CHAPTER FOUR

Design for the Other 90 Percent

WHEN BAHADUR'S FAMILY, WITH THE HELP OF HELVETAS, gained access to a half-inch pipe full of water coming to their house, they saw right away that they could use it to water a few vegetables. They just held the pipe and let the water fall onto the plants. But they couldn't figure out how to use it to irrigate a whole field of vegetables. Of course, they had never heard of drip irrigation, and even if they had, the smallest available drip system would have cost two thousand dollars, far more than Bahadur's family could afford.

A world-class irrigation expert like Jack Keller probably could have given them three practical solutions to their problem in ten minutes, but there were no Jack Kellers available. Bahadur and his family had no knowledge of modern plastics, or they might have been able to design a usable low-cost drip system themselves. I learned about farmers in Thailand who designed their own low-cost drip system by letting water dribble out of discarded intravenous tubes they got from a hospital and inserted into plastic water lines. But without the help or information they needed, Bahadur's family was stuck. Small-acreage

farmers like Bahadur have hundreds of critical problems like this that modern designers with access to worldwide information could solve rapidly.

The problem is that 90 percent of the world's designers spend all their time working on solutions to the problems of the richest 10 percent of the world's customers. A revolution in design is needed to reverse this silly ratio and reach the other 90 percent.

Transport engineers work to create elegant shapes for modern cars while most of the people in the world dream of being able to buy a used bicycle. As designers make products more stylish, efficient, and durable, prices go up, but people with money are able and willing to pay. In contrast, the poor in developing countries—who outnumber their rich, urban counterparts by twenty to one—have only pennies to spend on hundreds of critical necessities. They are ready to make any reasonable compromise in quality for the sake of affordability, but nothing is available in the marketplace to meet their needs.

The fact that the work of modern designers has almost no impact on most of the people in the world is not lost on those entering the design field. Bernard Amadei, an engineering professor at University of Colorado in Boulder, tells me that engineering students all over the United States and Canada are flocking to take advantage of opportunities made available by organizations such as Engineers Without Borders to work on problems such as designing and building affordable rural water-supply systems in poor countries.

If students can make meaningful contributions to design for poor customers, why does this area continue to be ignored? Is it because it is much more difficult than designing for the rich? I don't think so.

How Complicated Is It to Design for the Poor?

You don't need a degree in engineering or architecture to learn how to talk with and listen to poor people as customers. I've been doing it for twenty-five years. The things they need are so simple and so obvious that it is relatively easy to come up with new, income-generating products for which they are happy to pay. But these products have to be cheap enough to be affordable to the poor.

Twenty-three years ago in Somalia, International Development Enterprises undertook its first project by helping refugee blacksmiths build and sell five hundred donkey carts to fellow refugees. But there are a lot of thorns on the dirt roads in Somalia they traveled, and nowhere for a donkey cart owner to buy tools to fix flat tires. So I went to Nairobi and bought tube-patch kits; a large number of good-quality, twelve-dollar, British-made lug wrenches that carried a virtual lifetime guarantee; and a few six-dollar Chinese-made models that would be lucky to last six months. I offered both types of lug wrenches for sale to donkey cart owners at my cost.

To my amazement, the Chinese lug wrenches sold like hotcakes, while I failed to sell a single British model. How could this be? After talking to a lot of donkey cart owners, I realized a donkey cart operator could generate enough income in one month to buy ten British-made lug wrenches, but if he didn't have the money to buy a lug wrench to fix today's flat tire, he would earn nothing and might end up losing his donkey cart. So he bought the wrench he could afford in order to stay in business today and earn more money for tomorrow. Hundreds of poor people I talked to told me the same kind of story. For the 2.7 billion people in the world who earn less than two dollars a day, affordability rules.

The Ruthless Pursuit of Affordability

Vince Lombardi, famous coach of the Green Bay Packers, often said to his football players, "Winning isn't everything; it's the only thing."

With one word change, the same sentiment applies to the process of designing products to serve poor customers: "Affordability isn't everything. It's the only thing."

I have to confess that I am a born cheapskate, so the notion of putting affordability first comes naturally. When I need an umbrella, instead of buying a thirty-eight-dollar designer model in the department store, I opt for a functional black one bought for one dollar at the local Dollarama, where everything costs a dollar or less. I know the thirty-eight-dollar model will last a lot longer, but I also know that I will probably forget it somewhere within a month. If that one-dollar umbrella keeps my head dry for just one rain shower or, better still, for a

couple of months before I lose it, I've saved myself thirty-seven dollars.

The rural poor think in much the same way, with one critical difference—they will keep that one-dollar umbrella in good working order for seven years, at the end of which it will have more patches on it than Jacob's coat and three or four improvised splints on the handle yet will still be usable far into the future.

There is another big difference. To earn a single dollar, an unskilled laborer in the United States needs only to work about ten minutes, while his counterpart in Bangladesh or Zimbabwe must work for two full days. The equivalent of a Dollarama in the developing world would be a Pennyrama. To learn how to come up with affordable products for poor customers in developing countries, Western designers would do well to start with a brainstorming exercise to develop a serviceable ten-cent umbrella. But designers in the industrialized world continue to design the equivalent of thirty-eight-dollar umbrellas for the world's rural poor.

How Many Ants Does It Take to Make a Horse?

Put yourself in the shoes of Peter Mukula, a poor farmer who lives along a dusty road twenty-five kilometers from Livingstone in southern Zambia. If he could afford to buy a packhorse, he could make an extra six hundred dollars a year hauling vegetables to the Livingstone market. But there's no way he can beg, borrow, or steal the five hundred dollars it would take to buy a horse today. Try this brainteaser—see if you can think of a practical solution to Peter's dilemma.

Let me throw out some crazy ideas. What if Peter could buy a quarter-horse? Not a purebred quarter horse, but a horse that's a quarter the size of a regular packhorse. Let's assume that he could buy such a miniature horse for one hundred and fifty dollars and that it could pack sixty kilograms. Peter would earn less money each trip, but he could gradually use his profits to buy more miniature horses. Once he owned four of them, they would be hauling the same two hundred and forty kilos as a full-size packhorse.

But even if a small packhorse were available, one hundred fifty dollars is still far more than what Peter could afford to pay. Perhaps he

could find a pygmy horse one-twelfth the size of a standard horse that would cost fifty dollars and carry twenty kilos. After five years, Peter might be able to expand to a string of twelve pygmy horses and earn the six hundred dollars a year, the same as he would with a full-size packhorse. Interestingly enough, purebred miniature horses thirty-five inches high and weighing one hundred fifty to three hundred pounds are available. Unfortunately, they cost fifteen hundred to three thousand dollars!

Here's an even crazier idea. Suppose we could invent a way to harness the remarkable strength-to-weight ratio of the common forest ant? An engineering class in Germany designed tiny weights that could be attached to an ant's back and determined that forest ants can carry as much as thirty times their own weight. (A human can only carry about double.) How many ants would it take to carry the same load as a packhorse?

I did the numbers. It would take 1.25 million ants to carry Peter's two hundred forty kilos. Now 1.25 million ants would come pretty cheap. But designing the harness would be a challenge.

I have taken you through this imaginary design scenario to illustrate the central task of designing for poor customers—coming up with breakthroughs in both *miniaturization* and *affordability,* following exactly the same process as Henry Ford or Jobs and Wozniak. The next step in the holy trinity of affordable design is to make the new product *infinitely expandable.* If a farmer needs to drip-irrigate half an acre (two thousand square meters) but doesn't have enough cash to buy a half-acre drip system, he can buy a one-sixteenth-acre drip system and use the two hundred fifty dollars in net income it generates to expand to a half-acre system in the second year.

From Forest Ants to the Aswan Dam

Now, if you think the process of breaking a horse into twelve affordable pieces is complicated, try wrapping your mind around the problem of breaking down the Aswan Dam's water storage capacity into millions of ant-size pieces representing the small farms that could be nourished by the water stored in five-hundred-kilometer-long Lake

Nasser. Big dams such as Aswan are built to provide answers to the twin global problems of flooding and water scarcity. But when it comes to delivering irrigation water to poor, one-acre farms, giant dam water-storage systems are usually of little help.

The Nawsa Mad System

Spell Aswan Dam backward and you get "Nawsa Mad." This futuristic system would smooth out some of the peaks and valleys between perennial flooding and drought with the same strategy used by the Aswan Dam, but shrunk down to one four-millionth of its size so that it fits a two-acre farm and a small-acreage farmer's pocketbook. It is the ant to the Aswan Dam's horse.

In May 2003, I was interviewing farmers in Maharastra, India, who were using low-cost drip-irrigation systems to make the water in their open wells stretch a lot further than the flood irrigation they had been using. But the sixty-foot-deep, twenty-five-foot-diameter wells that were the only source of irrigation water during the dry season cost one hundred thousand rupees to build (about two thousand dollars US). Because the wells were so expensive, only 25 to 40 percent of the farmers in Maharastra owned one. The rest earned a paltry income from rain-fed farming and could survive only by finding work outside their farms.

But rainwater ran off their fields in sheets during the monsoon season in June, July, and August. What if we could find a cheap, simple way to trap some of this monsoon rainwater and store it until the dry season from March to May, when vegetable and fruit prices were at their peak, and deliver the water to crops through a low-cost drip-irrigation system?

To create a miniaturized, on-farm version of the Aswan Dam, we had to find ways to:

1. Collect monsoon rainwater on individual farms.
2. Settle out the silt and mud in it before storing it.
3. Store it for six months with no evaporation.

4. Deliver it from storage to crops without wasting a drop.
5. Most importantly, develop the whole system cheaply enough to be *affordable* to a poor farm family living on three hundred dollars a year, *profitable* enough to pay for itself in the first year, and *infinitely expandable* using the profits it generates.

Solutions for 1, 2, and 4 were easy. There were already all kinds of rainwater-harvesting systems in place that collected, settled, and stored rainwater, and the low-cost drip-irrigation system designed by IDE provided the means to deliver it efficiently to crops. The critical missing link was a zero-evaporation, enclosed water-storage system for individual farms that was cheap enough to pay for itself in the first growing season.

We estimated that a farmer could reasonably be expected to clear fifty dollars from drip-irrigated, high-value crops grown on a one hundred-square-meter plot in the dry season using ten thousand liters of stored water. So we set a retail price target of forty dollars for the ten-thousand-liter enclosed storage tank. This was a daunting target, since the cost of a ten-thousand-liter ferro-cement tank in India starts at two hundred fifty dollars. So we came up with the idea of a ten-meter-long, double-walled plastic sausage in an earth trench. By using the earth around it for structural support, we could reach our price objective of forty dollars for a ten-thousand-liter storage tank. This would allow farmers to harvest monsoon rainwater, store it for six months or so without evaporation losses, and then apply it through a low-cost drip system to dry-season crops that sell at two or three times their normal prices.

The Nawsa Mad concept makes use of three new, affordable, small-plot-irrigation technologies that small-acreage farmers have desperately needed for centuries—a very low-cost enclosed water-storage system into which they can direct monsoon rainwater, a low-cost efficient way of pumping water from storage to the field, and a low-cost drip system to deliver it efficiently to high-value dry-season crops. You can take the same elements and use them to create a two-hundred-thousand-liter pond, with a plastic liner and a floating lid, that costs four hundred dollars and stores enough water to drip-irrigate a quarter acre of dry-season fruits and vegetables that will earn five hundred dollars after expenses.

Here are some of the other critical, affordable small-farm irrigation tools that IDE and a few other organizations are designing, field-testing, and marketing.

- **Improved treadle pumps that are cheaper and pump deeper**
  Several multidisciplinary teams at the Stanford design school have created more affordable versions of treadle pumps for Myanmar, and KickStart has recently introduced a more affordable version for Kenya called the hip pump.

- **Motorized rope-and-washer pumps for irrigation**
  Rope-and-washer pumps provide affordable water-lifting at depths beyond the range of the treadle pump. Because it is difficult to use human power alone to lift the volumes of water required for irrigation, rope-and-washer pumps combined with microdiesel engines have potential to irrigate high-value crops from deeper water sources.

- **Lower-cost wind and solar pumping systems**
  Photovoltaics and wind energy have been too expensive for small farms, but ways of concentrating solar energy and making more-affordable windmills hold promise for small-acreage farmers.

- **Improved low-cost well-drilling tools**
  Practica, a Dutch organization, and several other development organizations are working to make a variety of affordable drilling techniques available to small farms.

- **A range of affordable enclosed water-storage systems, with one-thousand- to three-hundred-thousand-liter capacity**
  These are the systems I have described in Chapter 6 on affordable irrigation for small farms, which also describes the development of the microdiesel engine.

- **A one-hundred-dollar quarter-hp microdiesel pump set**

- **Larger low-cost drip systems with pre-installed emitters**
  The dramatic drop in price for drip irrigation has made it profitable for small-acreage farmers to use drip systems on lower-value

crops such as cotton and sugar cane, and some of them are even irrigating alfalfa for their milk buffaloes. I believe that low-cost drip systems like those developed by IDE will, over the next ten years, take over the majority of the world market for drip irrigation.

- **Low-cost low-pressure sprinkler systems**
  Low-cost drip irrigation works well for crops planted in rows. For crops not planted in rows—like wheat, mustard, and clover—the low-pressure affordable sprinkler system developed by Jack Keller and IDE in India provides more-efficient water distribution than does the flooding method.

- **A low-cost small-plot piped-water surface-irrigation system**
  By using a system of thin-walled tubes to deliver water to hand-formed micro-reservoirs, Jack Keller and IDE India are working to develop an efficient, low-cost surface-water delivery system suitable for small plots.

These are some of the design challenges for affordable small-plot irrigation systems. A similar array of design challenges exist for small-farm planting, harvesting, and postharvest-processing tools. Below are some examples.

- **A fifteen-dollar scythe for harvesting rice, corn, and wheat**
  This may surprise you, but most of the small-acreage farmers in the world still use a sickle to harvest their plots of rice and wheat. This usually takes several days, and in some places delays planting the next crop enough that it is impossible to grow a third crop. Of course, in Europe, peasants progressed from sickles to scythes, and then to wooden-fingered scythes called "cradles," which bunched the grain at the same time it was being cut. These tools were replaced by horse-drawn reapers and, eventually, by modern combines. If we went back in history to find the most efficient device to harvest wheat or rice from the typical quarter-acre plots of dollar-a-day farmers, it would probably be the cradle. We have a range of modern inexpensive, stronger, lighter materials such as fiberglass that could be used to improve both the wooden handle

and the blade of the scythes and cradles used more than a hundred years ago. A fifteen-dollar cradle would dramatically improve the harvesting efficiency on millions of small farms.

- **Postharvest processing**
  Small-acreage farmers need a range of new postharvest processing tools capable of adding value at the farm or the village level, parallel to the design and dissemination of affordable small-plot irrigation and harvesting tools. These include:

  - **A fifteen-hundred-dollar and a five-thousand-dollar steam distillation unit for essential oils**
    These units are described in Chapter 8.

  - **A fifty-dollar gasifier for generating heat**
    Many value-added processing procedures for crops produced on small farms require uniform heat. Silk reeling, for example, heats harvested cocoons in water to cause them to give up silk threads. A gasifier heats with a fuel source such as wood chips in the absence of air to produce burnable gases, acting somewhat like propane, that can be directed to a burner, providing uniform heat. A two-thousand-dollar gasifier developed in India by the Tata Energy Research Institute, backed by the Swiss government, cut wood use in silk reeling operations by 50 percent and produced a greater percentage of first-grade silk. Designing a commercial gasifier at the target price of fifty dollars would allow a variety of drying and other value-added processing procedures to be carried out at the village or farm level.

  - **Low-cost solar dryers to dry tomatoes and banana chips for high-end markets**

These are typical examples—the need for affordable farm-based value-added processing tools is longer than the one for affordable small-plot irrigation.

There is an even longer list for a range of consumer goods that dollar-a-day people are eager to buy when they increase their income, and people who earn two to six dollars a day are ready to buy now. This includes the billion or so people who would be customers for two-dollar

eyeglasses if somebody would design an effective global distribution and marketing system for them (see Chapter 8). There are more than a billion people in the world who will never connect to the electric-power grid who would be interested in buying a ten-dollar solar lantern, made possible by advances in light-emitting diodes (LEDs). More than a billion people would be willing customers for a four-dollar household-level filter that would make water safe to drink.

An attractive hundred-dollar house would make a huge positive impact on the lives of poor rural people.

A Hundred-Dollar House

In light of the fact that most young people in North America and Europe now can't afford to buy a house, it is remarkable that most of the 800 million rural people in the world who earn less than a dollar a day own the home they live in. But if they tried to sell it, they would get no money for it, and if they tried to offer it as collateral for a loan from a local banker, they would get turned down. This is because their home, made of sticks and wattle, with a thatched roof and dung floor, has no value in the local market and they have no opportunity to build something with value at a price they can afford.

But in every village, there are a few families who have a house built out of brick or cement block, with a tile roof, and these houses have both sales value and collateral value. They accomplish this by building it twenty-five bricks at a time, whenever they have a bit of cash left over, and taking ten or twenty years to do it. They take so long because construction loans aren't available in most of these places. I have seen far too many designs from Western architects for refugee camp shelters that look elegant to the Western eye and start at nine hundred dollars, or dwellings for poor rural families for fifteen hundred dollars and up, prices that are far too high to be affordable for dollar-a-day people.

The no-value stick-and-thatch home lacks a stable foundation and structural skeleton that will last. All we need to start a salable, bankable, twenty-square-meter home is eight strong beams and a solid roof that doesn't leak. Initially, this durable structural skeleton can be filled

in with local materials—for example, sticks chinked with mud for the walls. Then, as money becomes available, stick walls can be replaced with cement block or brick, twenty-five bricks at a time.

If, from the beginning, the one-hundred-dollar house is designed to accept added modules, in the manner of a LEGO set, the family who lives in it can eventually own a house as big as they can afford. When the bankable house is completed, the family has a source of collateral so they can borrow the money they need for inputs, implements, and livestock to increase the income they earn from farming.

A Revolution in Design

Designing products that are attractive to poor customers requires a revolution in the design process. This revolution is already happening. In the summer of 2007, Cooper-Hewitt Design Museum in New York, one of the Smithsonian museums, opened an exhibit called "Design for the Other 90 Percent,"[19] in which thirty-six examples of designs for the poor from all over the world are displayed. Included are several treadle pumps, a low-cost drip system, low-cost water purification systems, and a technology that allows village entrepreneurs to turn sugar cane leaves into marketable charcoal briquettes. The design community is fascinated with this exhibit, which has received ever-increasing press coverage.[20] More recently, we have incorporated an organization called D-Rev: Design for the Other Ninety Percent,[21] whose mission is to create the design revolution. My dream is to implement four initiatives at the same time:

1. Transform the way design is taught in developed countries, to embrace design for the other 90 percent of the world's population.
2. Transform the way design is taught in developing countries, to embrace design for the other 90 percent of the world's people.
3. Establish a platform for ten thousand or more of the world's best designers to develop practical solutions to the real-life problems of poor people.

4. Give birth to international for-profit companies that profitably mass-market to poor customers critical technologies such as two-dollar eyeglasses.

To be successful, the process of design for the other 90 percent needs to follow a set of principles and practical steps that depart radically from conventional design.

The Principles of Design for the Other 90 Percent

Miniaturization, the ruthless pursuit of affordability, and infinite expandability are the three building blocks necessary to "design cheap." Now here is some music to go with the lyrics.

THE POOR CUSTOMER RULES THE DESIGN PROCESS

Thinking of poor people as customers instead of as recipients of charity radically changes the design process. Poor persons won't invest in a product or service unless the designer knows enough about the preferences of poor people to create something they value. The process of affordable design starts by learning everything there is to learn about poor people as customers, along with what they are able and willing to pay for something that meets their needs. When in doubt, I resort to the "Don't bother" trilogy.

ADOPT THE "DON'T BOTHER" TRILOGY

1. If you haven't had good conversations, with your eyes open, with at least twenty-five poor people before you start designing, don't bother.
2. If what you design won't at least pay for itself in the first year, don't bother.
3. If you don't think you can sell at least a million units at an unsubsidized price to poor customers after the design process is completed, don't bother.

SMALL IS STILL BEAUTIFUL

E.F. Schumacher was right on target by writing beautifully about smallness, even though he didn't focus enough on affordability and marketability. A modern combine doesn't even have room to turn around on a typical quarter-acre plot of a small-acreage farmer, much less harvest the plot. Seventy-five percent of all farms in Bangladesh and India are less than five acres, and in China less than half an acre. Since most of these small farms are further divided into several quarter-acre plots, this is the gauge against which any new technology for small-plot farmers must be evaluated.

For those trying to survive on a one-acre farm, a pinch of seed is better than a bagful. For a long time economists have talked about the "divisibility" of technology. You can't take a tractor and cut it up into little pieces, so economists give it the rather curious but descriptive label of "lumpy input." But a twenty-kilo bag of carrot seeds can be easily divided into packets just the right size to plant two rows in a kitchen garden.

Doing the same thing with mechanical technologies such as irrigation, tilling, and harvesting devices as can be done with a bag of seeds is probably the most important challenge in designing cheap. A center-pivot sprinkler system is very efficient, costs a ton of money, and is designed to fit a one-hundred-and-sixty-acre field. How do we design a low-pressure sprinkler system that distributes water just about as efficiently as a center-pivot system, costs less than twenty-five dollars, and works on a quarter-acre field? An Israeli drip-irrigation system is very efficient, costs a ton of money, and is designed to fit fields larger than five acres. How do we design a drip-irrigation system that is just about as efficient as the Israeli system, costs less than twenty-five dollars, and fits perfectly into a quarter-acre plot? IDE has made great strides in solving both these design problems, but there are thousands more like them that have yet to be addressed.

CHEAP IS BEAUTIFUL TOO

Shrinking a drip-irrigation system from ten acres to a quarter acre not only makes it appropriate for a poor farmer's small field, but also makes it considerably cheaper. In India, a two-cigarette package probably

costs more per cigarette than the normal twenty-cigarette package, but it brings the purchase price down to an affordable level for a customer without much money. Affordability is the most important consideration in providing small-acreage farmers with access to income-generating technologies. Below are some guidelines I've found for designing cheap.

1. **Put tools on a radical weight-loss diet.** You can cut the cost if you can find a way to cut the weight. A good example of this is a small drip-irrigation system where most of the weight is in the plastic pipes. We cut the weight and the price of pipe by cutting system pressure by 80 percent. Doing this allowed us also to cut the wall thickness and weight of the plastic by 80 percent with a corresponding drop in price.

2. **Make redundancy redundant.** If a western engineer is asked to design a bridge capable of holding a ten-ton load, he is likely to build it to hold a thirty-ton load to lower the risk of a lawsuit if the bridge collapses. Because the legal risks are so much lower in poor countries, and affordability is so much more important, an engineer designing a water pipe for ten-pounds-per-square-inch pressure has no need to make the walls thick enough to withstand thirty-pounds-per-square-inch pressure. Eleven- or twelve-pounds-per-square-inch standard is sufficient.

3. **Move forward by designing backward.** Often, the most effective way to optimize affordability is to go back through the history that led to the modern form of the technology.

4. **Jazz up the old package with cutting-edge materials.** Update outmoded designs with any new materials that may have become available. As long as affordability is not compromised, all's fair.

5. **Make it as infinitely expandable as a LEGO set.** After miniaturization and affordability, infinite expandability is the third pillar of designing cheap. Initially, if a farmer can afford a drip system that irrigates only a sixteenth of an acre, design it so he can use the income it generates to double or triple its size the next year.

Practical Steps for Design for the Other 90 Percent

Here are some basic steps that I've found can cut the price of almost any expensive technology or tool by at least 50 percent.

SET A SPECIFIC PRICE TARGET

To be successful, the product or service you design has to meet a specific price point that poor customers are willing and able to pay. I usually start by setting a retail target price point that is about one-fifth of the price a product is selling for now. Since the price of ferro-cement water tanks in India starts at one rupee/liter, we set a target price for the design of an affordable water-storage unit at one-fifth rupee/liter.

ANALYZE WHAT THE TECHNOLOGY DOES

Make a list of the important functions that the technology will perform for the poor customers who will buy it.

IDENTIFY THE KEY CONTRIBUTORS TO COST

Identifying the key contributors to the cost of the current technology, from most to least important, provides a road map to finding affordable alternatives acceptable to poor customers. A key contributor to the cost of sprinkler systems is the thickness of the wall of the plastic lines carrying water to the sprinklers. Lowering the pressure in the system made it possible to use thinner-walled tubing.

DESIGN AROUND EACH OF THE KEY CONTRIBUTORS TO COST BY FINDING ACCEPTABLE TRADE-OFFS

Selecting acceptable trade-offs requires an intimate knowledge of the customer's situation and needs. Conventional drip-irrigation systems require a significant investment in a high-quality filter to prevent clogging of drip emitters. An alternative that small-acreage farmers find easily acceptable is to replace the expensive filter with a low-cost wire-mesh filter covered with a piece of cloth. The farmer's children can wash the cloth regularly and unplug clogged holes with a safety pin.

The key affordability trade-offs are:

1. **Capital for labor.** Since most poor people in rural areas are long on labor and short on cash, they will jump at almost any opportunity to trade capital cost for labor. Because of its lower cost, some farmers prefer to buy a smaller drip-irrigation system and shift it from row to row. Truckers in Nepal rarely invest in preventive maintenance—it's usually cheaper to wait till a part breaks, and then spend a few hours on the side of the road fixing it.

2. **Quality vs. affordability.** In the West, customers expect a tool to last at least seven years. Because of the lower cost, small-farm customers for treadle pumps or drip systems usually prefer a two-year product to a seven-year one. Always short of cash, they can use the 300 percent net annual return of a treadle pump to buy a seven-year pump if they want to after the first two years are up.

MAKE A MULTITUDE OF PROTOTYPES

The rapid prototyping process that is standard practice for design firms like IDEO fits perfectly for design for the poor. Using local rural workshops to produce prototypes is an advantage because they incorporate solutions to the constraints in materials and fabrication for the eventual local manufacture of the technology.

MAKE CHANGES BASED ON FIELD TESTS

Immediately after the proof-of-concept prototype stage, try out the new technology on at least twenty small farms with different conditions. Next, thoroughly question the farmers about what worked and what didn't, and then modify the technology based on their experiences.

ADAPT A TECHNOLOGY IF YOU MOVE IT TO A NEW PLACE

Bad news: Like fine wines, many technologies don't travel well. The good news is that the adaptation problems are usually easy to fix. That

is why it never ceases to amaze me that anyone would consider exporting tractors from the United States to Africa, or low-cost drip-irrigation systems from India to China, without first going through the relatively inexpensive process of field-testing and adaptation based on experience.

Many people tell me that designers don't work on solving the problems of 90 percent of the world's customers because there is no money to be made doing it. I see this as only a temporary aberration.

That's Where the Money Will Be

I keep asking why 90 percent of the world's designers work exclusively on products for the richest 10 percent of the world's customers. Willie Sutton, the infamous bank robber, was once asked why he robbed banks.

"Because that's where the money is," he said.

I suspect my question about the world's designers has exactly the same answer.

I have no problem with people who make money by designing products for the rich. My friend Mike Keiser, with no more professional training than his love of golf and nature, designed a golf course and resort—Bandon Dunes, on a spectacular section of Oregon coastline—that quickly became the number-two golf destination in America. Such entrepreneurial brilliance deserves to be rewarded.

What astonishes me is that the huge, unexploited market that includes billions of poor customers continues to be ignored by designers and the companies for which they work. In this, however, they are following a well-established tradition.

If you had asked a car manufacturer before Henry Ford came along why he designed only big, expensive, custom cars for playboys, I suspect his answer would be the same as Willie Sutton's: "Because that's where the money is."

But it's not where the money is now.

Before Steve Jobs and Steve Wozniak came along with the personal computer, if you had asked the CEO of IBM why his company built only computers that cost $2 million and filled entire rooms, he would undoubtedly have said, "Because that's where the money is."

But, again, it's not where the money is now.

Before the advent of transistor radios and Walkmans, had you asked the executives of RCA why they made only hi-fi systems that cost thousands of dollars, they would also have given Willie Sutton's answer: "Because that's where the money is."

But it's not where the money is now.

Today, you could ask the executives of Netafim, the world's biggest drip-irrigation company, why more than 95 percent of their products go to the richest 5 percent of the world's farmers, and they would say, "Because that's where the money is."

But think about this. If 100 million small-acreage farmers around the world each bought a quarter-acre drip system for 50 dollars—a total investment on their part of over 5 billion dollars—it would amount to more than ten times the current annual global sales of drip-irrigation equipment. These 100 million small-plot farmers could put 10 million additional hectares under drip irrigation and increase current global acreage under drip irrigation by a factor of five.

It's laudable that a small but growing number of designers are beginning to develop affordable products because they want to improve the lives of the world's poor. But I think that the best and most sustainable engine for driving the process of designing cheap is this:

Because that's where the money *will be*.

A treadle pump irrigates a seedling nursery.