Trees for Life Journal
a forum on beneficial trees and plants
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Essays

# Using Science to Help the Poor: Low-Budget Research Ideas. Part 2: Observations and Suggestions

**Martin Price, Ph.D.**
Executive Director, Educational Concerns for Hunger Organization (ECHO)
17391 Durrance Rd., North Ft. Myers, Florida 33917 USA, www.echonet.org

**In what ways can science and technology serve the poor and underserved?**

I have been unbelievably blessed in my middle class life by advances in technology. I think of the blood pressure medicine that probably keeps me alive, my shirt that does not need to be ironed, airplanes that take me to conferences, tires that seldom go flat, productive farms that keep the cost of food at a low percent of my budget, etc. All of these have one thing in common: either the government, another third party or I spend money on my behalf to bring these benefits to me.

Therein lies an important screen for recognizing a research project that would benefit the very poor—it must not require money to make use of the result. Some of the working poor might earn $100 a year. Some earn nothing and have only what they grow or collect. (There is one exception to this. I can envision research that develops a process or design that becomes the basis for a small business that costs money to establish, but the new product gives employment to the poor.)

What could we ever develop using science that would cost the poor nothing? It is not hard to think of examples. We could develop a non-hybrid seed of an important crop that is able to resist a serious disease. (However, even much university plant breeding research these days is directed toward developing hybrid, proprietary seeds to fund the lab, either under contract from a company or in hopes of patenting and selling the variety). We could develop a way to produce an effective antibiotic ointment as a micro-enterprise in a remote Third World community (see "Make an Antibiotic Ointment from Seeds of the Moringa Tree" in Part 3). We could study a medicinal plant, not with the aim of identifying and synthesizing the drug to make it into a pill, but to put quality information into the hands of doctors who serve the exceptionally poor so they could make reliable "prescriptions" based on use of the plant.

## The Nature of the Problem

Poor health, hunger, poverty and a lack of education are often the result of a community that is "economically sick" because the agricultural backbone of the economy is so unproductive. It is a bottomless pit to send only medical assistance to treat diseases caused by poor nutrition and yet to do nothing about unproductive farms. An example that might impact a farm's productivity is research on how to make a rat poison from a local tree (I will provide specific suggestions in a subsequent article for "Leaves of the Gliricidia Tree to Control Rats?")

Solving these problems requires the efforts of some of our most talented people, both in laboratories and in the field, by scientists and community development specialists. Agriculture needs skilled, dedicated and intelligent people every bit as much as does medicine or ecology. As for the academic value, a student can gain the same insights into the nature of the research process and experience using the tools of that branch of science by doing the right "applied" project as by doing basic research.

## Research at Universities or International Research Centers

First let me say that I am thinking of scientists who are primarily working in the "hard sciences" like chemistry, biochemistry, and biology because that is my background. Opportunities for applied research are likely to be more abundant and possibly more appreciated by others in the department if you work in applied science departments like agronomy, food science or animal science. (Opportunities are especially abundant in engineering fields. I do not address engineering because I know so little about it.) Many, but not all, of my comments will be relevant in either situation.

Larger institutions provide an order of magnitude more resources, including time, dollars and libraries. They would seem to be the ideal place to tackle problems like those I will later describe. But there is one serious problem—they lack flexibility to do something just because it is a great research idea and needs to be done.

As I understand it, university researchers must find a potential



**Contact:** Martin Price
**E-mail:** mprice@echonet.org
**Published:** May 23, 2006

The electronic version of this article is the complete one and can be found online at: http://www.TFLJournal.org/article.php/20060407142721774

Trees for Life Journal 2006, 1:8

funding agency and write a successful grant application that includes a portion of their salary plus overhead for the university. In contrast, low-budget research at a college can be undertaken at some minimal level at the decision of the researcher, but will require a lot of creativity and probably some personal sacrifice in terms of working for nothing during the summers.

Organization of universities into academic disciplines can be a serious barrier to problem-solving as well. Successful problem-solving research is often, even usually, inter-disciplinary. I was fortunate during my three years of post-doctoral research in the biochemistry department at Purdue University. The international studies office had pulled together several departments in a successful grant to work on a range of problems concerning cultivation and use of sorghum in the tropics. This allowed me to go in whatever direction was needed to solve a problem. I co-published with biochemists, agronomists and animal scientists and led one project in Puerto Rico with ornithologists from the US Fish and Wildlife Department.

A more common situation is that a scientist will have a grant for her department and that department only. There would be little enthusiasm if she suddenly asked the chairman to let another department use a big portion of the grant because she now realized that their help was going to be needed to solve the total problem. Since so little money is involved in research at colleges, the only barrier to collaboration is, hopefully, finding a like-minded colleague.

Another problem, if you are in one of the "hard science" departments, is that your colleagues may place little value on what they perceive as less elegant research. There are occasions where you must make a decision—to go in the best direction to solve a problem or to choose a direction that would require more skill, that stays clearly within your discipline, and that would lead to more elegant papers. That is not to say that problem-solving research cannot be elegant. For a great example, I would refer you to a research project between Purdue professors Dr. Larry Butler in biochemistry and Dr. Gebisa Ejeta in agronomy. Their research led to non-hybrid sorghum (i.e. farmers could save and increase their own seed) that was not affected by the horrible parasitic weed striga. The research was not only elegant but is a great benefit to the poorest of the poor in Africa (1, 2, 3).

The 15 international agricultural research centers that are part of the Consultative Group for International Agricultural Research (CGIAR) specialize in using agricultural science to help the poor. They are supported by the United Nations and other major donors. Each Center specializes in just a few areas of agriculture. For example, CIAT (International Center for Tropical Agriculture) in Colombia specializes in beans, cassava, tropical forages and tropical fruits. IRRI (International Rice Research Institute) in the Philippines specializes in rice. They bring together some of the best scientists in those fields from all over the world. They often work on problems of both the large and the small farmer. As an example of the work that these centers do, let me site one major project of the work of CIMMYT (International Center for Improvement of Corn and Wheat) in Mexico. CIMMYT specializes in corn and wheat. A few years ago they developed a high-yielding corn that had high amounts of the limiting amino acid lysine. They deliberately chose not to develop a hybrid so that farmers could increase their own seed. The CGIAR centers definitely would provide a career outlet for a scientist to do research that would benefit the poor. You can see a list of all 15 centers and links to their individual websites at www.cgiar.org.

If you are a student considering a research career, there will likely be greater opportunities at larger institutions, providing you can get around the problems just discussed. I would be surprised if either the International Centers or universities undertook projects such as I am proposing here. If I am wrong and they do, then no doubt they could devote much more time and resources to solving the problems than could the undergraduate college. Until they do, these research ideas are wide open to scientists at smaller institutions.

### Funding at Small Private Colleges

When I started at ECHO I had hardly a clue how to raise money to accomplish our goals. I have learned that churches, civic clubs, private company donations committees, and the public are all surprisingly supportive. If a non-profit organization can raise money for work on hunger, why shouldn't a small college raise money to support a modest hunger-related research program? (This would, of course, require the endorsement of the president and development director.)

I have learned that if four things are in place, successful fundraising becomes possible:

1. Vision. You must have a sharp, well-conceived idea that will cause people to say, "My gift to that program will really make a difference."
2. Competence. You must have competent people with the facilities and time commitment that will cause people to say, "This team can really make the vision happen."
3. Integrity. People must easily recognize a clear moral and ethical commitment and high principles so that they will say, "I can trust these people to use my money carefully and well."
4. Planning. You must have a convincing plan that shows you know how you are going to proceed toward your goal.

The reverse side of this is that if any one of these is lacking, either you will not easily succeed in raising funds or donors may well be disappointed in the results.

### Create a Post-Bachelors Research Associate Position

I have learned that there are many highly qualified young people who are eager for a meaningful opportunity for service that also prepares them for a future

career. They are willing to work for little, but seldom can work for nothing. For 25 years my organization, ECHO, has relied heavily on the service of interns. (As of summer 2005 we have had 140 interns). We pay them $450 per month plus housing, health insurance, and "browsing rights" to food produced on "the farm." [ECHO's farm or "Global Village" is designed to train interns, students and overseas development workers in tropical agriculture. Tours of the Global Village are enjoyed by over 10,000 tourists, local residents, schools, and church communities each year. Tours are used to educate about agricultural issues in developing countries, while discussing possible solutions.]

Many scientists have served in post-doctoral research associate positions, so why not create a post-bachelors research associate position at a private college? What an unusual opportunity you could provide. Dr. Rolf Myhrman at Judson college in Illinois has had some success with this model and I am sure would be glad to share his insights with you. Drop me an email for contact information.

### An Overseas Connection?

The range of possible research ideas would be greatly multiplied if you have a connection with someone working in a developing country. It might be a foreign student you knew who is now working outside of your particular zone of influence. Colleges often develop a special relationship with a particular college, NGO, mission or community. This might allow collection of plant material for your lab, testing of a medicinal plant for its ability to control worms in goats, or field-testing of a method for control of leaf-cutter ants in a real-life setting.

### Looking for Research Ideas

The ideas below and in Part 3 are meant to point you in a direction to help you develop a good idea that is likely to benefit the poor. Not all have equal potential to impact the poor. These are obviously not fully developed research proposals! Some are developed more fully than others. In particular, ECHO has usually not done thorough literature reviews. Naturally that is where you will want to start. It is possible that you will find that the question has already been answered. If so, that is bad news for you but good news for us. If it happens, please let us know what you found.

Many of the ideas to follow can be done in a small laboratory in a northern climate. Others will require someone going to a tropical or subtropical setting. How could you have such an opportunity if you live in a temperate climate? One possibility is to tap into any overseas connections that you or your college may have, as described above. ECHO operates an Agricultural Resource Center in Haiti that specializes in adaptive research at the center as well as by farmers in their own fields. There might be occasions where ECHO could become a collaborator.

One fertile field for finding research topics is the need for validating (or disproving) simple remedies that are widely held but have not been formally studied. Many times we have reported in ECHO Development Notes how an important problem can reportedly be solved by some technique. All too often the development worker reading it will, in effect, need to do his/her own research if this is tried, because no one can be sure it will work. Other times the validity of an appealing "solution" is so uncertain that we do not even mention it in EDN.

### Start with a Literature Search

A cornerstone of good science is that a research project is not begun until the literature has been searched to see what others have learned and suggested. Sometimes it is also necessary to phone or write for information that may not be published.

Sometimes people seem to be more interested in a creative experience than in solving a problem. I have seen this in appropriate technology designs in particular. From our perspective, a new design or experiment should be undertaken only if a clear-cut case can be made that it needs to be done. If you are considering the need for a more efficient cook stove and there are already 85 designs, your best contribution might be to provide a perspective to compare the various existing designs that have been made, rather than make an 86th design.

### A Great Example of a Research Project with Results That Are Readily Available to the Poorest of the Poor

A Tanzanian graduate student at Michigan State developed a simple solution to one of the world's major food storage problems. Larvae of the bruchid beetle bore entry holes in a bean's surface and eat the insides, leaving empty shells. Fumigation methods are effective, but are not always possible (or desirable) in the third world. She attacked the problem by studying how soft-bodied larvae are physically able to bore through the smooth, hard surface of a dried bean (4).

She learned that the larvae scrape the holes with their mouths, but first must brace themselves against a hard surface—a neighboring bean or the wall of a container holding the beans. A bean that does not abut another bean or other hard surface cannot be invaded.

She also learned that it takes 19-24 hours for a weevil to bore an entry hole. She hit on the idea of occasionally tumbling stored beans in order to dislodge weevil larvae before they could finish scraping their holes. Calculations showed that it would be highly unlikely after tumbling that a previously started hole would still be close enough to an abutting surface to be useful to a larva. The larvae would have to start new holes.

Experiments proved her right. "Rather than the normal 20-fold increase per generation, beetle populations in tumbled beans fell to 1/3 of the starting population." Tumbling intact beans morning and evening in a variety of glass and plastic containers, as well as burlap bags, consistently gained excellent results. The tumbled containers had 97 to 98% fewer weevils than were found in stationary control containers. Even when many of the beans had been cracked during

harvesting, results were excellent (95%). After only two or three days, the larvae, except for the few that managed to enter a bean, either starved or were crushed by the tumbling.

How was the tumbling done? "Sacks of beans were twice turned end-over-end 2-3 times a day. Tumbling was faithfully conducted until about one week after inspection revealed no live adults."

Will tumbling be a useful control for other storage pests? "Tumbling is unlikely to be as disruptive to the cowpea weevil, whose larvae bore directly into beans from eggs glued to the seed surface." Several criteria of pest biology are listed to help in evaluating the likely success of tumbling. But even if the pest biology is not known, "regular tumbling could be attempted, just to see if there were benefits worth the modest effort."

ECHO has compiled the first 15 years of EDN into a book called *Amaranth to Zai Holes: ideas for growing food under difficult conditions.* You can read it on our web site or purchase it at our on-line bookstore. Both can be found at www.echonet.org. This book can provide a wealth of ideas for research as well as an understanding of the kinds of things that are of concern to people working to assist small-scale farmers in developing countries.

I encourage you to look at Part 3 of this essay and in the *Call for Studies* section of this journal for an ongoing list of ideas that might interest or excite you, and may fit the needs of a currently underserved group of people.

### What is the Role of Small NGOs?

Though we are quite interested in each of these topics, we have time only to be a catalyst, idea generator, networker and disseminator of information. In some cases we may be able to provide products from a needed tropical plant, or at least seed for that plant. Each project will be the responsibility of the sponsoring faculty member. The ideas presented here will, hopefully, only be starting points from which that faculty member's research effort branches out, as led by the results of the initial work. One possible outgrowth of such research might be the establishment of a special arrangement with someone (perhaps a missionary or Peace Corps Volunteer) for faculty and/or students to conduct research in their community overseas on a volunteer basis during the summer.

You might want to check with us before beginning with one of these research ideas. Someone at another college may already be working on some aspect of the problem. We can at least put you in touch with each other. Maybe you are a chemist and the researcher at the other college is a biologist and the project would be much stronger (and more interesting) as a collaborative effort.

Each of the research questions that I will pose in Part 3 is directly relevant to ECHO's overseas network (over 2500 people in 160 countries). When results are obtained that we deem to be truly of general interest to those whom we serve overseas, we will be sure to make a note about them in our networking newsletter, *ECHO Development Notes* (EDN), and in this journal.

Refereed research publications are always to be encouraged. Both ECHO and Trees for Life can help make research even more rewarding by quickly getting information that is new and practical into the hands of those who can put it to immediate use.

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