

**Information and Communications Technology**  
**and**  
**The Eradication of Hunger**

“Hunger” and “malnutrition” are words that can hide a reality rather than reveal it. For most Internet users, “hunger” is a temporary discomfort easily reduced; that experience of hunger is not the subject of this essay. “Malnutrition” is a word used in the professional communities, deliberately distancing us from the brutal reality too often found in developing countries. The problem under discussion includes sick and dying children, workers who can’t put in a full days work for lack of energy, pregnant women unable to properly nourish the fetuses growing within them, and children whose brains won’t develop their full potential because they don’t get the required nutrients. It includes people whose vision is failing from lack of vitamin A, and adults who suffer from a variety of disabilities as the legacy of lifetimes of nutritional deprivation.

I spent a number of years as a health planner going in and out of hospitals in developing countries. Those hospitals were full of kids in desperate trouble; many were going to die very young. They were born too small. They got sick often – with respiratory infections and diarrhea most often, but with vector-borne diseases as well. They stayed sick with each episode comparatively longer than did the bigger, healthier kids of their ages, because their nutrient-deprived immune systems didn’t work very well. When they were sick, and that was a lot of the time, they were not very hungry. Their food needs were great because they had to catch up on stunted growth, and they had fevers that burned up energy and diarrhea that lost nutrients. Yet their families had few resources for food or medicine, had little knowledge or understanding of how to help, and lived in environments where the kids would be often exposed to disease. These children had big bellies and weak muscles; their hair was often discolored by the symptoms of protein deficiency; their eyes were staring, but disinterested. This is what results from the endemic nutritional problems in many developing countries; these are the children who have so far survived.

In a fundamental way, information and communications technologies (ICT) are not going to help these kids. They can’t eat computers, telephones won’t make them well. To make a dent in the social and economic problems that result in the suffering of millions of these children, you need cultural change and wide spread social and economic development. Good government, good policies, and stronger institutions seem good places to start the reforms.

However, given people, policies and institutions working to solve the problems of hunger and malnutrition, ICT can make a difference. Lets examine how.

The following discussion will be in the framework of the Millennium Development Goals.<sup>1</sup> The first Goal is Eradication of Extreme Poverty and Hunger, and the second target related to this goal calls for reducing the portion of people who suffer from hunger

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<sup>1</sup> <http://www.developmentgoals.org/>

by half between 1990 and 2015. Indicators are the prevalence of underweight children and the proportion of population below minimum level of dietary energy consumption.

Goal and target	Indicators
<b>Goal 1 Eradicate extreme poverty and hunger</b>	
Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger	<ul style="list-style-type: none"> <li>• 4. <u>Prevalence of underweight in children (under five years of age)</u></li> <li>• 5. <u>Proportion of population below minimum level of dietary energy consumption</u></li> </ul>

It is important to recognize that targets and indicators are simplifications that only partially and inadequately describe what is to be achieved. The goal of helping people be better nourished is a very wide one, and these specifics have been selected as measurable surrogates for the larger, unquantifiable goal.

The following discussion is divided for convenience sake into four sections:

- the production and distribution of food;
- the ability to acquire food;
- health and nutrition; and
- broader policy concerns.

### **Food Production and Distribution**

Food production is itself an incredibly complex process, and one in which ICT can be involved in almost every step. This discussion can only skim the surface. Food is produced by growing crops, by raising livestock, by hunting and gathering, and by fishing and aquaculture.

Consider some of the applications of ICT in crop production:

- Land: ICT has proved fundamental to efficient land surveys and cadastral registration; it can support the development of markets for agricultural property. Ownership of the land not only encourages the sustainable management of the resources, but allows it to be turned into capital and used as collateral for borrowing.
- Soils: ICT can be used in mapping soils, measuring soil properties, prescribing soil improvements, and automating the applications of fertilizers and amendments.
- Water: ICT can be used to forecast rain and drought; to disseminate weather information; to help plan, maintain, and operate irrigation systems; to help plan and build flood control and other water management systems; to help explore and manage underground aquifers; and to help improve understanding of the best uses of water for crop production.
- Crop varieties: ICT is increasingly a vital element in the breeding of improved crop varieties; computerized crop models can be used to predict the responses of new varieties and new crops.

- Seeds: ICT can contribute to the efficient production of improved seed; to the distribution of the best seed to each specific local; and to the efficient operation of seed markets and seed distribution chains.
- Fertilizer: ICT can be used in determining fertilizer needs; in exploration for new sources of mineral fertilizers; in improving the efficiency of fertilizer production; in improving understanding of optimum use of fertilization; and in improving the efficiency of fertilizer distribution systems and fertilizer markets,
- Control of crop pests: ICT are fundamental tools for basic and applied research on crop pests; they can help in the training of agricultural entomologists and other experts on agricultural pests; and they can help monitor and project the distribution of pests. Moreover, electronic media are fundamental to better dissemination of pest warnings to farmers; ICT can help determine optimum pest control measures and schedules for farmers and farming communities.
- Control of crop diseases: ICT can help automate the identification of crop diseases, can assist in the training of plant pathologists, and can provide more and better information for disease identification. ICT are fundamental tools for basic and applied research on crop diseases. They can be used in monitoring and projecting the distribution of disease, and then contribute to the better dissemination of disease warnings to farmers; they can, moreover, help determine optimum disease control measures and schedules for farmers and farming communities.
- Pesticides: ICT are fundamental tools in the R&D to develop new pesticides; they can improve the productivity of pesticide production processes; they can be used to help improve pesticide distribution and market efficiency.
- Biocontrol: Similarly, ICT are fundamental tools to researchers seeking to understand and to design biocontrol processes. They can help in the efficient production of biocontrol agents; they are fundamental to the dissemination of information to farmers and farm communities about biocontrol; and they enable effective monitoring of biocontrol efforts.
- Farming systems: ICT can help in understanding crop rotation, intercropping, mixed cropping systems, biological nitrogen fixation, and other aspects of farming systems - and electronic media are essential to the continuing education of farmers about such systems. ICT are equally fundamental to efficient large scale monitoring of environmental changes and farming practices, and to the planning and introduction of improved systems.
- Human resources: ICT can be used to improve the efficiency and effectiveness of training programs for those in the agricultural system; they can improve the efficiency of agricultural labor markets; and they can play a useful role in the efficient provision of health services to agricultural workers.
- Finance: Information-based financial services, such as farm credit and crop insurance, can be greatly improved via the appropriate applications of ICT.
- Agricultural machinery: ICT are now often embedded in agricultural machinery, contributing to efficient operation. They are an indispensable tool to modern agricultural machinery design, and can further be used to improve the manufacturing of machinery, as well as to make markets for agricultural machinery operate more efficiently.

- Extension services: ICT would seem increasingly indispensable for the government agricultural extension worker. They facilitate the provision of information services from other sources, such as extension services from commercial firms purchasing the produce or civil society organizations. Moreover, the electronic media are being used to provide new channels for the dissemination of agricultural information.
- Farm management: The personal computer and Internet connection are fundamental tools for farmers in developed nations, and Internet kiosks can provide affordable and useful tools for farm management to cooperatives and villages in developing nations.

ICT also play a role in the prevention of post-harvest food losses, and such losses waste a significant portion of the food that is grown. They are useful tools in the hands of those who would design and build grain storage facilities, and those who would reduce post harvest losses to pests. They can be used to improve food processing, and to make output markets and food distribution systems function more efficiently. Farmers network through cooperatives and many other means to seek answers to common problems, and to share information; ICT are increasingly important tools for such efforts.

It is widely understood that appropriate policies and institutions are necessary conditions for rapid improvement of agricultural production and productivity. Increasingly, ICT forms the technological backbone of the information infrastructure of the required institutions. ICT is an invaluable tool for agricultural policy makers as they seek to keep track of prices and production, to understand the influence of policy instruments on agricultural practice, to project agricultural conditions and the potential effects of policy alternatives, to draw upon and to apply world expertise to local problems, to improve the policy making process, and to disseminate and to implement policies.

### **The Ability to Acquire Food**

In order to eradicate hunger, people must have enough resources to acquire food, and food must be distributed equitably from where it is produced to where it is needed. Brazil is now one of the world's major exporters of food, yet its president has found it necessary to mount a major new program to deal with wide spread hunger.<sup>2</sup> Indeed, the potato famine in 19<sup>th</sup> century Ireland, marked by the deaths of more than a million people, occurred while Ireland was still exporting food.

Increasing per capita income is perhaps the most important step in fighting hunger and malnutrition; one seldom finds affluent people afflicted by hunger. Rich countries that produce less food than they consume can readily import food to meet the deficit. Poor countries export food while people go hungry.

In general, the poorer the country, the greater the portion of its workforce is in rural areas, and the worse the problems of hunger and malnutrition. Much hunger is

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<sup>2</sup> Madarasz, Norman, "Dissecting Brazil's Zero Hunger," [www.brazzil.com](http://www.brazzil.com), September 2003.  
<http://www.brazzil.com/2003/html/news/articles/sep03/p104sep03.htm>

concentrated in the very rural areas in which food is produced. Thus the previous discussion of the role of ICT in increasing food production is quite relevant to the problem of increasing the ability to acquire food; for the subsistence farmer, it is the same problem.

On the other hand, there is a great deal of hunger and malnutrition in urban slums of developing nations, and there is clearly the potential for worse; cities are already large, and urbanization is taking place at a historically unprecedented rate. Improving incomes for the urban poor therefore becomes a priority in the effort to reduce hunger. (Improving food production, as addressed above, also tends to help; more efficient production and distribution of food normally results in food being more affordable in urban centers.)

Ultimately, reducing poverty by increasing all forms of economic productivity is fundamental to increasing the economic ability of the poor to acquire food. The two targets of the first goal of the MDG—eradicating extreme poverty and eradicating hunger—are closely intertwined. In a previous essay, I discussed the role of ICT in poverty reduction.<sup>3</sup> That essay was part of a broader treatment of the topic.<sup>4</sup> Therefore I will not further discuss the general application of ICT to poverty reduction here.

It is not enough to increase average income; The distribution of incomes must be considered. There must be alongside and within pro-poor policies an assurance that disadvantaged ethnic minorities have access to the resources to assure adequate nutrition - and ICT can be useful in developing, implementing and monitoring policies so aligned.

It is especially important in the effort to decrease malnutrition that resources get to women, especially to mothers. It is most frequently a woman who makes household food acquisition decisions, and who is responsible for feeding the children. A previous essay was written on ICT, Gender Equality and Empowering Women,<sup>5</sup> and so that topic too will not be discussed further in this essay.

How can ICT contribute to the improved distribution of food? In many ways:

- Transportation systems (especially railroad, trucking, and water transportation) have been made more efficient through the application of ICT;
- Organizations at every point in the food chain (wholesale and retail distribution) can improve their efficiency through well understood applications of computers and communications technologies;
- Food stocks can be managed more efficiently;
- Markets can be made more efficient, and therefore the costs of intermediation in the food chain can be reduced;

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<sup>3</sup> Daly, John A., "ICT, Economic Growth and Poverty Reduction", Development Gateway, March 2003. <http://www.developmentgateway.org/node/133831/sdm/docview?docid=495495>

<sup>4</sup> "ICT for Poverty Reduction & Economic Growth". <http://www.developmentgateway.org/node/133831/sdm/docview?docid=492330>

<sup>5</sup> Daly, John A., "ICT, Gender Equality and Empowering Women," Development Gateway, August 6, 2003. <http://www.developmentgateway.com/node/133831/sdm/docview?docid=622821>

- Uneven availability of food supplies can be more easily recognized through the application of ICT; and food markets can be extended geographically and made more efficient, so that food can be transferred more effectively by those markets to places with relative shortages.

Famine conditions can be seen as the extreme consequence of the unequal distribution of food. Where food shortages occur over a large geographic region, normal distribution systems and markets are sometimes unable to make enough food available for all of the people in the region; food shortage becomes famine where transportation systems are not sufficient to bring enough food into the region of shortage, or where people do not have the resources to pay the higher costs of food imported for their needs.

In part the answer to famine is information. Information on the variability of food production is needed to plan to accumulate appropriate food stocks. The difficulties of moving food into isolated regions can be overcome if one can use the limited transportation facilities for enough time in advance of the crisis; the high costs of food imports can be reduced if there is sufficient time to purchase food efficiently on regional or world markets and to arrange for low cost shipment to the affected areas. The time needed can be obtained by gathering information needed to provide early warning of impending food shortages. Moreover, government policies contributing to the shortage can be modified or relaxed with sufficient warning. Thus there has been considerable interest in developing ICT-based systems such as the Famine Early Warning System<sup>6</sup> and the Global Information and Early Warning System on Food and Agriculture (GIEWS).<sup>7</sup>

### **Nutrition as a Public Health Problem**

Malnutrition and disease form a viscous cycle. Diseases can cause loss of appetite, failure to absorb nutrients from food, and increased energy demands on the body, making it more difficult to achieve adequate nutrition. Malnutrition can weaken the immune system, making it more difficult for the body to fight off disease. Therefore, public health interventions must be a part of any effort to deal with hunger and malnutrition. They are, of course, especially important in terms of the MDG's first hunger related target: reducing the numbers of underweight children.

Maternal and child health (MCH) services - nutrition education, pre-natal care for expectant mothers, well child care, immunizations, diagnostic and curative services for the ill, and more - are crucial. So too, family planning services help families in several ways to improve the nutrition of mothers and children. Commonly, measurements related to nutritional status are taken during MCH services and used as key indicators of physical wellbeing. While a later essay will focus on the application of ICT in health services, it should be clear that there are many areas of application. ICT can facilitate training and continuing education of health workers, can reduce the costs of otherwise time consuming information services, can support the accurate diagnosis and monitoring of

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<sup>6</sup> <http://www.fews.net/>

<sup>7</sup> <http://www.fao.org/waicent/faoinfo/economic/gIEWS/english/giewse.htm>

patients, can help improve the operation and efficiency of pharmaceutical supply chains, and they can do a great deal more.

Health and nutrition education are very important. Through education, people can be empowered to be more effective guardians of their own health and nutrition and those of their children. Health and nutrition education take place in schools, in health service facilities, in pharmacies, and via media such as radio, television and the Internet. But in all cases, innovative, thoughtful use of appropriate ICT can be of great use in making educational services effective and affordable.

Water and sanitation must be considered. Water-washed diseases even more than water-borne disease play a role in the disease clusters that most damage nutritional status. Hygiene becomes a factor in nutrition programs. Therefore provision of adequate potable water and effective waste disposal are important in achieving nutritional goals. ICT can play a huge role in finding water sources, designing low-cost potable water and sewerage networks, and improving the efficiency of the organizations that build and maintain those networks. Electronic media can help in hygiene education.

Control of infectious diseases is also important. In part this is done through immunizations within comprehensive maternal and child health and other health services. However, epidemiological surveillance and disease reporting are needed for public health officials to understand the status of epidemic and endemic diseases, and such surveillance can be greatly improved through the use of a broad suite of ICT – from remote sensing, to automated diagnostic tests, to computerized data bases, to geographic information systems, to large scale networks for disease reporting. And again, organizations engaged in the control of vector born disease and other communicable disease can be operated more efficiently and with higher quality services through the appropriate utilization of the technology.

While the emphasis implied by the Millennium Development Goals is on calorie-protein malnutrition, a century's public health experience indicates that poor countries must also focus on micronutrients. Lack of key minerals and vitamins in the diet can have very serious repercussions, even when people get enough calories in their diets and do not suffer from protein malnutrition. Public health officials need epidemiological information to understand the incidence and prevalence of micronutrient malnutrition, and obviously ICT can help obtain such information accurately, quickly and at reasonable cost. Interventions to reduce micronutrient problems include food fortification, and there are a number of ways in which automation can be used to improve processes to fortify salt, milk, bread and other foods, and to make their distribution more efficient.

### **Broader Concerns**

The discussion above suggests that the nutritional status of a nation's people results from its overall development program and its progress. That is not far from the truth. One of the themes of this series of essays is a refutation of "technological determinism." A nation's nutritional status is the outcome of its political, economic and social processes as

well as its technological processes. ICT can help give voice to those seeking to improve nutrition. It can help gather the data and present the picture of hunger and malnutrition that may help to develop the political will to improve the nutrition situation. It can be applied to help make nutrition interventions more timely and efficient.

That said, ICT is far from a panacea for nutritional problems. Indeed, I believe that the social and political will to improve nutrition (within a comprehensive development effort) are necessary for ICT to be used effectively in the process.

Nutrition policy can and should be defined at the national scale. In the above discussion, I have briefly sketched an array of policy instruments that can affect nutrition levels. There are more.

For example, policies on food prices (controls, subsidies) can affect the cost of food for consumers, and the incentives for food production of farmers. From Roman times (Bread and Circuses), governments have often tried to keep food prices low in their capitals for political or other reasons; in consequence they have often faced problems of failing food supplies for lack of economic incentives for farmers. Trade policies influence the availability of food, as does the food assistance provided by various donors. Recently we have seen regulatory policies on genetically modified crops and foods affecting food supplies in African countries threatened by severe food shortages. Clearly ICT should be crucial tools in the hands of the policy analysts supporting the wide range of policy-making affecting nutrition, and clearly nutritional implications of policy decisions should be included in computer models and decision support systems for such policy makers. Similarly, agricultural information systems, public health information systems, and information systems dealing with income and employment are all important for such policy making, and clearly there is a large and increasing role for ICT therein.

In an earlier essay in this series, on ICT and the environment,<sup>8</sup> I suggested that it was necessary to achieve a balanced national landscape so that agriculture and other economic activities could be carried out sustainably. Lands suitable for intensive agriculture should be used intensively, while fragile lands should be protected from overexploitation. We can add to this picture the issue of food and nutrition. The landscape pattern of agricultural activities should be such that food is available and affordable to the poor. Water and sanitation services should assure that people not suffer from avoidable disease, in part because of the nutritional consequences of those diseases. Transportation and communications infrastructure must allow the efficient transport of food from where it is produced to where it is consumed. ICT can obviously serve as powerful tools in the hands of those seeking policies that would achieve such balanced landscapes.

A crucial feature of the global acceptance of the MDG was an agreement that progress toward the targets would be monitored using standardized indicators. ICT will be important instruments in developing the data to monitor progress. Most countries should and will seek much more extensive statistical information to monitor nutrition status and

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<sup>8</sup> Daly, John A., "ICT and Ensuring Environmental Sustainability," Development Gateway, June 3, 2003. <http://www.developmentgateway.org/node/133831/sdm/docview?docid=569545>



progress in improving nutrition; they will consequently utilize ICT extensively in their nutritional reporting systems.

Many years ago a colleague<sup>9</sup> developed a sequential process for diagnosis of nutritional problems. He suggested that there were so many reasons that a community might face nutrition problems that efficient search procedures were needed to select among them. First one would test whether or not there was a community nutrition problem. If so, one might see if food was available and affordable. If the problem was inadequate availability of food, one might search one set of possibilities related to food production; if the problem were the affordability of food, a different set of possibilities might be studied relating to income and food distribution; if health problems were the culprit, still a third set of possibilities would come under consideration. Again, each of these three sets of possibilities can be partitioned into smaller sets by key tests based on specific data. Having developed a specific diagnosis of the community problem, one might then move efficiently to prescription and prognosis. My colleague was a systems analyst, and his approach depended on the application of information and communications technology in his diagnostic and prognostic procedures. I suggest this approach is in fact interesting and useful. I would note further that the ideas of systems analysis that grew out of the community of those seeking to apply ICT to complex social and economic systems apply to improving nutrition. Indeed, the systems approach may be the most important contribution of ICT to nutrition in developing nations.

### **Concluding Remarks**

There are huge numbers of ICT innovations that can contribute to the eradication of hunger and malnutrition. Some are simple and relatively inexpensive, such as the introduction of a cell phone in a village to allow a mother to make a pay call to a paramedical practitioner for advice on a malnourished and sick child. Some are complex and expensive, such as the introduction of a satellite remote-sensing-based warning system to serve a continental area and provide advance notice of developing food shortages. Developing countries face severe constraints on human, financial and other resources. Faced with the gravity of the problem of hunger and malnutrition, developing nations need to allocate these resources to ICT innovation in such a way that they are effective in saving lives and reducing hunger and malnutrition. However, even in the best of cases, progress will probably be slower than humanitarian concerns might dictate.

The ICT innovations to fight hunger and malnutrition form only a portion of the total set of ICT innovations that we see as the growth and elaboration of the Global Information Infrastructure (GII). The GII is already vast, and growing very quickly. It does so under the influence of economic, social, political, and cultural forces that we only poorly understand and partially control. Individuals, even the most powerful, have only limited power to affect the pattern of that growth. It is surely beyond our power to fully optimize the growth of the GII to eradicate hunger.

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<sup>9</sup> Dean Wilson.

Yet, developing nations can hope to develop an environment favorable to the rapid growth of their National Information Infrastructures. They can seek to provide incentives for people to innovate developing and using ICT in ways that contribute to the eradication of hunger. Systems can be institutionalized that allow innovators to compete for scarce ICT resources – systems in which contribution to the eradication of hunger are favored. We know how to institutionalize bureaucratic, political, and market processes of the kind that are needed. It remains to be seen where and how widely the political and social will are to be mobilized in order to do so.

### **Links related to ICT for the Eradication of Hunger and Malnutrition**

e-GFAR Electronic Global Forum on Agricultural Research  
<http://www.egfar.org/home.shtml>

World Agricultural Information Centre  
[http://www.fao.org/waicent/index\\_en.asp](http://www.fao.org/waicent/index_en.asp)

International Food Policy Research Institute:  
<http://www.ifpri.org/>

CTA  
<http://www.cta.int>

TeleFood project  
<http://www.fao.org/Food/english/about/index.html>

CGIAR: infofinder  
<http://infofinder.cgiar.org/>

World Bank Sustainable Agriculture: Information and Communication Technologies  
<http://lnweb18.worldbank.org/ESSD/ardext.nsf/26ByDocName/InformationandCommunicationTechnologiesParent>

International Consortium for Agricultural Systems Applications  
<http://www.icasa.net/>

Decision Support System for Agrotechnology Transfer  
<http://www.icasa.net/dssat/>

Bringing GIS to Bear on Global Hunger and Food Security Problems  
<http://www.esri.com/news/arcnews/fall02articles/bringing-gis.html>

The Famine Early Warning System  
<http://www.fews.net/>

Global Information and Early Warning System on Food and Agriculture (GIEWS)

<http://www.fao.org/waicent/faoinfo/economic/giews/english/giewse.htm>

World Health Organization: Nutrition

<http://www.who.int/nut/>

Case Studies of the PovertyMap Project:

<http://www.povertymap.net/casestudies.cfm>

### **Relevant Development Gateway ICT4D Resource Collections, Features and Highlights**

ICT for Agriculture & Rural Development (resource collection)

[http://www.developmentgateway.org/node/133831/browser/?keyword\\_list=452462](http://www.developmentgateway.org/node/133831/browser/?keyword_list=452462)

ICT for Health (resource collection)

[http://www.developmentgateway.org/node/133831/browser/?keyword\\_list=274295](http://www.developmentgateway.org/node/133831/browser/?keyword_list=274295)

Using Information and Communication Technologies (ICTs) for Health Care Delivery in Africa (highlight)

<http://www.developmentgateway.org/node/133831/sdm/docview?docid=369724>

ICT & Gender (resource collection)

[http://www.developmentgateway.org/node/133831/browser/?keyword\\_list=277008](http://www.developmentgateway.org/node/133831/browser/?keyword_list=277008)

Empowering Women Through ICT (highlight)

<http://www.developmentgateway.org/node/133831/sdm/docview?docid=347061>

ICT, Gender Equality and Empowering Women (feature)

<http://www.developmentgateway.org/node/133831/sdm/docview?docid=622821>

ICT for Poverty Reduction & Growth (resource collection)

[http://www.developmentgateway.org/node/133831/browser/?keyword\\_list=505328](http://www.developmentgateway.org/node/133831/browser/?keyword_list=505328)

ICT for Poverty Reduction & Economic Growth (highlight)

<http://www.developmentgateway.org/node/133831/sdm/docview?docid=492330>

Why ICT Matters for Growth and Poverty Reduction (feature)

<http://www.developmentgateway.org/node/133831/sdm/docview?docid=510867>

ICT & Millennium Development Goals (resource collection)

[http://www.developmentgateway.org/ict/browser/?keyword\\_list=467967](http://www.developmentgateway.org/ict/browser/?keyword_list=467967)