policy makers, who have to grapple with urban challenges on a daily basis. A systems

analysis approach, specifically designed to take into account the complexity of urban environments and the needs of policy makers, could help to redress this.

The main reasons for identifying Urbanization, both as an issue in itself, and as a priority for ICSU can be summarized as follows:

- conventional simplistic, ‘cause and effect’, approaches are largely insufficient to effectively inform policies;
- a ‘complete’ systems modeling approach would be novel and could reasonably be expected to provide important policy insights;
- it is a major concern in both developed and developing countries in all regions of the world;
- it requires a trans-disciplinary approach (basic sciences, medicine/health, engineering, behavioural and social sciences, economics);
- a very considerable amount of scientific data and information already exists to be incorporated into a systems analysis framework;
- a systems analysis approach would also help to identify future policy-relevant research priorities;
- it is explicitly linked to sustainable development, which is a major priority for ICSU;
- it brings together parts of GEC-Health, IHDP and SHWB (and African regional interest) and needs all of them to contribute.

However, urbanization is also a complex topic that can be considered on a number of different scales from the global and regional down to the city, community or street level. In order to limit the complexity but maximize the relevance to potential policy audiences (see below) it is suggested that the primary focus should be at the level of the city.

The Audience(s)

As mentioned above, one of the major reasons for focusing on urbanization is the need to provide scientific information in a way that can effectively inform the various actors involved in managing urban environments.

The selection of cities as the units of analysis allows one to define specific policy audiences including, elected municipal representatives and officials, town planners, service providers etc. These should be the primary audience for the systems analysis. Their major concerns and challenges need to be defined *a priori* and addressed in the development of the overall systems framework. The outcome of any analysis should be fed back to these policy stakeholders in such a way that it can usefully inform their future decisions. There are a number of potential partners in this context, including for example, the International Council for Local Environmental Initiatives (ICLEI), which is a network representing more than 475 cities worldwide with an interest in sustainable development.

Secondary, but also important, audiences are the private sector and NGOs, who have a major responsibility and interest in many aspects of urban development and healthy environments. The World Business Council on Sustainable Development (WBCSD) is already a partner with ICSU in relation to the Commission on Sustainable

Development (CSD) and there are various other NGO groupings involved with CSD that have a strong interest in the urban environment and health.

Having solicited input from these audiences, the overall aim would be to develop a systems analysis approach that is appropriate at the city level to inform policies and actions that enable *Management of the Urban Environment to improve Human Health and Wellbeing*.

Developing a systems analysis approach to health and the urban environment

The aim of an ICSU initiative would be to develop, test and refine an overall systems analysis framework for modeling the urban environment at the city level and, in so doing, to generate information to effectively inform policies that improve the health and wellbeing of urban populations. This could build on the methodological approaches already being developed in disciplines such as ecology and geography. Moreover, it could draw on the existing expertise and interests within the ICSU community, including many of the Unions and the ESSP.

A conceptual framework

A preliminary conceptual framework for modeling a ‘typical’ city system is sketched out at annex 2. This complex system is influenced by a several key external driving forces and made up of a number of distinct major sectors or sub-systems (for which some models already exist). The combination of external forces and sectoral factors generates risks for human health and wellbeing and the level of these risks dictates health outcomes. Some of these various factors are listed below, from which it can be seen that there is a complex interplay between them. By incorporating this complexity, using a systems analysis approach, the aim is to elucidate the essential steps where policy intervention can ameliorate health outcomes in a specific contextual context.

External driving forces	Major urban sectors	Risk factors	Health outcomes
Population growth	Water	pollution	Dehydration, poisoning
Migration	Nutrition	Poor diet	Obesity/diarrhea
Climate change	Health care access	infection	Infectious diseases
Economic pressure	transport	accidents	Physical disablement
Technological development	housing	overcrowding	Psychological wellbeing
	Waste disposal		
	Education		

Indicators and Measures

A large amount of information is already available on burden of disease and cost-effectiveness of interventions and much of this has recently been brought together in the context of the WHO Disease Control and Priorities Project (<http://www.dcp2.org/main/Home.html>). It would be important to assimilate this into both the design and testing of the systems models. However, measures of health and wellbeing need to extend beyond simple disease incidence and prevalence. A number of recognized and widely accepted measures for mental, physical and social wellbeing, e.g. Daily Adjusted Life Years (DALYs), already exist and the development of new measures was not considered by the Scoping Group to be an immediate priority. Likewise, existing economic and social indicators, from GDP *per capita* to crime rates, should be largely adequate. **The challenge and novelty is to combine these various measures and indicators into a complete systems model.**

Contextual factors: importance of social sciences and economics

Human perceptions and social interactions are central to health and wellbeing in the urban setting. The social and institutional/political environment is a major determinant of how the urban environment is constructed and developed and how urban populations evolve. Any relevant systems analysis and modeling approach must factor in these issues. This requires expertise and insights from social sciences, including political science, policy studies, human geography and urban planning. However, these diverse perspectives must be included within the central paradigm of a quantitative systems analysis approach.

The importance of social factors in determining health and wellbeing has been recognised by governments, with WHO having established a Commission on the Social Determinants of Health (http://www.who.int/social_determinants/en/) in 2005. The Commission brings together leading scientists and practitioners to provide evidence on policies that improve health by addressing the social conditions which people live and work. Potential links with the work of this Commission should be explored.

The economic base of a city, whether it is growing or shrinking or changing, and its multiple effects on peoples livelihoods, is a critical contextual factor that needs to be incorporated into a systems analysis approach. Economics is also an important as a reality check, i.e. economics puts restraints on proposed models and policy interventions. Economic realities are critical to any consideration of different policy options.

Vision, goals and actions required

The overall vision, with a 50-year perspective, is to make a significant contribution to increasing the average lifespan and wellbeing of all those living in an urban environment.

Achieving this entails a step-wise approach that focuses on specific goals.

Short-term goals (3/07-10/08)

- Define key policy questions to be addressed in systems modeling (and also by specific substantive research)
- Develop an overall systems analysis model framework that addresses policy concerns

Medium-term goal (10/08-10/11)

- Adapt and test the overall model framework for specific cities¹, providing answers to policy questions and defining further substantive research gaps

Long-term goals (10/11-)

- To define critical variables and best practices in different urban environments
- To provide the evidence for all stakeholders to enable the design and development of more healthy urban environments

Initial actions

Three initial actions are considered necessary by the Scoping Group in order to achieve the short-term goals and develop an appropriate systems analysis model framework:

1. Commission a study to define key policy issues and concerns: a qualitative survey of key urban policy stakeholders, including local authorities, industry and NGOs
2. Commission an academic analysis/review of the relationships between key drivers and sectoral factors (annex 2)
3. Convene a modelers meeting to develop an inventory of existing (sub-system) models

These three activities might be overseen by a small Planning Group that would be charged with developing the terms of reference for 1 and 2 and organising 3. This Group might also be charged with exploring future funding options.

The aim should be to make significant progress on these activities prior to the ICSU General Assembly in 2008. Each of the activities should in itself produce valuable outputs that should be published. Combining these and making significant subsequent progress towards the medium-term goals will depend on GA support and on whether substantive financial support can be secured.

¹ The suggested approach, is to define a limited number of cities, 3-5, that have broadly similar characteristics (population size and growth-rate, demographics, policy challenges) which will allow them to be included in a comparative analysis. These would be used as the basis for a developing a generic analysis framework, although a specific model would have to be tailored for each different setting.

Relationship with existing health initiatives within the ICSU community

Scientific Unions and SHWB

Considerable efforts were made to liaise with the Unions SHWB Initiative, which slowly organised its leadership but did not develop a substantive action plan during the course of the scoping exercise. In particular it appeared that little progress was being made by the Unions themselves in developing an integrated or collaborative programme. Potentially an ICSU initiative, based around a systems analysis approach, could help many of the Unions to combine their expertise. An initial meeting of the Scoping Group with the SHWB Executive Committee also indicated some enthusiasm for an 'umbrella' focus on the urban environment. A further meeting of the SHWB committee is planned for April 2007.

Several Unions have systems modeling expertise and could make important contributions to the design of the systems analysis model framework. Other Unions have expertise in defining the contextual issues that need to be considered in developing a systems analysis approach to the urban environment.

The initial stakeholder survey will almost certainly identify specific topics, where substantive scientific research is immediately required. Likewise the application of a systems analysis model will identify knowledge gaps, where new research is required. Unions can play an important role in addressing these research needs – combining their bottom-up scientific interests with identified policy concerns.

ESSP

Urbanization and Human Health is one of several themes in the new GEC-Health programme, which was approved in November 2006 but is not yet underway. The primary focus for this programme is the global system and environmental change. This is distinct but complementary to the proposed ICSU initiative whose focus would be on policy concerns at the level of individual cities. An ICSU initiative might also help to accelerate ESSP activities in this area.

There are also several ongoing ESSP projects that have adopted a systems approach to global environmental change and food security (GECAFS), or water (GWSP) and which could inform (and be informed by) the proposed ICSU initiative.

IHDP

The International Human Dimensions Programme launched a core project on Urbanization and Global Environmental Change in 2005. This addresses, mainly from a social sciences perspective, the roles of environmental change as both a driver and a product of urbanization. This is an important contextual aspect of the proposed ICSU initiative. IHDP also works with a number of urban policy stakeholders. Whilst the core project does not use a quantitative systems analysis modeling approach nor does it address human health and wellbeing, it is potentially an important source of information and expertise for an ICSU initiative.

African Regional Plan for Health

Whilst the final African Regional Health Plan was not available to the Scoping Group, one of the members (VT) was part of the regional planning exercise and a preliminary report on priorities for Africa was provided for the Group. Urbanization and its

consequences for human health and wellbeing is recognized as a very pertinent topic for the continent which is witnessing an accelerating migration of its population from rural to urban areas.

One specific topic which has been prioritized in Africa is traditional knowledge and medicine. ~70% of health care in Africa is via traditional medicine and traditional practices are also prevalent in other sectors such as water and nutrition. There is a major challenge for African science to define what is effective and what is not with regards to these different treatments and practices. There is potentially an important role for the Scientific Unions in working with African scientists to address this (see ahead). In the specific context of a systems analysis approach to cities, it will also be important to factor in traditional knowledge as it relates to key sectors such as health service provision or nutrition.

Other topics/issues for ICSU

In carrying out its preliminary scoping, the Group identified (but did not consider in detail) three additional areas, where ICSU potentially has a important role to play in supporting science for health and wellbeing:

- Access to health information
- Traditional medicine (validation, quality control etc)
- Funding advocacy

These areas arose out of the planning exercise that was being conducted in parallel by the Regional Office for Africa and they are a particularly high priority for many developing countries. They are all areas where ICSU and its Members have already done some work and should be prepared to support the efforts of the Regional Offices where possible.

Preliminary Timetable

Feb 07	report to CSPR
23-26/4/07	EB and Unions meeting
9-10/07	Commission stakeholder survey and analysis of 'key drivers and urban sectors'
?/08	methodological/planners workshop to establish a systems framework and guidelines
20-24/10/08	Report on progress to ICSU General Assembly

Resources

2007

Funding would be required for two planning group meetings (2x15k€) and the survey and analysis work (2x 20k€).

2008

A further Planning Group meeting would probably be necessary (~15k€) and some support for a 'modelers workshop', although IIASA may be willing to host the later event.

Institutional Partnerships

In addition to any initial seed funding that ICSU can allocate from its core resources, it will be important to rapidly develop partnership with appropriate academic institutions to lever additional human and financial resources. In this regard, both the International Institute for Applied Systems Analysis (IIASA) and the home academic institutions of some of the individuals involved in the scoping exercise are potential partners.

Annex I: Terms of Reference

1. To liaise with the coordinating committee for the Union initiative on Science for Health and Well-being (SHWB) and advise the Unions on the development of a specific integrated interdisciplinary programme.
2. To liaise with the developing ESSP joint project on Global Environmental Change and Human Health (GEC-Human Health) and advise, if appropriate, on potential links to Union interests and activities.
3. In the light of 1 and 2 above to advise CSPR as to what future involvement, if any, ICSU should have in the SHWB initiative.
4. To advise CSPR as to any other actions that might be appropriate to address ICSU's agreed strategic goal in relation to Human Health.

In relation to its liaison roles, 1 and 2, the Group is not asked to explicitly review the scientific quality of these proposals but rather to assess and offer advice on strategic direction and/or links to other activities within the ICSU community.

Membership

Chair: Dai Rees (Ex-CSPR, Biochemistry) [UK]
Anders Kallner (IUPAC, Clinical Chemistry) [Sweden]
Tony McMichael (GEC-Human Health, Epidemiology) [Australia]
Kari Raivio (CSPR, Pediatrics) [Finland]
Pierre Ritchie (CSPR, Psychology) [Canada]
Marvalee Wake (IUBS and named contact for SHWB) [USA]
Vincent Titanji (ICSU African Regional Health Initiative, Biochemistry) [Cameroon].
Edgar Gutierrez-Espeleta (SCOPE, wellbeing and indicators) [Costa Rica]
Indira Nath (medicine, immunology and society) [India]

Invited guests (meeting 2 only):

Andy Haines (London School of Hygiene and Tropical Medicine) [UK]
Landis MacKellar (International Institute for Applied Systems Analysis)
[Austria]

Annex 2: Preliminary conceptual framework for a systems analysis approach to Urbanization, Health and Wellbeing

NB this model to be further refined at the proposed methodological workshop, e.g. to include other factors such as Education and peri-urban agriculture

