# Special Reports

## The Linkages Between Population and Water: Forthcoming Articles from ECSP

***By Shanda Leather***

Population growth as well as the demand for and scarcity of clean water are all dynamics that stress the capacity of governments and societies to (a) provide basic services and (b) maintain a healthy human and natural environment. Neither population growth nor water supply, however, can be considered in isolation. Human usage puts the most consistent stress on water resources; in turn, the scarcity or misallocation of water resources greatly affects the well-being of human populations and natural ecosystems. In collaboration with the University of Michigan Population Fellows Program, the Environmental Change and Security Project (ECSP) commissioned in fall 2000 a series of articles to examine global and regional linkages between population and water. The interplay among these issues is at the heart of this project.

Each of the three articles (summarized below) has been jointly written by a pair of authors, representing both a Northern and Southern perspective. Each article also draws on regional case-study material. Rather than revisit the widely-researched area of water shortages and potential conflict in the water-scarce Middle East, we chose to expand the population-water discussion by focusing on Southern and East Africa, India, and the Philippines. It was also our goal in commissioning these articles to promote cooperation between the authors—allowing them to work collaboratively, to share concepts and experiences, and to bring that collaboration to a wide audience through the ECSP network. Since the opinions and work of Southern authors are not widely featured in North American publications, we also wanted to raise the profile and exposure of those with direct experience of these issues in developing countries.

### The Coming Fresh Water Crisis is Already Here
### by Don Hinrichsen and Henrylito D. Tacio

**Don Hinrichsen** *is a writer/media consultant and fundraiser for the Untied Nations Population Fund in New York. He has written five books over the past decade on topics ranging from coastal resources to an atlas of the environment.* **Henrylito D. Tacio** *is a Filipino journalist who specializes in science and the environment.*

In "The Coming Freshwater Crisis," Hinrichsen and Tacio assert that demand for fresh water is outstripping the ability of many governments to supply it. The authors look broadly at global trends in population growth and fresh water availability, highlighting areas that are already at crisis stage and looking toward those areas that will soon present difficulties. Their discussion sets the stage for some of the more in-depth topical discussions in the subsequent articles.

Hinrichsen and Tacio outline the global dynamics of (a) population and fresh water, (b) fresh water availability, and (c) fresh water use before moving on to a lengthy discussion of what they term "a future of scarcity"—an accelerating demand for fresh water accompanied by its declining per-capita availability:

> "...[Global] demand for water is rising not only because of population growth but also because of urbanization, economic development, and improved living standards. Between 1900 and 1995, for example, global water withdrawals increased by over six times, more than double the rate of population growth.
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> "Since 1940, annual global water withdrawals have risen by an average of 2.5 to 3 percent a year while average annual population has grown 1.5 to 2 percent. In developing countries, water withdrawals are rising more rapidly—by 4 to 8 percent a year for the past decade—because of population growth and increasing demand per capita.
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> "Moreover, the supply of fresh water available to humanity is in effect shrinking because many fresh water resources have become increasingly polluted. In many countries, lakes and rivers are used as receptacles for a vile assortment of wastes—including untreated or partially treated municipal sewage, industrial poisons, and harmful chemicals

leached into surface and ground waters from agricultural activities…"

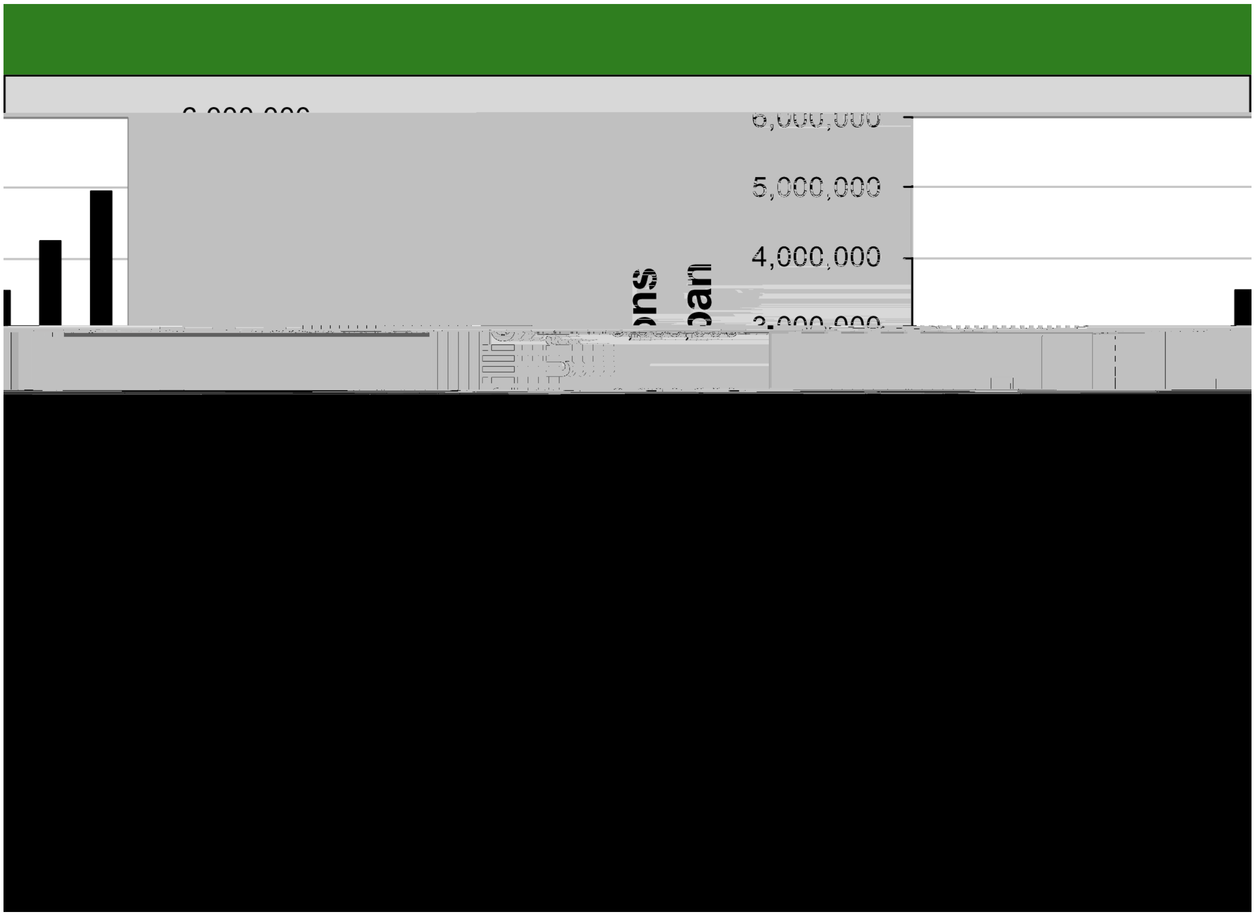
Hinrichsen and Tacio emphasize how developed countries have a much higher per-capita water usage (and thus greater demand) than developing countries. Low household use in developing countries also reflects the difficulty many people have in obtaining clean water. However, the authors are quick to point out that this pattern is changing dramatically, as countries become predominantly urban and demand for piped water increases. Through this, Hinrichsen and Tacio lay the groundwork for a discussion of intersectoral competition that is more thoroughly dealt with in the second article.

Finally, Hinrichsen and Tacio examine the degradation of water supplies and the effect such degradation has on increased demand and consumption. Pollution (both agricultural and industrial) is a problem faced by developed and developing countries alike. As pollution continues, current sources of clean water either will become unusable or will require clean up at great cost to either governments or consumers. All of these issues are vividly highlighted in the article's case study from the Philippines. Authoring the case study, Tacio details examples from throughout the archipelago to illustrate the trends of inadequate supply, polluted sources, and lack of access—all in a country that, as one of the wettest in Southeast Asia, is commonly perceived as water-rich.

## Water Crisis: The Case of the Philippines

"…The country's water is supplied by rainfall as well as rivers, lakes, springs, and groundwater. With changing weather patterns worldwide, rainfall is growing scarcer. The little that comes from the heavens is collected, or wasted, in watersheds with balding forests. As a result, there has been a dramatic drop of from 30 to 50 percent in the country's available stable water resources in the past three decades.

"A recent report released by the Philippines Department of Environment and Natural




becoming a predominantly urban species. More than half of humanity now resides in urban areas. This trend brings with it a shift in demand for and use of water resources. While agriculture still accounts for the largest volume of fresh water use, the percentage of fresh water now used to supply activities in urban areas has vastly increased. These rising urban demands means that water must be reallocated from agricultural activities to industrial and urban household usage. Authors Ruth Meinzen-Dick and Paul Appasamy take up this issue of this allocational intersectoral competition by exploring the dramatic demographic trend toward global urbanization and its effect on the distribution of and competition over water resources.

Worldwide, urban populations have grown by more than 2 billion since 1950, and are anticipated to grow by that much again in the next 25 years. (See Figure 1.) Two of the largest challenges to supporting this urban-based population are (1) the provision of water, and (2) the treatment and disposal of water-born waste. Meinzen-Dick and Appasamy point out that such provision is not a problem at an aggregate level: urban water use still makes up a fraction of that used for agriculture. However, highlighting a theme seen over and over in these articles, the authors argue that it is (a) the provision of water *when and where it is needed* as well as (b) *the quality of what is supplied* that pose the greatest problem. Meinzen-Dick and Appasamy probe not only the technical and economic implications of urbanization and intersectoral competition, but also the social and political implications of this trend:

- "…Domestic water demand is not simply a multiple of the population size. Per-capita demands increase with urbanization and rising incomes. Rural water supply systems in India, for example, use a norm of 40 liters/capita/day for domestic use without household piped connections (where it is assumed that other water (thbill-2 bywell as 5 Tw() - - -) -81 378.9it2m/Cs5 cs- -0- -sc/

"Providing water in an efficient, equitable, and sustainable manner to both urban and rural areas in the 21st century poses as much an institutional as a technical challenge. The ad hoc and sectoral approaches of the past are not adequate for the interrelated nature of urban water use. To meet urban water needs, water institutions must expand their vision in at least two directions: (a) to extend services to low income communities and peri-urban areas, and (b) to protect the quality of surface and ground water…

"…Finally, dealing with the water needs of the poor (who may make up one-third of the urban population) requires far greater efforts. Meeting these needs is an effort likely to go beyond conventional engineering approaches to include a wider range of options for water supply and sanitation. It also requires rethinking institutional approaches (such as thoroughly involving community organizations in decision-making as well as implementation)…"

## Exploring the Population-Water Resources Nexus in the Developing World

**by Anthony R. Turton and Jeroen F. Warner**

according to their natural water supply and their ability to effectively use that supply (see Figure 2).

Societies that are in positions 1 and 2 have relative abundance in both first and second order resources, while those in positions 3 and 4 have scarcity in both areas. A key additional element of Turton and Warner's analysis is that the rate of population growth has a great effect on both natural and social resource availability.

Using three variables (natural resource availability, social resource availability, and population growth rates), Turton and Warner go on to develop a unique and informative discussion of the positions of various countries in their study areas of East and Southern Africa. These countries fall into three categories: (1) Structurally-Induced Relative Water Abundance (SIRWA)—*social abundance but water scarcity*; (2) Structurally-Induced Relative Water Scarcity (SIRWS)—*water abundance but social-resource scarcity*; and (3) Water Poverty (WP)—

Republic of Congo (DRC) are politically unstable—being embroiled in seemingly endless civil war. Unfortunately, no end to this debilitating condition is in sight. Mozambique offers a glimmer of hope, as it has turned its back on civil war and is seemingly on the road to economic recovery. Institutional capacity there is extremely weak, however, and a high debt burden continues to hamper this recovery. The major floods that took place in Mozambique in early 2000 set its economic recovery back significantly and also were a manifestation of the inability to respond to crisis. Namibia is politically stable, but has become embroiled in the Angolan civil war and the DRC. This role does not bode well for its future, as Namibia is starting to hemorrhage precious financial resources that could be used in institutional development instead. Namibia also presents an interesting case in the sense that the first-order type of indicators shows the country to be relatively well-endowed with water. This impression is highly misleading, however, as the water that exists is found only on the northern and southern borders of the country, and is also difficult to exploit. The low population levels also create a false impression by presenting a relatively high per capita water availability, showing the flaws in first-order analyses. Zambia is politically stable but has a low level of economic activity, and the civil wars in both Angola and the DRC are impacting it negatively. Should Angola, the DRC, Mozambique, and Zambia manage to solve these problems, then they could conceivably become the regional breadbaskets, using their natural resource

Turton and Warner enter into a philosophical, theoretical, and practical discussion that explores not only the usefulness of GIS but also the concern that it is being used to exploit existing power relations and concepts of security.

yet it is also the source of water for South Africa via the Lesotho Highlands Water Project (LHWP). Water is one of the few natural resources that Lesotho can exploit (the other being labor and, to a lesser extent, diamonds); so it sells water to South Africa, using the royalties to finance other development projects. Significantly, all of the East African countries fall into this category, suggesting that the development problems in East Africa are

> the world in a way that reflects those interests. Depending on what gate-keeping elites want to show, they can manipulate their computer images to highlight and represent their preconceived image of reality. But what for? And for whom? Critical geographers have worried about who is empowered by GIS technology. The question 'what do you want to know and why do you want to know this?' is all the more apt in light of the potential for surveillance. Knowledge is power, and GIS could easily be used as a technology of power to reinforce the control of citizens by states."

In the final section of their article, Turton and Warner turn to examine four critical questions in the water debate: (1) Will there be enough water to support regional populations in the future? (2) Can GIS technology be used to map water resources and future population growth? (3) Has the question now become one of managing demand rather than supply? (4) How will demand management be achieved? Through a discussion

[1] Environmental Management Bureau. (1996). *Philippine Environmental Quality Report (1990-1995)*. Department of Environment and Natural Resources, Manila, Philippines.

[2] Tacio, Elena. (1994, March 27). "The great thirst." *Manila Chronicle*, A1.

[3]

# Environmental Mission Recommendations for the U.S. Intelligence Community

***By Captain Steve Kiser, USAF***

One important legacy of the Cold War is that the United States possesses a very well-functioning intelligence community with the capacity to collect once-unimaginable amounts of information and data. But strategists now rightly ask how or even if the current U.S. security posture—inarguably still defined by the Cold War—fits the chaos of the post-Cold War era. A new debate has opened regarding the place of non-state and non-military threats for national security planning, and many non-traditional areas (including food, water, and energy) are now being considered as essential "security" issues. Perhaps the most broadly discussed of these areas is the role and priority of environmental problems.

Environmental threats to both the United States and its interests abroad are clearly growing and will continue to grow in importance. And as environmental issues become more germane to U.S. security, the national security apparatus must be used to address them. While a considerable body of literature already addresses the significant emerging field of environmental security and its role in the U.S. national security paradigm, this article gives concrete recommendations to policymakers on how to use the U.S. intelligence community in an environmental role. It then broadly assesses the costs—both direct and associated—of these kinds of applications.

## Recommendations

There are many specific areas where the application of U.S. strategic overhead systems could significantly aid the environmental security mission. While many private, nongovernmental satellite programs and businesses already exist that could undertake some of the missions detailed below, it is important to note that U.S. intelligence community assets can do them better, quicker, more accurately, and at less cost.

### Treaty Verification

Treaty verification is perhaps the most compelling case for an expanded environmental monitoring mission by the U.S. intelligence community. The spate of environmentally-related treaties and protocols in recent years highlights a relative void in the United States' ability to monitor treaty progress and adherence. Indeed, the United States is signatory (although the U.S. Senate has not ratified all of them) to nine major international environmental conventions. These include: the recently signed Stockholm Treaty on Persistent Organic Pollutants (the so-called "dirty dozen" treaty, with approximately 50 signatories); the Montreal Protocol on Substances that Deplete the Ozone Layer of 1992 (136 signatories); and the Basel Convention on Transboundary Movements of Hazardous Waste (136 signatories) (U.S. Department of State, 1998(a); "US to sign," 2001). Literally hundreds of smaller agreements, treaties, and protocols also exist. While absolute verification and compliance with every single of environmental treaties. Kyoto requires significant reductions in six greenhouse gases, including carbon dioxide, methane, nitrous oxide, and various substitutes for ozone-depleting chlorofluorocarbons (CFCs). The Kyoto Protocol has been criticized for (among other things) lacking concrete verification procedures. Indeed, even the U.S. Department of State admits that this is one of the unresolved portions of the treaty (U.S. Department of State, 1998(b)). Critics charge that the protocol contains no provision for answering even basic informational questions such as: How much carbon is in the air now? How much did each individual country emit in 1990—the treaty's baseline year? How much of each kind of greenhouse gas is each country emitting today? And how will we confirm a government's claims that it is (for example) planting carbon sinks? In addition, no openly-available carbon baselines exist for many of the nations who are signatories to the protocol. With no baseline, how does one measure progress?

Such treaty verification is a specific mission for which intelligence community satellite systems can help a great deal. While commercially available satellites could perform some treaty verification, intelligence satellites could do the job more quickly, more thoroughly, and with a substantially higher resolution (and thus higher accuracy) than other organizations. Additionally, with a quicker revisit time over various targets, monitoring potential violations or efforts to return to treaty standards could be more thoroughly monitored. An excellent example of this capability was demonstrated when the Director of the Central Intelligence Agency's Environmental and Societal Center (DESC) used Medea to report that a vast boreal forest in Russia might not be the huge carbon sink the Russians hoped it to be (National Intelligence Council, 1999).

The U.S. intelligence community's vast databases could also easily be mined to assess a country's total and types of economic activity, its total forested area, and other pertinent data to establish environmental baselines with more accuracy. While 59 r3.to as6 w5s4(hee1ns)]TJaf9l (political, economic, and military, for example) is significant. A lack of food and water can be an early indicator of a failing state, as was the case in Somalia. Additionally, when U.S. troops are deployed to areas where access to water does not exist, this system can quickly be used to assess both how much water is available and how much stress the addition of U.S. personnel in the area will add to water supplies. Thus, the benefit of the system is twofold: while increasing the value and accuracy of the intelligence community's larger indications-and-warning system, it can also be used for more efficient military mission planning.

In addition, such a robust system could be a testing tool. By going back decades and collecting data from intelligence imagery archives, it could enable analysts to conduct retrospective analysis on a variety of conflicts as well as to develop theories and models of conflict causality with greater accuracy and precision. Analysts could also use the system to analyze thoroughly actual conflicts to determine better what role environmental factors might have played in them. Such testing would add empirical data to the now largely-theoretical debate about the role of environmental factors in conflict.

From a disease-prevention perspective, the higher-resolution imagery provided only by intelligence satellites can be very beneficial as well. The potential spread of vector-borne diseases (especially malaria) can be more thoroughly tracked with high-resolution infrared or optical satellite imagery. Such imagery can better identify and characterize standing water areas, vegetation types, and other variables that promote such diseases. With that data, governments and relief workers can then help track and have about how and why this stealthy disease flares up (Salopek, 2000). Other satellite-derived applications to human health at least ought to be explored.

## Setting Environmental Baselines and Continuums

The U.S. government could also create a program with the singular purpose of creating year-by-year baselines of environmental conditions of the world, starting with the 1960s. As of about 1990, non-intelligence community satellites were able to collect enough data to measure the larger aspects of environmental change. In February 1995, President Clinton issued Executive Order 12951, authorizing the CIA to make public more than 800,000 photos taken between 1960 and 1972 by two

> If the U.S. government were also to release enough data from images archived from 1972 to 1990, analysts could build an unprecedented and invaluable 40-year global environmental continuum.

other non-military sensors (such as the NASA Earth Observing System constellation of satellites) to calibrate the sensors on these platforms (Trevedi, 2000). With minimal impact to national security concerns, this cooperation could continue to extend to other environmental monitoring and assessment efforts both inside and outside the U.S. government. Data collected from all types of environmental sensors—ground-based, airborne, or space-borne—could be compared with environmental data collected from the highly-sensitive and fully-calibrated intelligence satellite platforms.

This comparison would accomplish two things. First, it would calibrate and validate other valuable sensors, using previously-cleared personnel to conduct such tests. This practice would be economical for both the U.S. government and nongovernmental environmental organizations (NGOs); it would cost NASA or an NGO far less to ground-truth its sensors using data from another government organization than it would to contract that work out or develop its own tests independently. Second, such calibration could also be used to adjust previously collected data, thus standardizing more and more environmental information. Such a synergistic combination of environmental analyses was illustrated assessment of where and to what extent human development in sensitive environmental areas is occurring.

- Continuous monitoring of the polar caps (an indicator of global climate change), improved monitoring of ice flows and icebergs within international shipping lanes, and other Arctic phenomenon could also be gleaned from the intelligence community's data. An excellent example of such cooperation is the data released in the early 1990s by the U.S. Navy. The Arctic ice data (especially polar cap thickness) that U.S. submarines collected during the Cold War has now become a very valuable dataset for environmental scientists.

## Costs

Assuming new responsibilities always carries costs, both direct and in opportunity. The proposals made in this article are no different: each carry a different kind of cost to be paid in different ways. While simply encouraging cooperation between the intelligence community and other federally-funded organizations and non-governmental organizations is relatively cost-free, funding for treaty verification would probably be rather high. And the creation of an environmental continuum would entail different sets of costs, both direct and indirect.

While a precise breakdown of costs for each of these proposals is beyond the scope of this article, it is possible to set up a framework of costs and analyze such concerns indirectly. The expenses associated with some of these recommendations fall into two broad categories—direct costs and associated costs.

The direct costs of these proposals are nearly impossible to calculate for a variety of reasons—the intelligence community's classified budget being the greatest barrier. Regardless, the direct costs of adding an environmental security mission to U.S. intelligence gathering activity are not in data collection but in adding the necessary personnel to conduct environmental analysis. For example, enormous amounts of archived U.S. intelligence information contain environmental data. The costs of putting these data to use for an environmental security mission lie in training and paying analysts to sift through these records and to glean the data needed, not in collecting additional data.

This same framework applies to intelligence collected both now and in the future. The U.S. intelligence community collects massive quantities of information every day; and there is more than enough collateral environmental data in this collection to keep analysts busy without necessarily tasking intelligence assets to collect specifically environmental data. In addition, future improvements in the capabilities of U.S. intelligence community satellites will be able to eliminate any potential competition between traditional and environmental security analysis needs. For example, U.S. Representative Larry Combest (R-TX) has strongly advocated the deployment of a series of 24 different small satellites, which could produce images of 40- by 50- square mile swaths with approximately three-foot resolution. Within a single hour, such a constellation of satellites could image 17,980 square miles—an enormous quantity of data (Fulgham & Anselmo, 1998; "NRO Opens Up," 1997; and "DARPA Eyes," 1997).

Still, the costs of analyzing such data would not be prohibitive. Should the U.S. government decide it will be the main purveyor of analysts to this mission, direct costs for analysts, space, equipment, and other related assets should be less than U.S. $2 million annually.[2] However, a different approach could also be used. Instead of the U.S. government being the exclusive purveyor of environmental analysts, it could simply serve as a clearinghouse—releasing data to environmental scientists and certain environmental NGOs that are already conducting extensive analysis of environmental security issues. Such a "cooperative engagement" policy would allow a far larger number of environmental experts to look at more data and allow many of the above proposals (such as creating an environmental continuum or assessing coral reefs worldwide) to be conducted essentially free-of-charge to the government.

The downside of this proposal is the substantial increase in associated costs and the greater challenge included with such costs. Again, the majority of the proposals of this article deal largely with handling and releasing archival or collateral data. Because of how this information is collected and distributed, associated costs would probably exceed direct costs. First, the release of classified information requires human eyes to review (or "scrub") the data to ensure vital national secrets are not also being released. Additionally, simply moving classified material around requires a certain amount of paperwork and tracking. And providing and maintaining the necessary security clearances to the additional number of persons who would become "environmental security analysts" is no small task: just the background investigation to provide such clearances can take months. In sum, the acts of finding and analyzing environmental data itself cost little; the increased requirements on the infrastructure and bureaucracy necessary to release classified data would be substantial. Estimating the necessary funds for this set of

## Endnotes

1 Dr. Norm Kahn is a former senior analyst with the DESC. He gave an interview and briefing to the author at which sample datasets were demonstrated.

2 This estimate is based off having 10 analysts, each paid an