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ApproTEC Kenya:

Technologies to Fight Poverty and Create Wealth

Poverty can be like a whirlpool, pulling its victims further and further down the spiral toward utter despair. How can one break free? Throughout history, technology has enabled people to make more productive and profitable use of the resources they already have available to them. By developing and promoting technologies particularly suited to the difficult circumstances faced by poor people in Africa, ApproTEC has empowered tens of thousands to break free of the whirlpool and gain control of their lives. These people are now active members of their communities, offering solutions to others. As successful entrepreneurs they are creating wealth and jobs, building local economies and shaping a brighter future for their children.

– ApproTEC Annual Report, 2001–2002

Appropriate Technologies for Enterprise Creation, or ApproTEC for short, was founded in Kenya in 1991 by two entrepreneurs: Nick Moon, a British national, and Martin Fisher, a U.S. citizen. For fiscal year 2001, the nongovernmental organizational (NGO) reported an income of about \$2 million, of which nearly \$500,000 was from the sale of its various products and the remainder from donors. Its budgeted expenditure that year was also about \$2 million. By 2001, ApproTEC employed a total of 74 full-time staff: 55 in Kenya, 18 in Tanzania, and 1 in the United States.

“What would you do,” I asked Moon, ApproTEC’s managing director, “if you had a windfall of \$5 million?” The question threw Beverly Wanjala, ApproTEC’s office manager, into an uncontrollable fit of laughter. “Five million dollars?” she asked me incredulously. Obviously I hadn’t realized the silliness of the question, so to cover my embarrassment I peered outside, pretending to study the landscape. I focused on the boundaries of two of Nairobi’s sprawling slums, Kariobangi and Korogocho (housing nearly a quarter of the city’s 2 million inhabitants), merging into each other in the vicinity of ApproTEC’s facilities—a three-storied rented space with about 2,000 square feet each of office space, a product development and display showroom, and an engineering workshop for building prototypes and producing the manufacturing jigs and fixtures needed to mass-produce ApproTEC designs. A faint stench seemed to emanate from a sewage plant within a stone’s throw of ApproTEC’s backyard. To my surprise, however, Moon had taken my question seriously. He scratched his head and then his beard as he punched out the following response, its decisiveness suggesting that this was no impulsive reaction but a summary of some deep thinking:

Professor V. Kasturi Rangan prepared this case. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

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“A windfall \$5 million? I would:

- Strengthen ‘core’ ApproTEC, which comprises those strategic functions that shape and direct our program—market research, technology development, coordinating distribution and promotion, and impact monitoring.
- Open up a distribution and promotion program for our micro-irrigation technologies in Uganda, extending into Rwanda.
- Deepen our promotion program in Kenya and Tanzania and extend into Burundi.
- Undertake exploratory missions to South Africa, Mozambique, Malawi, and Zambia to assess the potential for ApproTEC in those countries and to get an idea of what changes or refinements we would need to make to our strategy in order to work effectively there.”

And then, turning toward me with a wry smile, Moon expressed his skepticism:

That’s my wish list. But one problem is that our current donors do not really want to listen, but to prescribe. They seem culturally risk averse—not good at recognizing and responding to innovation and pushing the envelope. Also, they seem uninterested in institutional development plans or contributing to any activity that does not promise immediate return. Moreover, their funding comes in cycles of three or four years with very long lead times. At every funding cycle, there is uncertainty. We cannot rely on a continuous flow to plan anything long term. If we stay afloat from year to year, implementing a patchwork of individually negotiated projects, we are going great. Growth in this scenario is very difficult to manage.

It was exactly for the above reason that Fisher had relocated to San Francisco in January 2001 and registered ApproTEC-USA as a 501(c) 3 organization in October of that year. The plan was to use the U.S. organization to raise funds for sustaining its mission in Africa. (**Exhibit 1** provides an overview map of ApproTEC’s operations and plans in Africa.)

Fisher explained:

We have to scale up our ambitions and therefore our organization. When we first founded ApproTEC, it was a matter of proving that our idea had legs. We have more than demonstrated that. We have shown that poor people are in general willing and capable of exploiting economic and business opportunities that come their way, provided they are made aware of them and the technology they need to own is made available to them at prices they can afford. We are eager now to expand our horizons and help a vast number of poor people break the shackles of poverty. Staying put at our current level is simply unacceptable. The U.S. has vast resources: many technology millionaires who could all have a potential interest in our work. We have already raised about \$500,000 in the U.S., which will cover the California office overheads for two years. In those two years, we have to dramatically improve the funding base. We could easily use \$3 million to \$5 million right away in the fulfillment of our mission.

Founding: A Carpenter Joins a Scholar

Moon, a trained joiner/cabinet maker, having worked in the United Kingdom and Europe for eight years, including four years running his own company in London and doing a couple of contract jobs in West Africa, came to Kenya in 1982 as a British volunteer development worker. After two years as a technical instructor and manager in a technical training institute in rural western Kenya, he

joined ACTIONAID, a British charity, in 1984 to work in the slums of Nairobi and later with semi nomadic communities in the arid north of the country. Moon focused mostly on training and organizing the implementation of community infrastructural development projects—school buildings, clinics, water storage tanks, and so on. In 1985, at the age of 30, he met his 27-year-old counterpart, Fisher, who had a doctorate in applied mechanics from Stanford University. Fisher had arrived in Kenya with a Fulbright scholarship to study how development agencies applied simple (appropriate) technologies to address problems of development. Fisher found that ACTIONAID was doing interesting work, promoting the use of low-cost, manually operated equipment such as manual block presses and small-scale tile-making machinery. The two of them hit it off right away. Moon described the origins of their partnership:

As a child growing up in India and Southeast Asia, I saw many examples of extreme contrast between rich and poor. As a young student in the U.K., thinking about such matters, I leaned to the left, perceiving capitalism as the culprit, an exploitive business culture that could not serve its own interests and the common good at the same time. After leaving school at 18, I learned woodwork and general building skills, became self-employed in the construction industry in Europe, traveled a great deal, and at 23 started a small enterprise in London with a partner. Yet as the realities of running a business unfolded, we realized that our vision of “serving the community” and staying solvent were more difficult to reconcile than we had imagined. At a low point in our business fortunes, I took a contract job in Togo, my first visit to Africa.

Two years later, I joined the VSO [the British volunteer organization] and was posted to Kenya as a technical skills instructor. From there, I moved to ACTIONAID in 1984, and that’s where I met Martin. We found that we worked well together and seemed to have complementary skills and temperaments. Martin is a gifted engineer, very quick thinker, full of ideas, excitable, high energy levels, and achievement oriented—a high-octane fellow.

Fisher recounted his own trajectory and how he met Moon:

After growing up in an academic physics family in London and upstate New York, getting my Ph.D. in theoretical and applied mechanics seemed to be the expected thing to do. But having a mother who was extensively involved in public service, I was aware from a young age that there were other issues to care about. Spending my summers in the ‘70s traveling in southern Europe gave me an awareness of other ways of life and a hint of the effects of poverty. I made friends with other students from developing countries doing graduate work at Stanford and spent a summer in Peru. Hiking through poor villages in Peru made me believe that simple technologies had the potential to change lives for the better, but I had no idea how they could best be applied, and I returned hungry to learn more. After being offered jobs to teach engineering, do military research, or work for “big oil,” I decided to put off my engineering/academic career and find a way to spend a year studying technology for development. I applied for a Fulbright Fellowship to go to Kenya after being told my lack of Spanish would mean I couldn’t go to Peru and ended up in Nairobi in October 1985. That’s where I met Moon, sort of a laid-back but sanguine guy, with something of the hippy about him. Every time I interacted with him, he said something or did something that was deceptively simple and yet incredibly wise. We clicked right away because I think we had complementary personalities and skills. His measured and pragmatic approach modulated my desire for immediate action.

From 1987 to 1989, the duo built up and expanded the technical support unit of ACTIONAID. The focus was predominantly technology—making it appropriate and cheap and practical in rural/poor

situations by using local materials and community labor. Yet despite the impressive technical accomplishments, Moon and Fisher were disillusioned by the agency's "development" philosophy.

According to Fisher:

As I learned more, I soon became disillusioned, both with much of the work that we were doing and with the work of most other development NGOs. We were still making many of the same mistakes that had doomed past efforts. We promoted self-made technologies that were difficult to make, uneconomical to use, and not what the people wanted in the first place. We manufactured farming equipment in our own nonprofit workshop and sold/gave it to farmers at a subsidized price in competition with local private workshops. We organized and held the hands of poor groups of handpicked rural youth or community groups. We donated to them equipment and tools and subsidized their use. The groups were not entrepreneurial, and the enterprises were not viable or sustainable and would collapse after we stopped working with them, but not before discouraging investment by other local entrepreneurs who couldn't compete. We were creating dependency and all too often left things no better off, or even worse, than we had found them.

Moon provided this perspective on the appropriate-technology movement:

It wasn't that the technologies themselves were intrinsically poor, although many were badly designed, but that they were often peripheral or irrelevant to the main concerns of their intended beneficiaries, and furthermore, even for those that did answer a real need, were usually disseminated ineffectively as well. So we had to change the way we presented and packaged the technology in order to attract the interest and action of very poor people. That was our main challenge.

So Moon and Fisher agreed with ACTIONAID to part ways and founded ApproTEC. Lacking funds, they formed their first few projects as consultancies. Because of their reputation at ACTIONAID, British Overseas Development Assistance (ODA), now called the Department for International Development (DFID), agreed to fund up to \$500,000 over a four-year period, provided matching funds were obtained from other sources. The search for a substantial project was on. Then, in 1992, Somalia's internal strife caused thousands of refugees to seek sanctuary in Kenya. ApproTEC was invited to take part in the relief effort. Moon recalled:

In 1992, 350,000 Somali refugees poured into northern Kenya, and UNHCR [United Nations High Commission on Refugees] built camps and provided food and water, but sanitation quickly became a problem. The Somalis refused to use communal toilets, and for the first time a refugee camp had to be built with individual family latrines. We had recently developed an unreinforced, domed, concrete pit-latrines slab, which cost a fraction of the price of reinforced concrete slabs. We were approached by UNHCR to help solve the problem, and although it fell outside of ApproTEC's mission, ApproTEC became an official UNHCR implementing partner, and we won a multimillion dollar contract to install over 40,000 latrines in refugee camps in northern Kenya. We trained some 800 refugees and produced and installed as many as 150 slabs per day. We later built U.N. staff housing and trained other NGOs to make and install latrine slabs. There are now over 90,000 ApproTEC slabs in refugee camps in East Africa. We used the 7% overhead on the UNHCR contract and incomes from the training to unlock our DFID grant, allowing us to get ApproTEC going in the direction we wanted—developing and promoting technologies for micro-enterprise. We carried on operating on an ad-hoc basis until we had enough proven results to convince new donors to fund our program. We eventually got significant grants from the Netherlands, DFID, and USAID [U.S. Agency for International

Development], starting in 1995, and ApproTEC was truly in business. It was a 1997 micro-private-enterprise development project from USAID that enabled us to undertake a series of subsector studies to identify a select number of high-impact small-business opportunities in Kenya.

Poverty in East Africa¹

East Africa, especially Kenya and Tanzania, is best known for its spectacular game parks and for its colorful cultural heritage. The Serengeti (in Tanzania) and Maasai Mara (in Kenya) alone house over 3 million animals in a huge enclave of 2,000 perimeter miles. Hundreds of thousands of tourists flock to that part of the world to see lion, elephant, rhino, migrating antelope, and other wild game and to visit Maasai villages. Yet the tourist industry, although crucial to their economies, is not the most significant. These two countries and Uganda, which together comprise the East African Community, depend ultimately on agriculture. Exports of tea, coffee, and horticulture account for the bulk of their foreign exchange earnings. As the region adjusts to the demands of a rapidly globalizing market, they face the common challenge of uplifting the masses of their people from poverty.

Kenya

Kenya's gross domestic product (GDP) in 2000 was estimated at \$10.7 billion (\$30 billion at purchasing power parity). With a population of 30 million people, the per capita GDP was around \$360. That year, the Kenyan government declared that over 55% of its people lived below the poverty line. Approximately 70% of Kenyans were subsistence farmers and pastoralists. Only 14% of Kenyans were formally employed, of whom half were in the government sector. Under the policies of President Moi's government, "Jua Kali," or small-scale informal enterprises, were strongly encouraged, employing 2.4 million people in nearly 1.25 million micro-enterprise establishments.

Infant mortality had declined, and life expectancy had increased from 35 years in 1948 to 56 years in 2000. The great majority of Kenya's population in 2002 was under 20 years old. There was a considerable urban drift of its young population and consequent overemployment in unskilled sectors. On the other hand, there was underemployment in the rural areas. Even as Kenya tackled its high birth rate (2.7%), it was afflicted by HIV AIDS, which had affected about 10% of its population.

Jomo Kenyatta, Kenya's charismatic first president, had led the country to freedom from British rule in 1963. Daniel arap Moi assumed the presidency of the country in 1978 after Kenyatta's death. In recent years, especially in the 1990s, government corruption and economic mismanagement were widely recognized as the main obstacles to increasing economic prosperity. By the mid-1990s inflation was running at over 50%, and Moi's government had come under increasing criticism. International donors had frequently expressed dissatisfaction with his social and economic programs and more than once withheld aid completely. Internally, too, the government was viewed as autocratic and corrupt, and the political process was overwhelmingly skewed in favor of the ruling party.

Little of this, however, seemed to have affected ApproTEC's operations directly. Fisher offered this observation: "Local governments do not actively support ApproTEC, but they have not discouraged us because ultimately what we do is to improve the life and livelihood of people. It is all

¹ Some of the information contained in this section has been compiled from three publicly available sources: <www.infoplease.com>, <www.cia.gov>, and <www.worldbank.org>.

economic; we have no political agenda. As a matter of fact, much of what we do is consistent with declared government policies for helping the informal sector, so we fit right in.”

Tanzania

With a GDP of \$9.3 billion (\$18 billion at purchasing power parity), a population of 34 million, and a per capita income of \$275, Tanzania was one of the poorest countries in the world. Its economy was heavily dependent on agriculture, which accounted for half of its GDP, providing 85% of exports and 80% of the employment in the country. Topography and climatic conditions, however, limited cultivated crops to only 4% of the land area. Industry was mainly limited to processing agricultural products and light consumer goods.

Tanganyika, variously administered as a German colony, a British protectorate, and a U.N. trust territory, became independent in 1961. Zanzibar, a British protectorate, achieved independence in 1963. The two countries came together as Tanzania in 1964 under the socialist presidency of Julius Nyerere. Tanzania’s third, and current, president, Benjamin William Mkapa, who took office in 1995, sought to increase economic productivity while dealing with other social and environmental problems. The country had a birth rate of 3.9%, with about 1.3 million people living with AIDS and another 2 million infected by the HIV virus. Malaria was the number one public health problem.

Uganda

With a GDP of \$6.8 billion (\$27 billion at purchasing power parity) and a per capita income of \$310, a large percentage of Uganda’s 22 million people faced severe economic hardships. Uganda, unlike its East African neighbors, was well endowed with rainfall and water, making over 25% of its land lush and arable. Agriculture accounted for nearly 85% of its economic output. Uganda achieved independence from the United Kingdom in 1962, but it has had a checkered history ever since. The dictatorial regime of Idi Amin (1971–1979) was responsible for the deaths of some 300,000 opponents; guerrilla war and human rights abuses under Milton Obote (1980–1985) claimed another 100,000 lives. Peace, stability, and improved governance finally arrived with the overthrow of Obote in 1985 by Yoweri Museveni, Uganda’s current president. The country had a birth rate of 4.9%, with about 850,000 people living with AIDS and another 1.5 million infected by the HIV virus. Tropical diseases like malaria were the number one health problem.

Fisher provided the following root cause of the underlying poverty problem in East Africa:

One would have thought that the end of the Cold War era would bring peace and ultimately prosperity to the many bitter civil wars and feuds in Africa. After all, the Soviets and the Americans no longer have the motivation and desire to prop up their respective factions overtly or covertly. While that is true in a way, the drying up of enormous international subsidies has left African governments cash poor and government officials vulnerable and without discipline. During the Cold War, education and health care were generally free, and prices of essential commodities were subsidized to be easily affordable to the poor. Now, state funding has dried up, and suddenly the poor find themselves needing cash for everything—to buy food, health care, education. At the same time, fast-increasing populations have reduced the viability of subsistence farming. There has been no systematic effort to help these countries make the transition into market/cash-based economies. That’s why countries like Kenya and Tanzania, which grew up on opposite sides of the Cold War, suddenly find themselves facing similar economic crises. In fact, this same situation is true of

the majority of developing countries, both in sub-Saharan Africa and elsewhere around the world.

Describing ApproTEC's role in addressing the poverty situation, Fisher concluded:

Suddenly the people have found themselves needing to make money just to survive. However, there is a dire shortage of jobs in these countries. In Kenya, only 14% of the labor force is employed in the formal sector, and half of them work for the government. In Tanzania, it is less than 7% that have a formal job. As investors pull out and government spending shrinks, the formal sector can no longer be relied on to provide jobs. So while they leave their families on their small plots to continue with subsistence farming, family members do whatever they can to make a bit of money. The majority get involved with petty trade sitting on the side of the road and buying and selling whatever they can get their hands on—maize, tomatoes, or secondhand clothes—while a few get involved in simple manufacturing [tailoring, carpentry, or metalworking]. But they are all selling the same products and competing with each other, so the profit margins are tiny.

So we asked ourselves, where are the opportunities to create new jobs and new livelihoods? Clearly a percentage of the people are real entrepreneurs who can beg, borrow, or save a small amount of money to start a business. That is the segment of people we are here to serve.

ApproTEC, not High Tech, in a No-Tech Region

ApproTEC designed, engineered, and managed the production of several products, all aimed at empowering small-scale entrepreneurs to make the transition from a “subsistence” to a “cash” economy. It had crafted its mission “to promote sustainable economic growth and employment creation in East Africa and other countries by developing and promoting technologies that can be bought and used by dynamic entrepreneurs to establish and run profitable small-scale enterprises.”²

Its strategy consisted of five important steps:

- Identify extremely profitable, environmentally sustainable small-business opportunities for which capital investments can be recovered in three to six months.
- Design and develop the new technologies and business plans required to start the new businesses. Design all the tooling for mass production of this new equipment.
- Train local private-sector manufacturers to mass-produce the new technologies.
- Buy the technologies from manufacturers and mass-market them to poor entrepreneurs using innovative marketing techniques and selling them through local private-sector retail shops.
- Monitor the impacts of its work—the new profits and wages generated by the new businesses.

Its first few products included an oil press and a block press.

² ApproTEC Annual Report, 2001–2002.

1. *Action Pack Block Press*³

The first technology commercialized by ApproTEC was the Action Pack block press, which made highly pressurized blocks from a mixture of soil and a small amount of cement (1 bag for 100 blocks). The soil used was usually excavated from the construction site, and after curing, the compressed block was ready for construction use without the need to “fire” the brick in a kiln. With about half a dozen workers, the press could produce nearly 600 blocks a day on-site, enabling the completion of a 15' x 25' classroom in just a few days. Many classrooms, retail shops, and other such commercial constructions have been built by entrepreneurs using the Action Pack block press. The press retailed for about \$350.⁴ About 1,500 presses had been sold since 1991.



2. *Mafuta Mali*

ApproTEC's second real commercial application came in 1992, when its engineers designed a manually operated oilseed press that extracted oil from widely available sunflower and sesame seeds, producing seedcake as a by-product for animal feed. An ancillary filtration stand completed the process of providing consumers with nutritious cooking oil. The entire setup cost about \$400. Until then, most Kenyans used imported cooking oil, which was considered an essential commodity and thus price controlled by the government and distributed by a government agency and exempt from import duties and taxes. With the lifting of price controls in 1992, prices for oilseeds and oils almost tripled overnight, and micro-entrepreneurs could now produce and market oil for local consumption at a profit. Three workers could produce over 20 liters of oil and 60 kilograms of seedcake per day, allowing the capital to be returned in six to eight weeks.



³ Source of all photos: ApproTEC Annual Report, 2000–2001.

⁴ In 2002, \$1 exchanged to about 80 Kenyan shillings.

About 1,000 oil presses had been sold since 1992.

While several of ApproTEC's initial products had significant potential to alter the "subsistence" equation in Kenya, the real breakthrough came with the creation of a series of micro-irrigation pumps.

3. *The Super-MoneyMaker*

Easily its biggest commercial seller so far, the Super-MoneyMaker was a treadle-operated pump that looked and operated like a small "home-use Stairmaster." As the operator stepped back and forth, the two treadles, which were connected by a rocker, drove pistons in and out of the two cylinders to pump the water. This pump could pull water from as deep as 25 feet and had a total pumping head (suction plus pressure) of over 45 feet. At low pumping heads, it could irrigate up to 2.5 acres of land in a six-hour day. The complete pump weighed 55 pounds and retailed in Kenya for \$75. This pump was launched in 1998.



4. *The MoneyMaker-Plus*

The MoneyMaker-Plus had a single piston and cylinder and was driven by a single rocker by placing one foot on each end of the rocker and stepping back and forth from side to side. It could pull water from as deep as 7 meters and had a total pumping head (suction plus pressure) of 20 meters. At low pumping heads it could irrigate up to 1.25 acres of land in a six-hour day. All of 2½ feet long, 1 foot wide, and about 15 pounds, the MoneyMaker-Plus was small enough to be carried on a bicycle and simple enough that it could be installed by the farmer and repaired without any tools. The MoneyMaker-Plus was launched in Kenya in July 2001 and sold at a retail price of \$38.



Wired Magazine wrote about the robust design of these pumps:⁵

The MoneyMaker is based on the kind of treadle pump that International Development Enterprise (IDE), a nonprofit design outfit engaged in development, made successful in Bangladesh. But ApproTEC adapted the IDE model in several critical ways. First, it added a pressurizing head so water can be driven through a sprinkler or up a slope and into Kenya's

⁵ *Wired Magazine*, April 2002.

hilly fields—something the simple suction design of the IDE tool couldn't do. And second, whereas IDE built a pump that remains fixed in the fields, ApproTEC developed a lightweight, portable model that can be carried indoors at night and protected from thieves.

There were cultural considerations, too. The treadles of the Bangladeshi pumps were positioned high for maximum lift. But Fisher knew that a majority of his customers would be women—the traditional water carriers in Africa—and that such hip swaying would be considered too provocative. So ApproTEC treadles are lower and shorter.

Then there was the question of durability: Fisher's design has no nuts, bolts, or fasteners—such parts could easily rust—and the valves are engineered to last at least three years.

These two pumps (the Super-MoneyMaker and the MoneyMaker-Plus) were being mass-produced by two ApproTEC-trained but privately owned factories in Nairobi, Kenya, and one more in Arusha, Tanzania. One of these assemblers was Kenya Vehicle Manufacturers, which used to assemble Nissans and Land Rovers. These pumps, including all the tooling for mass production, were fully designed by ApproTEC engineers and technicians in Kenya at ApproTEC's workshop. Like other ApproTEC products, the pump was made from locally available materials (rolled steel, pipes, chains, and molded rubber). After training and coaching the factory personnel in the manufacturing processes, ApproTEC ordered and bought the pumps from them, with the factories making a 25% margin. The pumps were then distributed and sold through a network of over 190 local farm-supply retail shops located in large and small towns all around Kenya (135) and Tanzania (55). ApproTEC's built-in margin on that sale was about 20%. From that 20%, ApproTEC financed the transportation costs to the retail store, the working capital support for the retailer, and marketing, advertising, and promotional expenses. The retail shops had a 20% margin on the sale of pumps to the farmer-entrepreneurs. ApproTEC then carried out a large-scale marketing campaign using newspaper and radio advertising and mounting live demonstrations in front of each store. ApproTEC directly employed about 65 such sales promoters to do the missionary selling on behalf of retailers. Most of them were part-time workers, often young and enthusiastic and quite happy to be store demonstrators. Their display of the pumping action attracted many curious onlookers.

When a farmer bought a pump from a retail shop, it came with 8 meters of suction pipe, a non-return inlet valve, and a detailed operation manual. In the same shop, the farmer could purchase a 60-foot or 120-foot coil of 1-inch hosepipe. The buyer carried the new pump home on a bus or by foot; attached the suction and pressure hoses to the pump (using strips of recycled inner-tube rubber); lowered the suction pipe into a shallow well, stream, or pond; and started to pump the water. The water was sprayed onto the crops most often by a second operator who held the hosepipe, but sometimes through sprinklers. Most buyers used the pump to grow commonly consumed local crops including tomatoes, kale, and cabbages in the off-season, and they then sold them in the local market or to middlemen who took them to the nearest city. Others (25%) grew crops for export to Europe, including snow peas, sugar snaps, French beans, and high-quality cut flowers.

With micro-irrigation, a Kenyan farmer could grow three or four crops per year instead of one or two high-value crops such as fruits, vegetables, and cut flowers, and he or she could bring them to market in the dry season when prices were high and the supply was low. In Kenya, farmers could make between \$300 and \$2,500 profit per planting season per acre growing irrigated crops. The large farmers knew this and installed expensive mechanized irrigation systems, but for a poor farmer there was no suitable technology for lifting water out of a shallow well, pond, or river. Electric pumps were cheap but not a viable option for rural Africans. Less than 20% of Kenyan's (mainly those in the cities) had electricity. Petrol pumps were expensive (starting at \$200) and hard to maintain, and petrol was not easily available in rural areas. Solar electric pumps were too expensive. The only alternative left

to a poor farmer was a rope and bucket, but with that it was very hard for a family to irrigate more than one-eighth of an acre.

Each ApproTEC micro-irrigation pump was sold with a one-year warranty that was filled out at the retail shop by the buyer, who wrote down on the form the intended site for the equipment's use (near this church or that school, etc.). ApproTEC's impact-monitoring staff got a copy of these forms, leading to a database of all users. Visits were made to randomly selected buyers, both in the first month and after 18 months, to interview customers and assess the value created by the technology.

The casewriter visited about half a dozen farms randomly selected to suit my itinerary. Needless to say, the roads to some of these villages were poorly paved, and though we drove a sports utility vehicle, the journey in parts felt like a ride on a camel. Most farms I visited were between half an acre to two acres, growing a variety of vegetables. One was a large farmer who had an ApproTEC hay baler (to be described later), one was an urban entrepreneur who had his two nephews growing vegetables on a one-acre plot for commercial sale, and the rest were subsistence farmers who had purchased a micro-irrigation pump. In every case, a rough back-of-the-envelope calculation indicated that annual incomes had risen by about \$500 to \$1,500 after the MoneyMaker was put to use. Most of this extra income came in the dry season from November to March, enabling the farmer to get an extra crop. ApproTEC data indicated that nearly 22,000 such pumps had been sold since their introduction. The average life of the pump was estimated to be about three years.

In addition to the farms, I visited a couple of retailers as well. One hardware store in a small town had run out of stock of ApproTEC pumps. There had been a change in ownership, and the new owner expressed an interest in ApproTEC's micro-irrigation pumps. In another small store, one of ApproTEC's sales promoters was enthusiastically engaged in demonstrating the pump, with a complete water source and a closed-loop recycling system. He told me that the store sold about one or two pumps a month. He was paid about \$600 a year by ApproTEC. About two-thirds of that was salary, and the rest was sales commission. In Nairobi itself, I visited a rather large farm retailer who had an annual sales volume of about \$1 million (all products). He sold about 50-to-75 ApproTEC pumps a month. He seemed to have a large stock (about 200) of ApproTEC pumps. Moon, who accompanied me to the store, explained:

As for the small retailers, we get paid after they sell. For the large retailers, they pay us about 50% at the time of the shipment and the other 50% at the time of the next order. I do not believe that the pumps by themselves are a large part of their turnover. There is a lot of convincing evidence to show that farmers who buy pumps later spend much larger sums of money on other inputs [seeds, fertilizers]. So there is a pie-expansion effect.

In addition to the several technologies described thus far, ApproTEC was constantly attempting to innovate. One such new idea was the manual hay baler. Because of an increasing constraint on available grazing land, many dairy farmers were resorting to zero grazing: keeping their cows in a pen and feeding them fresh grass in the wet season and baled hay in the dry season. Thus, ApproTEC's technology would help private entrepreneurs to bale excess hay from their farms for sale in the open market. Initially the plan was to sell a small number of machines (about 20 or so) to study the design robustness of the application before full-fledged commercialization. The machine was expected to retail for \$500.

Other technologies under consideration were:

- "Little Darling" micro-irrigation handpump – It would retail for about \$20 and be suitable for "kitchen garden"-size plots.

- Deep well pump and well drilling—In collaboration with IDEO, a highly regarded design firm in America, ApproTEC was attempting to develop a manual pump capable of drawing water for irrigation from 60-foot-deep wells and retail for about \$125. To complement the pump, ApproTEC was collaborating with another U.S. firm to develop an efficient process for drilling 60-foot-deep wells.
- Xtracycle—Working with the Xaccess Foundation, ApproTEC had come up with the engineering to retrofit a standard bicycle with an extra-large luggage carrier so that entrepreneurs could use bicycles to transport marketable quantities of farm and other commodities for trading in local markets. This would also involve complementary retrofitting of the rear wheel and the chain drive and would cost about \$25 in all. A new bicycle cost about \$50.

While consultation, training, and services were not the main focus of ApproTEC's mission, it undertook such projects from time to time to complement the efforts of its donor agencies and local government. For example, the AKILI project was launched in October 1997. AKILI is an acronym for "advancing Kenyan industry through local innovation." As part of AKILI, ApproTEC trained over 300 "Jua Kali," or small-scale entrepreneurs, in the metal, wood, and fabric sectors in product design, production, and business skills.

Social Impact

By August 1, 2002, nearly 28,000 pieces of ApproTEC-designed machines and tools had been purchased in East Africa, and over 600 new pieces of equipment were being sold every month. At the time, local entrepreneurs had used these new tools and equipment to directly create over 24,500 active new small enterprises. In turn these new small businesses had directly created over 25,000 new jobs (defined as 5 hours of work a day for 150 days a year) directly operating the new technologies. Over 17,000 of these jobs were new waged jobs, while the rest were jobs for the family or owner of the new businesses.

Over 22,000 of the new enterprises were micro-irrigation businesses, and women managed 70% of them. On average, each micro-irrigation pump was lent out to 0.25 additional local households (friends or relatives) for their own use. This meant that an additional 5,500 new micro-irrigation businesses had been created by these technologies and that these new businesses had created an additional 3,000 new waged, pump-operating jobs.

Given that the average size of a Kenyan family was five, the 28,000 new jobs created by ApproTEC since its founding impacted the lives of over 140,000 Kenyans.

Going to Scale

In the July 2000–2001 financial year, ApproTEC's total income in Kenya and Tanzania was \$2.09 million, and its total expenditure was \$2.06 million. About 26% of its budget came from technology sales and 4% from other incomes, including charges for consulting and training jobs for other NGOs and donors. The remaining 70% came from donors—46% from DFID, 16% from USAID, 7% from British and European private trusts, and 1% from private donations thru Charities Aid Foundation-USA. (See Exhibits 2, 3, and 4.)

Fisher's enthusiasm for ApproTEC's expansion was evident from his animated explanation of its rationale:

If we simply wish to continue at this pace, perhaps we can drum up the approximate \$1.5 million a year we need, but that would be so far short of our ambitions and mission. I believe we are on to something very important that deserves a larger scale. That's why in January 2001 we registered ApproTEC-USA, with the primary mission of raising significant funds to finance ApproTEC's expansion. We were granted our 501(c)3 status in October 2001 and since then have raised grants and commitments from the Mulago Foundation, Skoll Fund, and individual donors worth over \$500,000. We need to leverage the California office to raise significant money.

We have reached a stage in our life cycle where scale-up is not only a distinct possibility but also an attractive strategy. There's a time in the life of any organization that the fixed overheads—engineers, development infrastructure, commercial partners, etc., can all be significantly leveraged. We have a portfolio of successful technologies that need wider adoption. In our estimate, the demand for micro-irrigation pumps in Kenya alone could exceed 300,000 units. ApproTEC presently works in Kenya and Tanzania, but there is a growing demand for our technologies and for new ApproTEC enterprise-creation programs from people and countries around the world. When we first opened in Tanzania, we sent out two casual workers on a bus and on wages of \$2 per day. They came back having sold 50 micro-irrigation pumps. Now we have three wholesalers and numerous retailers there. We are readying a manufacturer there to make our Super-MoneyMaker pumps. Our technologies have been requested in southern and western Africa and we have been invited, among many other places, to establish ApproTEC in India, Haiti, and Kyrgyzstan.

We have spent the last 10 years developing, testing, and proving a very cost-effective method of creating new businesses and new jobs in developing countries, and we are now ready to take it to scale. However, we fully understand that to keep our program effective, we have to do this in a systematic and controlled manner. To expand quickly we have to have a strong base, and we need to start with our strongest hand. Thus, over the next few years we plan to first strengthen our operational base in Kenya and Tanzania and then do a market rollout across eastern and southern Africa. We will start in Uganda, where we are already selling pumps across the border, and then on to Rwanda and Burundi before moving down to southern Africa, where we hope to establish programs in Mozambique, South Africa, Zambia, and Malawi. [See **Exhibits 5 and 6** for ApproTEC's history of growth.]

Moon dropped me off at the Jomo Kenyatta Airport for my long flight home. "I never shared with you my plan for the \$5 million windfall. May I?" asked Moon as he walked me to a cafeteria at the airport. There, he pulled out a piece of paper and began to explain a three-year development plan:

1. We have to get our core infrastructure funded fully. Office facilities, staff motivation, marketing programs and the like. Our current donors seem very reluctant to go anywhere near such activities. In fact, there's even some consternation regarding our direct intervention in the supply chain as a distributor. We need to strengthen all our core elements—\$1 million.
2. Our current product development and engineering facility (for manufacturing tool development) is outdated. A few years ago we purchased an empty plot of land at Ngando, just about 10 kilometers from here, which we want to develop. If we want to expand and diffuse our program, we need institutional development and capacity building. Apart from decent, proper, tailor-made buildings, the symbolic value of such a development would raise

our profile and make a huge difference—pride, commitment, recognition—don't underestimate the importance of all this—even as we slog away at the front line—\$1 million.

3. Move into Uganda using a “private investor” approach—very much on the lines of Tanzania. We need manufacturing, marketing, and sales partners—\$1.5 million.
4. Deepen ongoing technical and product development of micro-irrigation in Kenya—\$500,000. This year [2002] is an election year in Kenya, so we may not be able to scale up manufacturing or marketing in a big way. Better to focus on Tanzania and Uganda. Tanzania will perhaps need another \$500,000 for strengthening and expanding the manufacturing and marketing base.
5. Promote Rwanda from a strengthened base in Uganda and Burundi from a strengthened Tanzania—\$250,000.
6. Shift manufacturing of pumps to China or India, thus cutting down costs by almost half. Those countries have access to better quality steel, excellent managerial supervision, and better manufacturing technology. We'll then have to get the pumps by boat by bulk shipment. This entire logistics chain would need to be carefully configured and built—\$250,000.

“Well, that adds up to \$5 million,” I said.

“Zat so?” responded Moon jokingly. “I have a list in my other pocket that is just as long. But I realize you are not a funder, only a professor.”

I kept the joke alive by joining in, “You may be better off carrying two independent proposals, one for \$500,000, and another for \$1.5 million. But I am only half-joking,” I added. “This way, you'll be able to clarify the priorities to yourself.”

I then took leave of Moon and headed to the departure gate wondering what makes social entrepreneurs like Moon and Fisher tick and what drives them to reach for the stars.

Exhibit 1 Map of East and South Africa



Source: Casewriter.

Exhibit 2

**DURING THE FINANCIAL YEAR 2000/2001 ApproTEC RECEIVED DONOR SUPPORT
FOR THE FOLLOWING ONGOING PROJECTS:**

PROJECT / ACTIVITY	TIME FRAME	BUDGET (MILLIONS)	PRINCIPAL DONOR	TOTAL DONOR COMMITMENT (MILLIONS)*
<i>Central Programme</i>	<i>Apr 96 - Mar 01 (5 yrs)</i>	<i>\$ 1.90</i>	<i>DFID</i>	<i>\$ 0.78 (42%)</i>
<i>MicroPED Project</i>	<i>Apr 97 - Oct 00 (3.5 yrs) Extended - Dec 01</i>	<i>\$ 1.73</i>	<i>USAID Kenya</i>	<i>\$ 1.63 (94%)</i>
<i>Long Term Micro Irrigations Project (LTMIP)</i>	<i>Jun 99 - May 04 (5 yrs)</i>	<i>\$ 4.06</i>	<i>DFID</i>	<i>\$ 2.30 (58%)</i>
<i>AKILI Project Phase II</i>	<i>Oct 97 - Sep 01 (4 yrs)</i>	<i>\$ 0.70</i>	<i>APT D&D - EU - NLCF - TN</i>	<i>\$ 0.36 (54%) \$ 0.30 (40%) \$ 0.04 (6%)</i>
<i>Micro Irrigation Promotion Project (MIPP) Tanzania</i>	<i>Jul 00 - Jun 03 (3 yrs)</i>	<i>\$ 1.36</i>	<i>DFID</i>	<i>\$ 1.20 (88%)</i>
<i>Money Maker PLUS! Project (MMPP)</i>	<i>May 00 - May 04 (3 yrs)</i>	<i>\$ 0.97</i>	<i>USAID Washington</i>	<i>\$ 0.60 (62%)</i>

KEY: DFID : Department for International Development (UK Government)
 MicroPED: Micro Private Enterprise Development
 USAID : United States Agency for International Development
 APT D&D : APT Design & Development is a UK based NGO partner to AKILI (Advancing Kenyan Industry through Local Innovation) project.
 APT has raised funds for the AKILI project and also provides special management support.
 EU : European Union
 NLCF : National Lottery Charitable Fund (UK)

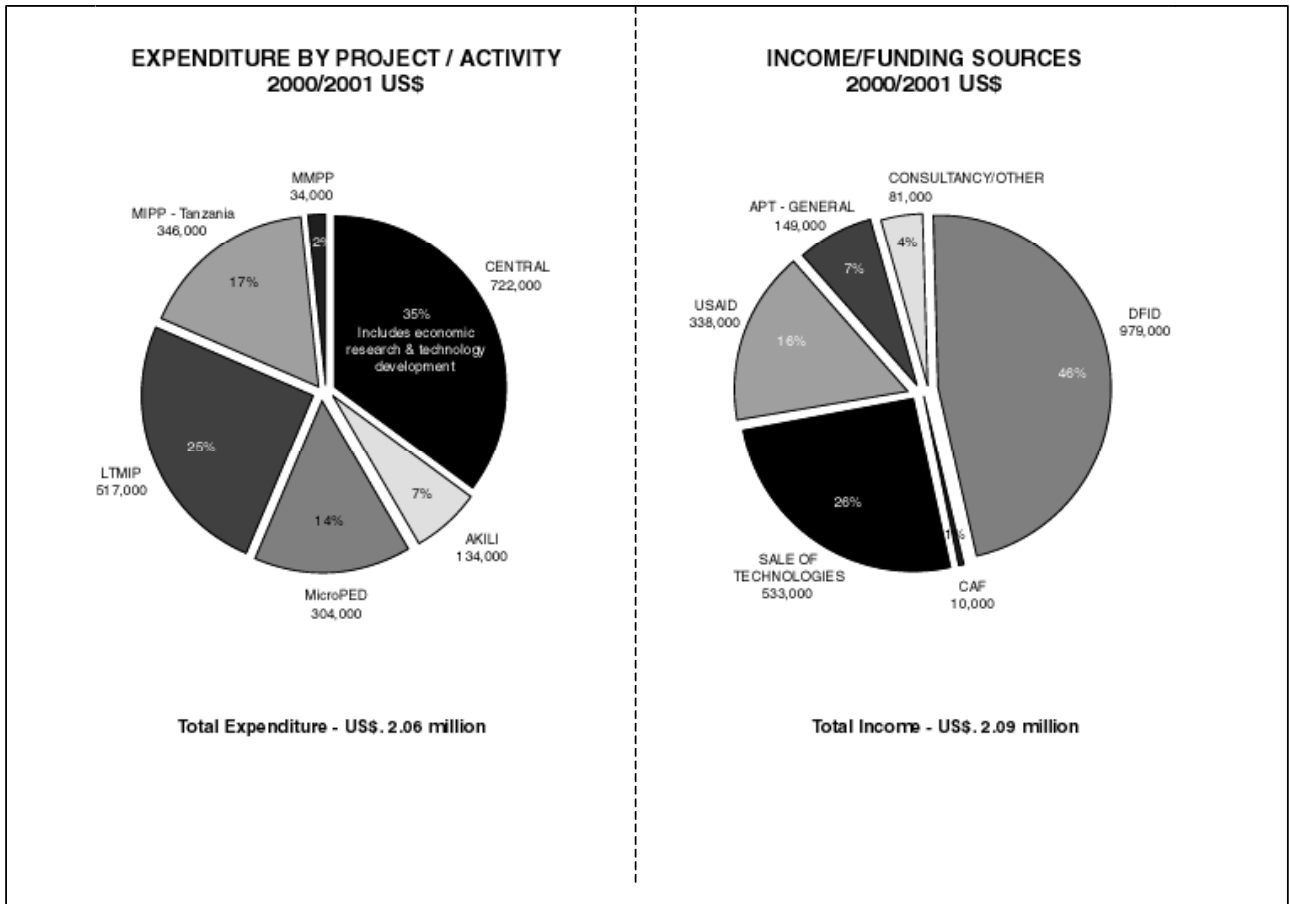
* The (%) refers to donor commitment. The rest was raised through fundraising or cost recovery. In some cases where such efforts did not bridge the gap, the project's targets were appropriately revised.

Source: ApproTEC Annual Report, 2001.

Exhibit 3

"WHERE THE MONEY GOES'

ApproTEC's Finances



Source: ApproTEC Annual Report, 2001.

Note: CAF: Charities Aid Foundation, a U.S. nonprofit that was able to receive and channel donations from U.S.-based supporters. With the setting up of ApproTEC USA, the role for CAF would go away in the future.

Exhibit 4

BALANCE SHEET AS AT 30 JUNE 2001

	2000/2001 US\$	1999/2000 US\$
ASSETS		
Non-Current Assets		
<i>Plant property & equipment</i>	312,374	223,408
<i>Deferred expenditure</i>	-	-
	<u>312,374</u>	<u>223,408</u>
Current Assets		
<i>Inventories</i>	99,331	35,582
<i>Trade & other receivables</i>	226,592	153,419
<i>Bank & cash balances</i>	79,584	142,741
	<u>405,507</u>	<u>331,742</u>
Total Assets	<u>717,881</u>	<u>555,150</u>
FUNDS & LIABILITIES		
Accumulated Fund	425,799	393,195
Current Liabilities		
<i>Gratuities payable</i>	51,234	40,614
<i>Trade & other payables</i>	240,848	121,341
	<u>292,082</u>	<u>161,955</u>
Total Funds & Liabilities	<u>717,881</u>	<u>555,150</u>

**INCOME & EXPENDITURE STATEMENTS
FOR YEAR ENDED JUNE 2001**

	2000/2001 US\$	1999/2000 US\$
Income	2,090,080	1,505,523
Expenditure	2,057,476	1,409,318
Surplus (Deficit)	32,604	96,205

Source: ApproTEC Annual Report, 2001. \$1 = 80 Kenyan Shillings

Exhibit 5 ApproTEC Growth History^a

Year	Income (US\$) ^a	Expenditure (US\$) ^b
1992	69,489	40,330
1993	118,358	103,447
1994	240,695	168,526
1995	356,834	236,275
1996	304,820	350,083
1997	761,205	602,407
1998	899,898	906,908
1999	903,512	985,661
2000	1,524,825	1,427,386
2001	2,116,876	2,083,854
2002	2,195,670	2,268,058
TOTALS	9,492,182	9,172,936

Source: ApproTEC documents.

^aThe numbers for 2001 and 2002 do not exactly match those in Exhibits 3 and 4 but are very close to the audited statements appearing there.

^b1US\$ = Kenya Shilling (Ksh) 80.

Exhibit 6 ApproTEC Staff Positions from July 1991 to June 2002^a

Staff Category	1991/92	1992/93	1993/94	1994/95	1995/96	1997/98	1998/99	1999/2000	2000/01	2001/02
Executive Directors	3	3	3	3	3	3	3	3	3	3
H.R. & Administration	2	5	7	10	15	20	19	17	16	15
Finance						4	5	8	7	6
Technology Development	4	8	12	13	9	11	9	11	11	15
Project Managers				2	3	4	4	4	6	4
Information				1	3	1	1	2	3	3
Impact Monitoring						1	2	2	2	2
Promotion and Marketing				3	8	14	10	12	19	17
Training (AKILI or MicroPED)				1	2	6	8	8	7	7
TOTAL	9	16	22	33	43	64	61	67	74	72

Source: ApproTEC documents.

^aThe table does not include staff turnover of about 10 to 15 people each year post-1997/1998. In the initial years, the turnover was under five people a year.