GLOBAL FOREST WATCH

A Global Solution Network to Protect the World's Forests

Lighthouse Case Study

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GLOBAL SOLUTION NETWORKS

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Case in Brief

Global Forest Watch (GFW) is a global watchdog network that improves transparency and accountability in forest management decisions by increasing the public's access to information on forestry developments around the world. First launched in 1999 and then re-launched in 2013, the underlying principle is that increasingly powerful information technologies make transparency one of our most potent mechanisms for strengthening the incentives for responsible industry practices and building the capacity for sustainable forest management.

Tapping into near real-time satellite monitoring systems and intuitive visual maps, the network provides access to a wealth of information about threats to forests and the entities behind those threats. Within minutes, an interested researcher can see the location and duration of a company's logging concessions, look up local forestry regulations and check whether the logging companies have paid their taxes. After more than a decade of successful deployment in West Africa, Asia, South America and Canada, GFW illustrates the power of a technology-enabled network to allow interested stakeholders to share information, participate in forest monitoring and hold decision-makers accountable.

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Introduction

Technologists and science fiction writers have long envisioned a world where a seamless global network of Internet-connected sensors could capture every event, action and change on earth. Today, that vision of an "Internet of Things" is edging closer and closer to reality. In the past few years, powerful scientific instruments and pervasive computing have powered quantum leaps in the amount of data available to scientists, public policy makers and other stakeholders, raising both new challenges and new opportunities. The challenges include the need to develop methods, tools and institutions for managing and exploring massive datasets. The opportunities include the ability to extract powerful new insights for researchers and problem solvers focused on global issues ranging from climate change to deforestation to infectious disease prevention.

With the right tools and the right training, global solution networks (GSNs) can harness this vast cloud of data to develop more analytical, timely and effective approaches to problem solving. For example, GSNs can use pervasive computing and the data it generates to revolutionize our ability to model the world and all of its systems, giving us new insights into social and natural phenomena and the ability to forecast trends like climate change with greater accuracy. At the forefront of this computational approach to problem solving are the Washington, DC-based World Resources Institute and the Center for Global Development. In collaboration with Google, they recently re-launched the Global Forest Watch platform, which displays near real-time satellite imagery on interactive maps to enable an international network of forestry watchdogs to monitor the health of the world's forests.

At the same time, Global Forest Watch highlights the deep challenges GSNs will face in coming to grips with the infrastructure, tools and talent required to take advantage of big data. Data-intensive projects provide tremendous opportunities to develop new knowledge and inform action with credible data. But they will revolutionize the practice of public policy advocacy and even alter the basic skill set required to participate effectively in global public policy debates. Managing big data projects effectively will also require GSNs to invest in data-literate talent and devote significant resources to software development and cloud computing.

Technology, Planetary Stewardship and Global Solution Networks

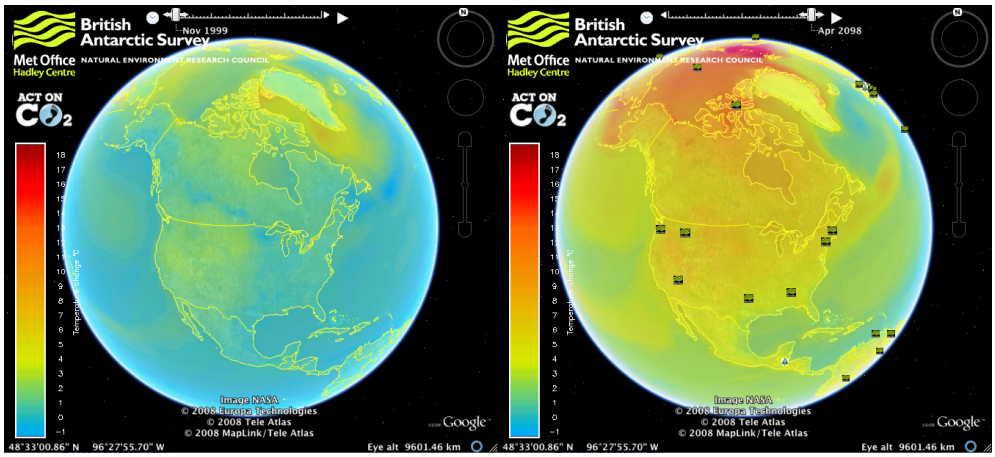
Before exploring the specifics of Global Forest Watch, it is worth reviewing how scientific advances, technology and networks are coming together to transform the way the world governs critical resources like forests and oceans. In the past, natural resource management came down to the capacity of an authoritative, centralized body in a geographic territory to monitor and control the exploitation of a given resource, whether forests, minerals or fisheries. Today, five forces are opening up the regulation of natural resources to a much broader global audience, making new models of planetary monitoring and natural resource management by GSNs a genuine possibility.

Remote monitoring capabilities. First and foremost among these forces are the powerful advances in monitoring technologies. When the devices we use to capture and process data are sparsely distributed and intermittently connected, we get an incomplete, and often outdated, snapshot of the real world. But thanks to the advances in remote sensors and satellite monitoring, obtaining granular information about the status of natural systems or even the behaviors of entire populations of people will be cost-effective and increasingly accurate and timely. There are sensors for light, temperature, barometric pressure, airflow and humidity. There are even sensors that can "taste and smell." Low-power intelligent wireless sensors, for example, can already measure chemical composition and air pollutants and report that information back in real-time. And current research is exploring the use of nanomaterials to boost standard chemical and biological detection technology (Raman spectroscopy) to 100 million times its usual sensitivity rates. The ability to cull staggering quantities of data from our natural and built environments in turn empowers policy-makers and practitioners to produce much richer virtual models of real-world systems.[1]

Scientific methods. Second, new scientific methods have been developed to take advantage of increasingly powerful computers and an increasingly data-rich world. Consider the work of Greg Asner and Carlos Souza, two scientists at the forefront of environmental science who are hoping to map the locations and rates of deforestation around the world and link the results to climate change. Instead of traversing through vast tracks of jungle in Indonesia or Brazil, the scientists are analyzing satellite images that can shed light on the status of the world's forests without the need for expensive field studies.[2] Over time, Asner and Souza hope to gather together all of the earth's raw satellite imagery data—petabytes of historical, present and future data—and make it easily available through the Google Earth platform to anyone who cares to make use of it. The

evidence accumulated to date is already helping scientists, governments and conservationists assess the scale of the deforestation problem on a global basis.

Visualization tools. Asner and Souza's work highlights a third trend. Intuitive new visualization tools like Google Earth provide the broader public with access to information that was once inaccessible and hard to understand. Indeed by displaying this information in bold visual formats, the tools not only help communicate complex phenomena in a way that most laymen can easily grasp, they can be used to model future scenarios and forecast the impact of various policy choices. Whether mapping the world's oil spills, simulating the effects of sea-level rises in the future, tracking mammals on the verge of extinction or showing national per capita CO_2 emissions, Google Earth (along with the data crunching capabilities of Google's server farms) provides an ideal platform on which to enhance our understanding of humanity's present and future impact on the biosphere. The result is that information that was once only available to scientists and policy-makers is now freely available on the Internet, which gives considerable ammunition to conservationists and local communities.



An example of Google Earth displaying climate data – November 1999 and projections for 2098[3]

Demand for global stewardship. Fourth, there is growing recognition that at least some resource stocks should be considered global public goods, due to the ecological services they provide to the global biosphere. Citizens around the globe have taken an increasing interest in the protection of these public goods, and in doing so they call into question traditional notions of national sovereignty when it comes to planetary stewardship. For example, we now know that emissions from tropical deforestation are comparable to the emissions of all of the European Union, and greater than those of all the cars, trucks, planes, ships and trains on the planet. And thanks to the work of economists

> *"Within minutes, an interested researcher can see the location and duration of a company's logging concessions, look up local forestry laws and regulations, and check whether the logging companies have paid their taxes."*

such as Nicholas Stern, we also know that protecting the world's standing forests is one of the most cost-effective ways to cut carbon emissions and mitigate climate change.[4] Some nations will protest that it is their sovereign right to exploit the natural resources within their borders, but there is no denying that the consequences of local deforestation will be felt globally.

Global solution networks. Finally, there are well-organized and increasingly agile networks of conservation and environmental groups that reach across national borders and wield considerable influence in global environmental decision-making. Their roles on the international stage are numerous. Some networks contribute to path-breaking environmental science projects. Some focus on lobbying governments, influencing key policy debates and/or making contributions to international treaties and agreements. Some serve as industry watchdogs, while other networks work arm-in-arm with companies to foster more sustainable business practices. A number of GSNs play all of these roles simultaneously. Regardless of the roles played, the ability of GSNs to fuse the resources and competencies of multistakeholder groups has generated more robust and dynamic resource management solutions.

Protecting the World's Forests with Global Forest Watch

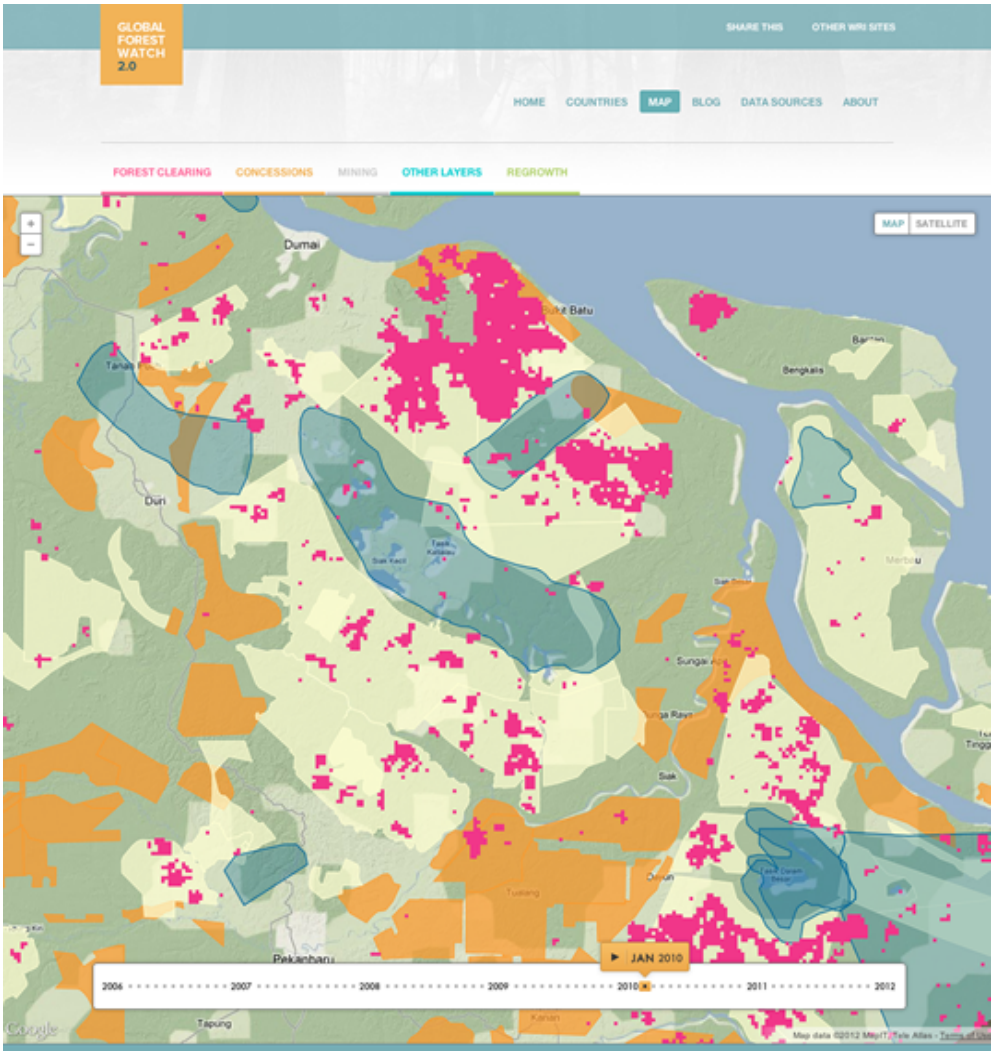
Documenting sea level rises or the locations and rates of deforestation on an interactive mapping platform provides a powerful input to science. But when it comes to actually mobilizing local communities to do something about deforestation, there is perhaps no better example than Global Forest Watch (GFW).

Maintained by the Washington, DC-based World Resources Institute (WRI), GFW improves transparency and accountability in forest management decisions by increasing the public's access to information on forestry developments around the world. First launched in 1999, the underlying principle is that increasingly powerful information technologies make transparency one of our most potent mechanisms for strengthening the incentives for responsible industry practices and building the capacity for sustainable forest management. The site provides access to a wealth of information about threats to forests and the entities behind those threats. Within minutes, an interested researcher can see the location and duration of a company's logging concessions, look up local forestry laws and regulations and check whether the logging companies have paid their taxes. Most information can be easily navigated using a visual map interface that taps into a combination of satellite imagery, national forest data sets and "on-the-

ground" reports. More advanced users can download geographical data from GFW's data warehouse and manipulate it for their own analyses using third party apps like Google Earth.

Global Forest Watch empowers local communities to report and prevent illegal logging operations.[5]

According to Crystal Hamilton, the WRI's senior manager for GFW, the technology for forest monitoring has improved dramatically since they first launched in 1999. In the past, data on forest cover in countries with advanced regulatory regimes was updated annually, while data for developing nations was updated much less frequently, if at all. Regardless of the source, Hamilton called the data scattered, inconsistent and unreliable and noted that assessing the rates of deforestation was extraordinarily difficult and labor intensive. "Someone would need to go through the data to compare past and present satellite imagery," she said. "It required a lot of technical expertise and a lot of time."[6]



Global Forest Watch provides near real-time forest monitoring capabilities.[7]

Today, GFW taps into NASA's satellite imagery and an advanced analytics platform called FORMA that was developed by computer scientists at the Center for Global Development. The new system analyzes the entire planet every 16 days at a resolution of 250 meters. FORMA's built-in algorithms can automatically detect changes in forest cover, allowing researchers, policy makers, industry and communities to respond to issues immediately. Hamilton calls the new system "exceptionally powerful and a vast improvement in the tools available to communities, policy makers, scientists and companies."[8]

David Wheeler, one of the lead developers at the CDG, began constructing FORMA several years ago based on a hunch that better data on tropical forest clearing and degradation could be obtained if they looked in the right places. "I have always operated on the principal that the data is always out there somewhere, in either public or private hands," Wheeler explains." The

"Deforestation rates in the Brazilian Amazon have dropped by 80 percent since 2004. This is in part due to their efforts to improve the quality and availability of information about what is happening to those forests and to make it rapidly available to those who can take action."

key to moving forward," he says "is to locate the information and then try to negotiate an arrangement with the proprietors to reveal the essence of that info that would be useful in a sector like forests."[9] In this case, there was a satellite dataset available from NASA, but no one had designed the algorithms required to make use of the imagery to identify changes in forest coverage around the planet.

FORMA data also informs CGD's Forest Conservation Performance Ratings—a system of color-coded ratings for tropical forest conservation performance that can be implemented for local areas, countries, regions and the entire pan-tropics.

The most recent ratings, published in a new CGD working paper, are quite alarming. Forest clearing continues to accelerate, and large-scale logging is even occurring in officially protected areas in some of the world's largest national parks.[10]

Building the Capacity for Sustainable Forest Management

For many communities that rely heavily on forest ecosystems, GFW fills a gaping hole in their capacity to move toward sustainable forest management. Take Gabon, a small West African country with an extensive system of lush tropical forest that covers 80% of its territory. During past decades, forest data and maps were guarded from the public—sowing confusion on the ground and creating a significant obstacle to sustainable forest management. Citizens living within Gabon's forests were frequently confronting logging operations that had crossed into their communities or customary lands unannounced, posing a serious threat to their livelihoods. Companies operating logging concessions faced a similar predicament, unable to secure their concession borders and prevent neighboring companies from poaching trees. In the absence of clearly defined, publicly available logging boundaries, forest communities and companies alike lacked a platform from which to defend their rights. So in 2006, WRI signed an agreement with the Gabonese Ministry of Forest Economy, Water, Fishing and Aquaculture (MEFEPA) to collect data and create interactive tools to support sustainable management.[11] These efforts culminated in the publication of a collection of maps and data sets in May 2009. For the first time, policy-makers, companies and citizens have access to an accurate presentation of activity occurring within Gabon's forest sector.[12]

Gabon is just one example. Since 2001, the WRI has built a network of 75 environmental groups and universities that monitors forest development

> *While the multistakeholder process will necessarily embody people who may not always agree, the availability of shared reference data creates the possibility to build trust.*

activities in nine countries, encompassing over 60% of the world's remaining large tracts of intact forest.[13] The network's broader footprint includes hundreds of additional forestry groups that rely on its data to mobilize global concern and build local capacity in their countries.

Several of these countries have made progress in improving the quality of information gathered about forests and have used this information to police actors who violate national forestry laws and policies. One example is Brazil, with its near real-time forest-monitoring systems that have greatly enhanced enforcement efforts. "Deforestation rates in the Brazilian Amazon have dropped by 80 percent since 2004," said Nigel Sizer, Director, Global Forests Initiative, World Resources Institute. "This is in part due to their efforts to improve the quality and availability of information about what is happening to those forests and to make it rapidly available to those who can take action."[14]

Similar efforts are being undertaken in Indonesia, where some of world's largest remaining reserves of tropical forestland are under threat from raging forest fires linked to land-clearing efforts undertaken by the country's biggest commodity producers in wood pulp and palm oil. In fact, WRI's analysis of satellite imagery shows that 57 percent of Indonesia's deforestation is attributable to clearing for palm oil plantations, with another 20 percent coming from pulp and paper.[15] With GFW, governments, companies and civil society can quickly and effectively pinpoint exactly when and where forest fires are happening and determine who is responsible.

At the same time, WRI has identified ample opportunities to shift agribusiness development onto already-cleared degraded lands, which are low in stored carbon and biodiversity. As this concept gains traction, WRI and its partners in Indonesia are working to identify degraded lands suitable for palm oil production, using biophysical, economic, social and legal criteria. The initiative has support from Indonesia's President Susilo Bambang Yudhoyono and multistakeholder groups such as the Roundtable on Sustainable Palm Oil (RSPO).

Unleashing Multistakeholder Models of Environmental Governance

Global Forest Watch shows how the ability to monitor the world's forests or understand the ecological effects of global climate change will improve as a combination of satellite monitoring and remote sensors placed in sensitive natural environments gives us instant access to current indicators and data. The granularity and timeliness of the data will not only help establish greater

> *"By fostering a global network of nature watchers, we are extending the Internet's reach and immediacy beyond the human species."*

certainty about cause and effect and current and future impacts, it will help provide a basis for sound policy responses. "It fundamentally addresses a key component of governance—transparency—enabling people to communicate with each other around an agreed set of consistent information about what's going on," says Sizer.[16]

Jacqueline McGlade, the European Environment Agency's former executive director, goes further, arguing that the knowledge and increased openness fostered by initiatives like Global Forest Watch create new possibilities for cross-sector dialogues where outcomes and scenarios can be visualized and negotiations over strategy are underpinned with the reference data. "We can now bring complex strands of information together into a single, simple-to-use and easy-to-understand application," says McGlade.[17] "And, as more people understand what's happening in their area, more will contribute to solving environmental problems." McGlade calls Global Forest Watch "an intelligence service for global problem solvers" and argues that shared knowledge has become a critical pathway for creating multistakeholder networks based on trust. And once armed with data, networks can make more effective, data-driven decisions. "Communities are bound together by a shared understanding of the context in which they are trying to solve problems," she says. "While the multistakeholder process will necessarily embody people who may not always agree, the availability of shared reference data creates the possibility to build trust."[18]

Wheeler provides a concrete example of how GSNs can be mobilized around GFW data, suggesting that development agencies, governments and civil society groups could use the data to create and pay for performance mechanisms, where rich countries or other donors financially reward developing countries for preserving their forests. Research shows that most forest clearing occurs in developing countries that have limited resources and regulatory capacity. Since these countries also focus on poverty alleviation, their support for forest conservation will be weak as long as forested land has a higher market value in other uses. Under these conditions, many proprietors will continue clearing their forested land unless they are given conservation payments that match or exceed the opportunity cost of the land. Such payments would be costly, however. The UN estimates that full conservation of remaining forests in the tropics and subtropics will require $12.2 billion annually.[19] Sustained international support for such enormous payment flows would hinge on the operational credibility of the programs. Such accountability could only be guaranteed by a monitoring system that provides detailed, accurate and timely identification of deforestation in conservation-payment areas.

Global Forest Watch provides an ideal platform for such monitoring. According to Wheeler, "The idea is that in each country you would establish a timeline toward very low forest clearing in some future date. Then over time you would watch progress toward that goal. You could provide financial rewards and there would be compensation to people who have suffered losses from holding their forests intact."[20]

The Future of Forest Monitoring

As the WRI continues the ongoing development of Global Forest Watch 2.0, many new powerful features are set to launch. For example, communities will be able to engage with the forestry industry directly as companies sign-on to use GFW to report to the public on their forestry operations. Crystal Hamilton suggests that companies criticized by Greenpeace for unsustainable forestry practices will have a credible way to demonstrate that they are logging more sustainably. Civil society watchdogs, meanwhile, will be equipped with powerful tools for monitoring compliance with industry commitments.

Other new features include a utility to allow users to post video clips, pictures and audio testimonies, thus bolstering the ability for the public to participate more directly in monitoring nearby logging activities. GFW will also integrate more advanced map servers and social media technologies into its platform. And third party developers will be encouraged to build new applications on top of the Forest Watch platform, creating the potential for even more powerful and ubiquitous applications in the future.

In fact, forest management and climate change are only two of many domains where new technologies have enabled participatory models of governance led by GSNs. Biodiversity and water scarcity provide other useful examples of how GSNs can augment local regulations and management systems by pooling the resources of a diverse group of stakeholders and leveraging ever-more powerful information technologies to scale up their impact.

Project Noah, for example, is a watchdog network dedicated to monitoring the state of biodiversity on the planet. Launched by students at NYU in 2010, it now enjoys the backing of National Geographic. Like GFW, the project uses crowdsourcing and visual maps to plot the pictures of plants and wildlife taken by nature watchers with their mobile phones. "By fostering a global network of nature watchers, we are extending the Internet's reach and immediacy beyond the human species," says Martin Ceperley, the Chief Technology Officer for Project Noah. "As members grow, I envision an army of citizen scientists, ready to use their cameras and mobile phones to tackle the latest issues at a moment's notice."[21] When it comes to biodiversity, Ceperley argues that the speed of participatory monitoring solutions can be critical, as when an aggressive invasive species threatens the natural order of delicate ecosystems. "Thanks to the speed at which citizen scientists can document and share observations, invasive species and their effects can now be closely identified, studied and remedied before widespread ecosystem troubles emerge—allowing ample time to enact policies to help mitigate further damage," says Ceperley.[22]

Implications for Network Leaders

The promise of technology-enabled watchdog networks like Global Forest Watch boils down to the capability to provide all of the relevant stakeholders with a more granular, encompassing and immediate view of the problems they are trying to solve. Whether monitoring nature or people or built environments, accurate information at the right time can lead to better decision making and inform timely action. The following are the key implications for network leaders.

Watchdog networks are powerful complements to traditional regulatory systems. Today's national regulators face a long list of daunting challenges including the sclerotic pace of rulemaking, growing economic complexity, increasing international interdependency, the corrosive influence of "junk science" and industry lobbying and a broadly insufficient capacity for effective oversight. While these challenges undermine the effectiveness of traditional "command-and control" regulation, watchdog networks like GFW demonstrate how actors outside government can collaborate to advance powerful new solutions. Increasing transparency and public participation in a broad swath of areas that affect the health of our children, families and communities could dramatically bolster the monitoring and enforcement capabilities of governments. In fact, just about every area of regulation today—from air and water quality to food safety and financial services—could benefit as a result of having a larger crowd of informed and empowered individuals helping to protect the public interest.

Combating complex issues like deforestation requires stakeholders from all sectors to work together to implement novel solutions. Paying tropical nations to conserve their forests, for example, helps resolve the tension between the role forests play in supporting livelihoods and economic development and their ecological role in absorbing carbon from the atmosphere. Watchdogs such as GFW complement pay for performance systems by monitoring the accountability of the various parties in honoring their conservation commitments. Meanwhile, large companies such as Unilever, Johnson & Johnson, Walmart and IKEA recently pledged to reduce and eventually eliminate the sourcing of materials from land that was recently cleared of forests. These pledges were undertaken by the industry-led Consumer Goods Forum (a network of 400 retailers, manufacturers and service providers in 70 countries), which in turn is working with the multistakeholder Tropical Forest Alliance 2020 to develop concrete guidance for how to implement the forum's pledge. Once again, monitoring systems like GFW are essential to enabling stakeholders to assess whether companies are delivering on their promises.

A shared evidence base among diverse stakeholders establishes trust and paves the way for more effective collaboration. Disagreements over whose "version of the truth" is correct have derailed many potential partnerships between industry, government and non-governmental actors. But when

irrefutable satellite imagery of Indonesia reveals, for example, that rapid deforestation is linked to two major commodity production operations there can be no denying who is responsible for the problem. Indeed, when all stakeholders consider a shared evidence base credible, the focus can shift from defining the problem and assigning blame to finding solutions and assembling the knowledge and resources to implement them—just as the WRI and its partners are doing in Indonesia today. The promise of more transparent and participatory forms of environmental governance is that increased trust and stakeholder participation will help deliver concrete outcomes could not have been delivered by industry or government alone.

GSNs can combine satellite monitoring and remote sensing with local crowdsourcing efforts to engage the public. In fact, the combination of these methods provides a powerful way to capture local irregularities and issues that are impossible to detect remotely. GFW has recognized, for example, that while visual maps and computer algorithms can help detect deforestation patterns, there is no substitute for local knowledge and on-site intelligence when it comes to identifying the source of deforestation. The same is true in other domains, including biodiversity and water. Project Noah's detailed maps displaying biodiversity around the planet would not be possible without the on-the-ground photos and reports contributed by its global network of nature watchers. And as Sara Boettiger noted in her report "New Tools for Tackling Poverty,"[23] GSNs are working all over the world to address water quality and water supply issues, and crowdsourcing features prominently in the toolkit of effective approaches. In addition to the Akvo FLOW case featured earlier, IBM worked with the government of South Africa in 2013 to create a crowdsourcing platform that allows users to report problems with water pipes and leaks, and generally comment on the delivery of water.[24] In Berlin, WaterWatcher is a simple, cheap test of water quality that interfaces with your mobile phone.25 Whether tracking forests, water quality or biodiversity, the potential for citizens to participate directly in environmental governance could vastly expand the human resource pool available for ecological monitoring.

GSNs will need data scientists and must invest in data literacy training. Basic data literacy is assumed amongst scientists, but the general population has nowhere near the level of data literacy that will be required in most professions in the near future. And the same can be said of the vast majority of organizations that participate in GSNs, with the GFW team representing a rare exception. Even in science, recent developments have upped the ante. To do path-breaking science, scientists need to be fluent in large-scale data analytics or partner with those who are. Similarly, skills in managing, presenting and extracting insight from data will be increasingly valuable in the business of solving the world's problems. Indeed, it will be increasingly difficult to convince anyone—citizens, governments or corporations—of the need to change behavior in the absence of convincing data. Accordingly, GSNs will need to foster data literacy within their memberships through workshops and training sessions and should also work with organizations such as World Resources Institute and the Center for Global Development to cultivate an interest in global problem solving among the broader community of data scientists.

GSNs will need to harness cloud computing and parallel programming. As already noted, the emergence of crowd sourcing and citizen science, along with widely dispersed sensors, will produce vast amounts of new data from low cost unstructured sources. The implication is that implementing these distributed monitoring and data collection strategies will only be viable if sufficient infrastructure is developed in parallel. For example, massive volumes of data might be collected in real time and would need to be uploaded, synthesized and analyzed in relatively short order. Even with numerous real-time sensors, measurements would not be collected at all places at all times, so analytical techniques would be required to discern temporal or spatial patterns from raw data. GSNs will need to enhance their computational and analytical infrastructure, or alternatively, partner with companies already utilizing similar technologies (e.g., Google). Similarly, global problem solvers will need to increase resources devoted to statistical analysis, including Bayesian techniques and other strategies to optimally combine model outputs and monitoring data. In short, the time has come for the global problem solving community to get serious about its need to take advantage of advanced computing services, including new approaches such as parallel programming and cloud computing.

by Anthony Williams for Global Solution Networks

Endnotes

1 See the California Institute for Technology and Carnegie Mellon experiments where low-power intelligent wireless sensors measure everything from temperature to movement to chemical composition and report that information back in real-time.

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Global Solution Networks is a landmark study of the potential of global web-based and mobile networks for cooperation, problem solving and governance. This project is a deliverable of the research program, offered through the Martin Prosperity Institute at the Rotman School of Management, University of Toronto.

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Ten Types of Global Solution Network

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