Solutions for the Developing World

As scientists and engineers engaged in nanotechnology and materials science, we are trained to examine highly complex problems and consider how our understanding can be applied toward a solution. We generally focus on intricate details of a fairly narrow and highly defined realm within chemistry, physics, materials, or other fields. However, it can also be extremely rewarding to apply these skill sets to entirely new problems that are central to the challenges of the developing world.[1]

This past month, I was able to take part in such an opportunity as a member of a science team assembled by the Meridian Institute[2] for a project funded by the Bill & Melinda Gates Foundation, to look at problems that are very real, yet far removed from the direct science and engineering problems that are a part of daily life in a classic academic or research institution. We were charged with examining problems confronting typical smallholder farmers in Africa (*i.e.*, farmers earning $1−$2 per day), with specific emphasis on three important agricultural products: dairy, maize, and cassava. A diverse group of scientists, engineers, and agricultural and food technology experts set out together on a field trip to examine the problems of poor farmers in the rural regions of Kenya and Ghana, with the goal of improving their ability to move products to market, thus increasing their incomes and improving local economies. Many of the problems were ones that could easily be addressed in places with access to capital and strong infrastructure such as well-paved roads, electricity, and plumbed water; however, the solutions needed to be implemented in regions that lacked many of these things. For example, dairy farmers who live far from milk processing centers that can chill their milk can often lose the afternoon milk produced by their cows to spoilage due to the inability to store it overnight. Maize farmers with little or no access to power are limited to sun-drying their grain, leaving the process at the mercy of weather conditions and the risk of toxins generated by fungus and other invasive species.

When first asked about joining this team, I found the topic to be remote from problems more familiar to me; however, the team intentionally included people from many

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IMAGE COURTESY OF PAULA T. HAMMOND

In the Kisumu province in Kenya, farmers and their families make up small collectives that share resources to increase the local economy of the village. Maize (pictured in background) is an important agricultural product of this region.

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different backgrounds with the idea of generating opportunities for collaborative innovation. The fresh perspectives that each of us brought, along with the critical needs and limitations that we observed firsthand, provided fuel for us all to think differently. In retrospect, it is clear that new technologies, including those using nanomaterials and nano- to microscale systems, can play an important role in addressing critical global problems such as those concerning food security in developing countries. Can nano approaches be used to develop new, exceedingly rapid, stable, and easy-to-use diagnostic tools to detect disease in cattle or quality of milk for less than a dollar per test? Are there materials structured on the nanometer length scale that can lead to tough, sterilized food containers that resist bacterial and fungal invasion at very low cost? Is it possible to create extremely low-cost membranes from existing materials that enable water purification or water capture from the environment? Unique to addressing these problems are the constraints of cost, ability to manufacture materials, energy source, and the fact that the solution must be robust and fit into the farmer's market needs and lifestyle if it is to be adopted.

There are many problems such as these where potential nanoscience and nanotechnology solutions exist and could have enormous impact, but which may not get significant attention from the fully developed scientific world. It is exciting to consider these possibilities and greater focus on the broader needs of our world community.

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REFERENCES AND NOTES

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2. Meridian Institute, http://www.merid.org/.